LIFE SCIENCES AND NATURAL RESOURCES

PLANT SCIENCES

WAGENINGEN UNIVERSITY

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CONTENTS

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REPORT ON THE BACHELOR'S PROGRAMME PLANT SCIENCES, THE MASTER'S PROGRAMME PLANT BIOTECHNOLOGY, THE MASTER'S PROGRAMME PLANT SCIENCES AND THE MASTER'S PROGRAMME ORGANIC AGRICULTURE OF WAGENINGEN UNIVERSITY

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point (September 2016).

ADMINISTRATIVE DATA REGARDING THE PROGRAMMES

Bachelor's programme Plant Sciences

Name of the programme:	B Plantenwetenschappen
International name of the programme:	B Plant Sciences
CROHO number:	56835
Level of the programme:	bachelor
Orientation of the programme:	academic
Number of credits:	180 EC
Specializations or tracks:	Plant Genomics and Health Plant Production and Ecology
Location:	Wageningen
Mode(s) of study:	Fulltime
Language of instruction:	Dutch
Expiration of accreditation:	31/12/2019

Master's programme Plant Sciences

Name of the programme:	M Plant Sciences
CROHO number:	66835
Level of the programme:	master
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	Crop Science Greenhouse Horticulture Natural Resource Management Plant Breeding and Genetic Resources Plant Pathology and Entomology Plant Breeding Biomass Production and Carbon Capture
Location:	Wageningen
Mode(s) of study:	Fulltime, part-time (online)
Language of instruction:	English
Expiration of accreditation:	31/12/2019

Master's programme Plant Biotechnology

Name of the programme:	M Plant Biotechnology
CROHO number:	60105
Level of the programme:	master
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	Functional Plant Genomics Plants for Human and Animal Health Molecular Plant Breeding and Pathology

Location:	Wageningen
Mode(s) of study:	Fulltime
Language of instruction:	English
Expiration of accreditation:	31/12/2019

Master's programme Organic Agriculture

Name of the programme:	M Organic Agriculture
CROHO number:	69300
Level of the programme:	master
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	Agroecology Sustainable Food Systems Double Degree Agroecology
Location:	Wageningen
Mode(s) of study:	Fulltime
Language of instruction:	English
Expiration of accreditation:	31/12/2019

The visit of the assessment panel Plant Sciences to Wageningen University took place on 21-23 November 2018.

ADMINISTRATIVE DATA REGARDING THE INSTITUTION

Name of the institution:	Wageningen University
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

COMPOSITION OF THE ASSESSMENT PANEL

The NVAO approved the composition of the panel on 7 March 2018. The panel that assessed the bachelor's programme Plant Sciences, the master's programme Plant Sciences, the master's programme Plant Biotechnology and the master's programme Organic Agriculture, consisted of:

- Prof. dr. S. (Stanley) Brul, professor Molecular Biology and Microbial Food Safety at the Universiteit van Amsterdam and chair of the Dutch institute for Biology (NIBI) (chair);
- Dr. A. A. J. (Annik) Van Keer, educational policy advisor at the Faculty of Science at Utrecht University;
- Prof. dr. G. (Geir) Hofgaard Lieblein, professor Agroecology at the Norwegian University of Life Sciences (Norway);
- Prof. dr. R. O. (Rodomiro) Ortiz Rios, professor Genetics & Plant Breeding at the Swedish University of Agricultural Sciences (Sweden);
- Prof. dr. E. (Els) Van Damme, professor at the Department of Biotechnology at the Faculty for Bioscience Engineering at Ghent University (Belgium);
- B. (Boas) van der Putten BSc, graduated in 2017 in Biomedical Sciences at the University of Amsterdam. He is currently working on two PhD tracks at the AIGHD/AMC (student member).

The panel was supported by Dr. F (Floor) Meijer, who acted as secretary.

WORKING METHOD OF THE ASSESSMENT PANEL

Preparation
In preparation of the site visit, the panel studied several documents, amongst others: the NVAO assessment framework (2016), the institutional audit of Wageningen University (WU) and the previous programme assessments (of 2012). The accreditation system has entered its third phase (concurrently with a second round of institutional audits). Wageningen University has recently successfully passed its second institutional audit. The new NVAO assessment framework is 'geared to a quality assurance system that is based on trust in the existing, high quality of Dutch higher education'.

The most recent assessment of the programmes took place in 2012. In this assessment, the bachelor's and master's programmes Plant Sciences were assessed as very strong programmes. The panel was pleased with the unique profiles of the programmes, the solid curricula and competent staff and diverse assessment strategies. The panel assessed the assessment strategies and examination methods as appropriate and was impressed by the level of the final products. An aspect to further improve was the phrasing of goals and objectives. Both programmes received partial scores of 'good' on all standards and therefore a final assessment of 'good'. The master's programme Plant Biotechnology received partial scores of 'satisfactory' on Standard 1 and 2 and a score of 'good' on Standard 3, leading to an overall score of 'satisfactory'. From the objectives and curriculum of the programme, it was not entirely clear to the panel why the programme is a separate programme rather than a specialisation of the master's programme Plant Sciences. The panel was, however, pleased with the integration of multiple disciplines within the courses, the research qualities of the staff and the good facilities. The level of the theses was deemed impressive. The master's programme Organic Agriculture, finally, received partial scores of 'good' on Standard 1 and 3 and 'excellent' on Standard 2, leading to an overall score of 'good'. The panel clearly appreciated the intended learning outcomes (ILOs), which were translated into an 'extremely well organized teaching-learning environment', which was characterized as experimental, authentic, interactive and interdisciplinary. The panel was impressed with the level of the theses.

With the new philosophy of the framework and the last assessment of these specific programmes in mind, the panel does not want to elaborate too long on the different criteria of the four standards of the limited framework. The overall evaluation of the programmes by this panel is, as it was in 2012, positive. In this report, therefore, the panel will concentrate specifically on developments since 2012 and on providing suggestions that might help to make the programmes even better than they already are.

QANU received the self-evaluation reports of the Plant Sciences programmes on 16 October 2018 and made them available to the panel. The panel members read the self-evaluation and prepared questions, comments and remarks prior to the site visit. The secretary collected these questions in a document and arranged them according to panel conversation and subject.

In addition, panel members read a selection of theses completed in the academic years 2015-2016 and 2016-2017. In consultation with the chair, fifteen theses were selected for both the bachelor's and master's programme Plant Sciences and ten theses each for the additional two master's programmes, covering the full range of marks given and all specialisations. The panel members also received the grades and the assessment forms filled out by the examiners and supervisors. An overview of all documents and theses reviewed by the panel is included in Appendix 5.

The programme management drafted a programme for the site visit. This was discussed with the secretary and chair of the panel. As requested by QANU, the programme management carefully selected discussion partners. A schedule of the programme for the site visit is included in Appendix 4.

Site visit
The site visit took place on 21-23 November 2018 at WU. In a preparatory meeting on the first day of the site visit, the panel members discussed their findings based on the self-evaluation and on the theses and formulated the questions and issues to be raised in the interviews with representatives of the programme and other stakeholders.

During the site visit, the panel studied a selection of documents provided by the programme management. They included course descriptions, course materials, written exams, assignments and other assessments.

The panel interviewed the programme management, students, alumni, staff members, members of the Programme Committee and members of the Examining Board.

Report
After the visit, the secretary produced a draft version of the report. She submitted the report to the panel members for comments. The secretary processed corrections, remarks and suggestions for improvement provided by the panel members to produce the revised draft report. This was then sent to WU to check for factual errors. The comments and suggestions provided by the programme management were discussed with the chair of the assessment panel and, where necessary, with the other panel members. After incorporating the panel's comments, the secretary compiled the final version of the report.

Definition of judgements standards
In accordance with the NVAO's Assessment framework for limited programme assessments, the panel used the following definitions for the assessment of both the standards and the programme as a whole.

Generic quality
The quality that, in an international perspective, may reasonably be expected from a higher education Associate Degree, Bachelor's or Master's programme.

Unsatisfactory
The programme does not meet the generic quality standard and shows shortcomings with respect to multiple aspects of the standard.

Satisfactory
The programme meets the generic quality standard across its entire spectrum.

Good
The programme systematically surpasses the generic quality standard.

Excellent
The programme systematically well surpasses the generic quality standard and is regarded as an international example.

SUMMARY JUDGEMENT

Intended learning outcomes
The panel notes that Plant Sciences are a particularly strong and internationally visible domain at WU, which makes the university an ideal host for degree programmes in this domain. For all four programmes it was sufficiently demonstrated that these are unique within the Netherlands.

The panel is pleased with the broad, integrated profile of the *bachelor's and master's programmes Plant Sciences* (BPW and MPS) that addresses all relevant levels from molecule to ecosystem and thereby encourages systems thinking. The profile of the *master's programme Plant Biotechnology* (MPB) is also relevant and the panel appreciates the combination of biotechnology with approaches from the social sciences. While the profile of this programme is sufficiently distinct from that of the master's programme Plant Sciences, the panel noted that the differences might need to be better explained to students, who found it difficult to pinpoint the defining characteristics of both programmes. The interdisciplinary, internationally oriented profile of the *master's programme Organic Agriculture* (MOA) is highly attractive, but the panel wonders whether the current programme title fully reflects the broad scope of the programme.

The ILOs of all four programmes match the programmes' profile and correspond to the Dublin descriptors for academic bachelor's c.q. master's programmes. The domain-specific ILOs of the master's programmes Plant Sciences and Plant Biotechnology would, however, benefit from more specificity in order to more prominently highlight the differences in the knowledge, understanding and experimental skills that students of both programmes acquire. In this respect, the ambitious ILOs of the master's programme Organic Agriculture are exemplary, as they are more attuned to the specific nature of the field. While the panel appreciates that ethical aspects are mentioned in the ILOs of all four programmes, it feels that research integrity should also be given a proper place.

The programmes align their objectives and curricula with the professional field by means of informal contacts with stakeholders as well as annual consultations of their respective EAC. Currently the master's programme Organic Agriculture seems less connected to the professional field than the other programmes. Expanding the scope of the EACs to the international professional field is an opportunity for improvement for all programmes.

Teaching-learning environment
The panel concludes that the curriculum, teaching-learning environment and staff of all four programmes in the Plant Sciences domain enable students to realise the ILOs.

With respect to the bachelor's programme Plant Sciences, the panel found the curriculum to be clear and coherent, with attractive options for students to pursue their own interests. All of the relevant disciplines are sufficiently covered in the curriculum as a whole, resulting in a multidisciplinary study programme that reflects the systems-approach of addressing all spatial levels. The level of the courses is appropriate for an academic bachelor's programme. A recommendation is to pay more structural attention to societal and ethical aspects. To ensure that these issues are more clearly recognizable to students throughout the courses, the programme could consider developing a dedicated learning line.

The master's programme Plant Sciences spans a wide variety of specialisations on different spatial levels (including the online specialization Plant Breeding) that start directly in the first period of the first year. This setup guarantees that students enjoy maximum freedom of choice, but at the same time the flexibility and large number of courses also seem to pose challenges in terms of scheduling and keeping an overview of everything that is on offer. The panel supports the current initiative to map the (knowledge and skills) curriculum in an attempt to minimize overlap between courses and between the bachelor's and master's programme Plant Sciences. The content of the curriculum ties in with the research of the WU Chair Groups and is topical and sufficiently

innovative. Even so, the connection with the labour market could be strengthened. The panel supports the recommendation of the EAC to put more emphasis on 'soft skills', which are considered important by future employers, and to increase the attention for bioinformatics, quantitative analytical skills and handling big data in general.

The panel was pleased to find that the core curriculum of the master's programme Plant Biotechnology was redesigned since the previous assessment, with the intention to increase its specificity and introduce the recently established dual focus on technology and societal aspects into the courses. Nonetheless, the panel believes that further action is needed in order to make the common core truly effective in building a recognisable cohort of MPB students. At present, the considerable flexibility in the programme seems to lead to some fragmentation. After studying material from a number of sample courses, the panel is satisfied with the level and content of the curriculum, which is clearly academic in orientation. Even so, it is worth looking into the opinion expressed by some students that the course content is sometimes too basic and not entirely representative of the cutting-edge research that takes place at the relevant WU Chair Groups.

The panel is generally contented with the level and content of the integrated, interdisciplinary MOA curriculum that was designed to strike a balance between fundamental knowledge on the one hand, and its application in agro-ecology and sustainable for systems on the other. It particularly notes the international outlook of the curriculum, including the option for students to complete a double degree from WU and ISARA Lyon. A major factor in successful cohort building is the *MOA Masterclass* that runs throughout the programme. Nevertheless, the panel notes that the diversity of the student population does provide somewhat of a challenge in terms of determining the right level and content for courses.

A general comment that applies to all four curricula is that there is a close relation between the ongoing research of the WU Chair Groups and the teaching. One topic that could, however, receive more structural attention is research integrity.

The panel established that students are satisfied with the teaching-learning environment, especially with the close interaction between staff and students and the open atmosphere. The programmes use a variety of teaching methods that match the ILOs and learning goals at course level. The panel concludes that these teaching methods are sufficiently interactive and activating. It especially appreciates the innovative online teaching in the Online Master Plant Breeding, which is a specialization of the Plant Sciences master's programme and to a certain extent functions as a 'laboratory' for innovative teaching from which the other programmes also benefit. A specific remark that was made with respect to the master's programme Plant Biotechnology is that some students perceive the teaching as rather scholastic, with too little recognition of the level of student responsibility that could be expected at master's level. Characteristic of the master's programme Organic Agriculture is the large share of group work, which is both an asset and somewhat of a liability. All programmes have an adequate number of weekly contact hours and are sufficiently feasible. Important to note is the demand-driven system of student guidance, in which study advisers play an important role. While the panel appreciates the principle of leaving much of the initiative to the student, it wonders whether this works for all parts of the student community. Finally, the panel established that the programmes offer excellent facilities, including the state-of-the-art greenhouse facilities at Unifarm and experimental fields at the Droevendaal Experimental and Training Farm.

A concern is that the current level of WU-wide growth appears to put pressure on facilities and teaching. The panel hopes that the current level of small-scale education can be maintained, preferably by rerunning/splitting up larger courses rather than adding a variety of new courses, which would take up a lot of time and resources. Offering the same courses twice a year could help solve current scheduling issues, particularly for students who enter the programme in February instead of September, while splitting up courses offers the opportunity to cater to the needs of particular groups of students. A specific recommendation is to put an end to the practice of

master's students participating in bachelor's classes by creating two versions of the course, a regular version for bachelor's students and a fast-track version with more advanced learning outcomes for master's students.

The teaching staff of the programmes is motivated and qualified. Lecturers are experts in their fields and participate in relevant international networks. On the whole, diversity is somewhat of an issue in the bachelor's and master's programme Plant Sciences and the master's programme Plant Biotechnology: the gender-balance and balance between different national/cultural backgrounds could be improved. The staff of the master's programme Organic Agriculture stands out in a positive way because many staff members are from non-Dutch backgrounds. The increasing workload of staff members requires intensive monitoring. The panel strongly feels that staff numbers should reflect the growing student numbers.

Assessment
All four programmes have developed a solid system of assessment, which is based on the WU-wide assessment policy. Sufficient attention is paid to the validity, reliability and transparency of examinations, but it is not entirely clear to the panel that internal peer review in the design phase of examinations is always part of the assessment cycle. The design of sample tests studied by the panel is adequate: the examinations sufficiently match the course specific learning goals and teaching methods. The level and content of the examinations is appropriate.

The procedures for assessing the final product of the programmes, the thesis, are clear and the assessment itself is sound. To further increase the transparency and comparability of thesis assessment, the panel recommends further streamlining thesis procedures, including the use of a Go/No Go assessment, across Chair Groups and introducing separate assessment forms for both assessors. Furthermore, the panel advocates the university-wide implementation of a digital assessment system in which the subsequent steps in the thesis process are fully automated. This should help to prevent the submission of incomplete assessment forms, which currently seems to be a widespread problem.

Finally, the panel established that the Examining Board safeguards the overall level of assessment in the programmes to the best of its abilities. Increasing the capacity of the EB, as is the intention of the Executive Board, could help to strengthen its agency in relation to the rather autonomous Chair Groups. Nonetheless, the panel feels that the central university should also critically reconsider whether the design of the current quality assurance system optimally suits its purposes.

Achieved learning outcomes
Both the sample theses that were studied by the panel and the position of graduates indicate that students achieve the intended learning outcomes of the programmes. The general level of the final projects is high: the work is of good academic quality when compared to the international standard and adequately reflects the domain of Plant Sciences. Theses are often of publishable quality.

Graduates of the bachelor's programme are successful in associated master's programmes, while graduates of both of the master's programme find employment in relevant positions at companies, non-profit organisations and research institutes/universities.

The panel assesses the standards from the *Assessment framework for limited programme assessments* in the following way:

Bachelor's programme Plant Sciences

Standard 1: Intended learning outcomes	good
Standard 2: Teaching-learning environment	good
Standard 3: Student assessment	satisfactory
Standard 4: Achieved learning outcomes	good
General conclusion	good

Master's programme Plant Sciences

Standard 1: Intended learning outcomes	good
Standard 2: Teaching-learning environment	good
Standard 3: Student assessment	satisfactory
Standard 4: Achieved learning outcomes	good
General conclusion	good

Master's programme Plant Biotechnology

Standard 1: Intended learning outcomes	good
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Student assessment	satisfactory
Standard 4: Achieved learning outcomes	good
General conclusion	good

Master's programme Organic Agriculture

Standard 1: Intended learning outcomes	excellent
Standard 2: Teaching-learning environment	good
Standard 3: Student assessment	satisfactory
Standard 4: Achieved learning outcomes	good
General conclusion	good

The chair, prof. dr. S. Brul and the secretary of the panel, dr. F. Meijer, hereby declare that all panel members have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 6 March 2019

DESCRIPTION OF THE STANDARDS FROM THE ASSESSMENT FRAMEWORK FOR LIMITED PROGRAMME ASSESSMENTS

Governance structure of Wageningen University
In contrast to many other Dutch Universities, WU has just one faculty: the Faculty of Agricultural and Environmental Sciences. Therefore, the governance structure of WU differs from most other universities. The Rector Magnificus of the University is also the Dean of the Faculty. The Dean of the Faculty appoints the Programme Board, which consists of four professors and four students. The Programme Board is the legal governing body of the university's 18 bachelor's and 28 master's degree programmes. It is responsible for the design, content, quality and financing of the programmes. Each cluster of programmes has its own Programme Committee, which consists of an equal number of students and staff members who are appointed by the Programme Board. Programme Committees advise the Programme Board on the design and content of their degree programmes. The Programme Board does not employ the lecturers; these are employed by the 94 Chair Groups, which generally include a Chair Holder (full professor), academic and support staff, postdocs and PhD students. The Programme Board, the Programme Committees and the Chair Groups together form the WU education matrix organization.

The Executive Board of WU has appointed four Examining Boards (EBs), each responsible for a group of related degree programmes (domain) and Chair Groups. Examining Boards are independent from the Programme Board and include staff members from the domain. The Examining Boards assess the individual study programmes of students and award student degrees. The Examining Boards also appoint the course examiners and monitor changes to the assessment strategy of interim examinations in the annual education modification cycle. The Examining Boards assure the quality of the interim examinations, and for that reason periodically visit Chair Groups to discuss the validity and reliability of the assessments.

This report discusses the panel's observations and conclusions regarding four programmes in the domain of Plant Sciences: the Dutch-taught bachelor's programme *Plantenwetenschappen* (BPW, Plant Sciences) and the English-taught master's programmes Plant Sciences (MPS), Plant Biotechnology (MPB) and Organic Agriculture (MOA). The panel chose to discuss all four programmes in one report since many aspects with respect to their profiles, teaching-learning environment and assessment are shared. Graduates of the bachelor's programme Plant Sciences most often continue their studies in the master's programme Plant Sciences, but they can also directly enrol in the master's programmes Plant Biotechnology and Organic Agriculture.

Standard 1: Intended learning outcomes
The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Findings

Bachelor's and master's programme Plant Sciences
Profile
The bachelor's and master's programmes Plant Sciences study the relations between plants and environmental factors, with a fundamental and applied perspective on the sustainable production of healthy food and renewable resources, human health, global food security, and climate change mitigation. Characteristic for the domain, and for the programmes, is a systems approach: the dynamics and complexity of plants are dealt with at different spatial levels, from molecules, cells, organisms and populations to complete ecosystems. The panel applauds this integrated, holistic perspective on plants and their various uses, which is highly topical and relevant. Furthermore, it notes that WU is ideally situated for offering these programmes, because of its leading role in the domain of Plant Sciences. Students particularly mentioned WU's reputation in the domain as an

important reason for coming to Wageningen. A large number of WU Chair Groups are involved in the programmes, amongst which internationally renowned groups in Plant Breeding, Plant Physiology, Plant Production Systems, Crop Systems Analysis, Entomology, Genetics and Nematology.

The specific focus of both programmes is clear. The panel has established that the Dutch-taught bachelor's programme Plant Sciences (*Plantenwetenschappen,* BPW) is the only programme in the Netherlands that focuses specifically on plants. While it shares a common basis in cell and molecular biology, genetics, plant physiology and ecology with bachelor's programmes in Biology, it establishes an additional link with the applied fields of plant breeding (including biotechnology) and agriculture. Students of the programme are offered a choice between two majors: (1) Plant Genomics and Health and (2) Plant Production and Ecology. Similarly, the master's programme Plant Sciences (MPS) is the only Dutch master's programme that specifically addresses the full domain of plant sciences. While there is overlap with related master's programmes at WU, for example the master's programme Plant Biotechnology and the master's programme Organic Agriculture, the focus of the master's programme Plant Sciences is broader, focusing on the ecological, physiological and technological aspects of crop production, applying scientific knowledge to design breeding programmes, plant growth models or cropping systems and addressing issues of regional and global food security. The panel was informed that this broad outlook resembles that of master's programmes in Biology, but in the master's programme Plant Sciences it is specifically directed at plants, not life in general. Students are offered a broad choice of seven specialisations: (1) Crop Science, (2) Greenhouse Horticulture, (3) Natural Resource Management, (4) Plant Breeding and Genetic Resources, (5) Plant Pathology and Entomology, (6) Biomass Production and Carbon Capture, (7) Plant Breeding (distance learning). The panel is pleased with the number and variety of specialisations, which cover important aspects of the domain.

Specific mention should be made of the Plant Breeding specialisation that was initiated during the reporting period and is offered as an online programme (Online Master Plant Breeding, OMPB). This part-time only programme of 3–4 years enables participants to combine work and study by way of distance learning. The panel established that the profile of the OMPB was specifically tailored to the needs of the rapidly expanding Dutch plant breeding and propagation industry, which has an increasing need for qualified personnel. From its conversations during the site visit, the panel learned that significant time and resources were invested in the development and regular upkeep of the online master. So far, the programme has not succeeded in attracting many students who already work at plant breeding companies, the original target audience. The total number of students is rather low, which means that a cost-benefit analysis may have to decide whether it is viable to continue the OMPB, without it becoming a burden on, or influencing the quality of, the other programmes. Even so, the panel appreciates the experiment, which has given rise to a number of innovations that also benefit the regular programmes.

Intended learning outcomes

The bachelor's programme has translated its objectives into eleven intended learning outcomes (ILOs), which are linked to the Dublin descriptors (see appendix 2). The ILOs are clustered into domain specific learning outcomes (ILOs 1-4, two of which are major-specific), learning outcomes on scientific skills (ILO 5-7) and learning outcomes on general academic skills (ILO 8-11). According to the panel, the ILOs match the broad, integrated profile of the bachelor's programme. The domain-specific ILOs adequately cover the relevant knowledge, understanding and experimental skills in Plant Sciences. Amongst others, graduates are expected to be able to explain the biology of plants in their environment, both at a fundamental level and in terms of the various functions of plants for people, animals and the environment, based on knowledge of plant physiology, morphology and taxonomy, biochemistry, organic and physical chemistry, molecular and cell biology, mathematics, statistics, genetics and ecology. Moreover, there is ample attention for research skills, which underscores the research-based character of the programme, as well as for important professional competencies, such as cooperation, communication and reflection ('soft skills').

The twelve ILOs of the master's programme Plant Sciences follow a similar format of domain-specific learning outcomes (ILOs 1-3), which are mostly phrased at the level of the six specialisations, learning outcomes on scientific skills (ILO 4-7) and learning outcomes on general academic skills (ILO 8-12). Like in the bachelor's programme, the ILOs are linked to the Dublin descriptors and adequately reflect the systems approach of the programme, as well as its fundamentally academic character and attention for valuable professional skills. All in all, the panel has established that the level and orientation of the ILOs of both programmes match the demands of the professional field and the academic community. There is sufficient differentiation between the ILOs of the bachelor's programme and those of the master's programme; the latter are clearly phrased at a higher level. This is especially clear from the ILOs that specify the academic and research skills that students need to obtain (ILO 4-7, notably ILO 4). On one aspect the panel noted an opportunity for further improvement: while it was pleased to find that the bachelor's and master's ILOs include explicit attention for ethical debates in the Plant Sciences domain, it concluded that the ethics of scientific research are not specifically addressed. In the opinion of the panel it is vital for a programme that trains future researchers to stress the importance of research integrity from an early stage.

Link with the professional field
To ensure compatibility with the demands of the professional field, the programmes nurture formal and informal ties with potential employers. In addition to the frequent contacts and meetings of staff with representatives of the professional field, there is an External Advisory Committee (EAC) that meets annually to discuss the ILOs, the content and quality of the programme and the performance of graduates. The panel established that recent feedback from the EAC was mostly positive. Appreciated aspects include the balanced setup and academic quality of the programmes. Importantly, the EAC stressed that there is currently a shortage of plant scientists on the Dutch labour market and that WU graduates at master's level are in high demand, encouraging the programmes to train more students. For bachelor's graduates, by contrast, there are fewer opportunities, as the current labour market is more attuned to four-year bachelor's programmes of universities of applied science (hbo) than to three-year academic bachelor's programmes. Like the previous panel, the current panel believes that the programme should take up an active role in carving out a niche for bachelor's graduates, not just on the Dutch labour market but also on the international labour market, which is more used to academic bachelor's graduates joining the work force. The panel concludes that the professional field seems sufficiently invested in the Plant Sciences programmes. An opportunity for further improving the connection to future employers of graduates is to internationalise the EAC by adding at least one foreign member, which would ensure a better fit with the international character of the master's programme.

Master's programme Plant Biotechnology
Profile
The master's programme in Plant Biotechnology (MPB) trains students in the development of biotechnological and molecular tools for the analysis of plant genomes to enhance and speed up the selection process in plant breeding and to elucidate plant-pathogen interactions at the molecular level. A further aim of the programme is to develop crops that produce biopharmaceuticals, bio-fortified food, or bio-based resources. While it has a strong technological basis, the programme has specifically chosen to also address the societal connotations of biotechnology, public engagement and responsible governance.

The panel appreciates that the programme aims to combine cutting-edge technological and scientific knowledge with approaches from the social sciences. It notes that this is a recent development that was motivated by the recommendation of the 2012 panel to increase the distinctiveness of the programme. The result is a relevant and unique profile that is – in the panel's view – sufficiently different from that of the master's programme Plant Sciences. However, the panel concludes from its interview with students that they find it difficult to pinpoint what distinguishes the MPB from the MPS or even from the master's programme in Biotechnology. The programme may therefore wish to work on raising the awareness of the programme's profile

amongst (prospective) students in order to make sure that they choose the master's programme that best suits their interests and preferred career path. The panel notes that the three specialisations that the programme offers students clearly connect to strategic research themes at WU. These are: (1) Functional Plant Genomics, (2) Plants for Human and Animal Health and (3) Molecular Plant Breeding and Pathology. A total of 12 WU Chair Groups contribute to the specialisations of the programme.

Intended learning outcomes
The master's programme Plant Biotechnology has formulated a set of twelve ILOs, which are linked to the Dublin descriptors (see appendix 2). The setup of these ILOs is quite similar to that of the MPS ILOs, in the sense that there are three domain-specific learning outcomes (ILOs 1-3), four learning outcomes on scientific skills (ILO 4-7) and five learning outcomes on general academic skills (ILO 8-12). The particular profile of the MPB specifically resonates in the domain-specific learning outcome that delineates the content of the three specialisations (ILO 2 a-c). Other than that, the ILOs are almost identical to the MPS ILOs. In order to underline the different profiles and objectives of the master's programmes Plant Sciences and Plant Biotechnology, the panel encourages more distinction between the domain-specific learning outcomes in the two respective sets of ILOs. In addition, the panel repeats its recommendation to include attention for research integrity in the ILOs. A positive aspect is that the ILOs clearly reflect the academic orientation of the programme, while still emphasising that application of scientific knowledge is also considered important ('understand to apply'). By linking the ILOs to the Dublin descriptors, the programme has made sure that the learning outcomes are suitable for an academic programme at master's level.

Link to the professional field
To stay in tune with developments in the professional field, the programme has established an informal network of contacts as well as a formal External Advisory Committee (EAC), consisting of representatives of relevant employers. The EAC meets annually to provide its input on the ILOs and curriculum. The panel was pleased to learn that the redevelopment of the curriculum that took place over the reporting period was discussed with various stakeholders, including graduates, agribusiness professionals and representatives from international universities as well as with the EAC. These discussions principally pointed towards the necessity of strengthening the focus of the curriculum on bioinformatics as an essential tool in genomics and breeding research, which was subsequently taken up in the newly added courses. To make up for the lack of international representation in the EAC, the programme specifically sought the feedback of international graduates through a digital questionnaire. The panel appreciates this initiative and therefore encourages the management to explore more structural ways of involving the international professional field in the programme.

Master's programme Organic Agriculture
Profile
The master's programme Organic Agriculture (MOA) explores (agro-)ecosystems, food systems and multi-functional land use from the viewpoint of various disciplines (i.e. plant, soil, animal, social and environmental sciences), multiple perspectives (i.e. sustainability, health and ethics) and different geographical scales (i.e. local, regional and global). Like the other programmes in the Plant Sciences domain, it adopts a systems approach, integrating theory and practice by focusing on action learning and action research. Ecological concepts are applied in various domains, such as agro-ecology, organic agriculture, permaculture or conservation agriculture, and are connected to the societal context. A total of fourteen WU Chair Groups contribute to the programme, amongst which not only groups in the Plant Sciences domain, but also Social Sciences groups. The programme offers students a choice of three specializations: (1) Agroecology, (2) Sustainable Food Systems, (3) Double Degree Agroecology.

The panel was pleased to learn that, since the previous review of 2012, the programme has clarified its overall profile and objectives, as well as the profiles of the underlying specializations. It

established that the current general profile is well described and highly relevant, with clear aims that match the character of the field and tap into the growing world-wide interest in sustainable food production systems. From its conversation with students, the panel learned that they were particularly attracted to the programme because of its interdisciplinarity and global approach, which are indeed strong features in the programme's profile. An attractive aspect of the programme is also that it offers students the opportunity to pursue a Double Degree in cooperation with ISARA-Lyon (Institut Superieure d'Agriculture Rhone-Alpes, France), which was added as a third specialisation starting from 2015-2016. Prior to the site visit, the panel was presented with the letter of agreement for the Double Degree.

A topic that was discussed during the site visit, is whether the name of the programme fully covers the content, as the (current) programme is much broader than its name suggests, not limiting itself to organic farming but also including other forms of sustainable food production. The panel understands the reasoning behind the current name, which is more distinctive and resonates better with prospective students than, for example, the umbrella term agroecology, but even so, it suggests that the programme may wish to continue its conversation on alternative programme titles.

Intended learning outcomes
The master's programme Organic Agriculture has formulated a set of thirteen ILOs (see appendix 2), with a setup that is largely similar to that of the other two master's programmes in the domain of Plant Sciences. There are three domain-specific learning outcomes (ILOs 1-3), four learning outcomes on scientific skills (ILO 4-7), two learning outcomes that reflect the programme's emphasis on societal awareness (ILO 8-9) and four learning outcomes on general academic skills (ILO 10-13). The ILOs are linked to the Dublin descriptors, which guarantees that the learning outcomes are suitable for an academic programme at master's level. The panel is very pleased with the ambitious learning outcomes. The domain-specific and specialisation-specific ILOs are phrased in such a way that they transcend the disciplinary lines of the Chair Groups involved in the programme, which makes them truly interdisciplinary. Not just the domain-specific ILOs, but also the other categories adequately reflect the profile and objectives of the programme. Compared to the ILOs of the other two master's programmes, the MOA ILOs are more specific, also because of the addition of a fourth category, societal awareness, which is highly relevant for the particular field. One aspect that might be introduced into the ILOs is attention for research integrity.

Link to the professional field
Like the other programmes, MOA has an External Advisory Committee (EAC), which mainly consists of representatives of the Dutch organic agriculture sector. During annual meetings, the EAC provides input on the ILOs and curriculum. Contacts with the professional field in general, however, seem less intensive and frequent than in the other master's programmes, which may be due to the fact that MOA trains students for a particularly wide range of positions and sectors. Further intensifying the interaction with the multitude of (potential) stakeholders could be made a priority for the coming period. The panel notes that this was also pointed out during the most recent meeting of the EAC, which proposed to more regularly invite guest speakers to link course content with the professional perspective and, vice versa, to share current developments in research and teaching with professionals. As for the other programmes, the panel stresses the importance of not limiting this to the Dutch labour market, but to also increase interaction with international stakeholders. From the documentation and interviews it was sufficiently clear that the management is aware of this issue and aims to address it in the coming period.

Considerations
The panel notes that Plant Sciences are a particularly strong and internationally visible domain at WU, which makes the university an ideal host for degree programmes in this domain. For all four programmes it was sufficiently demonstrated that these are unique within the Netherlands. The panel is pleased with the broad, integrated profile of the bachelor's and master's programmes Plant Sciences that addresses all relevant levels from molecule to ecosystem and thereby encourages

systems thinking. The profile of the master's programme Plant Biotechnology is equally relevant and the panel applauds the combination of biotechnology with approaches from the social sciences. While the profile of this programme is sufficiently distinct from that of the master's programme Plant Sciences, the panel noted that the differences might need to be better explained to students, who found it difficult to pinpoint the defining characteristics of both programmes. The interdisciplinary, internationally oriented profile of the master's programme Organic Agriculture is highly attractive, although the panel wonders whether the current programme title fully reflects the broad scope of the programme.

The ILOs of all four programmes match the programmes' profile and correspond to the Dublin descriptors for academic bachelor's c.q. master's programmes. The domain-specific ILOs of the master's programmes Plant Sciences and Plant Biotechnology would, however, benefit from more specificity in order to more prominently highlight the differences in the knowledge, understanding and experimental skills that students of both programmes acquire. In this respect, the ambitious ILOs of the master's programme Organic Agriculture are exemplary, as they are more attuned to the specific nature of the field. While the panel appreciates that ethical aspects are mentioned in the ILOs of all four programmes, it feels that research integrity should also be given a proper place.

The programmes align their objectives and curricula with the professional field by means of informal contacts with stakeholders as well as annual consultations of their respective EAC. Currently the master's programme Organic Agriculture seems somewhat less connected to the professional field than the other programmes. Expanding the scope of the EACs to the international professional field is an opportunity for improvement for all programmes.

Conclusion
Bachelor's programme Plant Sciences: the panel assesses Standard 1 as 'good'.
Master's programme Plant Sciences: the panel assesses Standard 1 as 'good'.
Master's programme Plant Biotechnology: the panel assesses Standard 1 as 'good'.
Master's programme Organic Agriculture: the panel assesses Standard 1 as 'excellent'.

Standard 2: Teaching-learning environment
The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Findings

Bachelor's and master's programme Plant Sciences
Curriculum bachelor's programme
Intake in the bachelor's programme Plant Sciences has increased sharply over the reporting period, which eliminates the concern expressed by the previous panel about low student numbers. In 2017 the programme had a healthy intake of almost 90 students. To enter the programme, a Nature & Health or Nature & Engineering profile at VWO-level is required.

The panel established that the structure of the three-year Dutch taught bachelor's curriculum (180 EC, see appendix 3) is clear and coherent. It consists of a common part (108 EC), major (24 EC), elective space (30 EC) and thesis (18 EC). The courses of the common part, which are spread across all three years, fall in one of three categories: (1) supporting courses, (2) (plant) biology and domain specific courses or (3) integration courses. Supporting courses, including chemistry, mathematics, statistics, management studies, provide an essential basis for the understanding of (plant) biology and domain specific courses. This second category provides students with essential knowledge of plants and other living organisms at all integration levels (ranging from molecular aspects in *Fundamentals of Genetics and Molecular Biology* to ecological aspects in *Ecology I* and *Ecology II*). From this fundamental base, students build knowledge and understanding of concepts

central to the specific domains of agroecology, plant breeding, plant pathology, environmental plant physiology, agrobiodiversity and integrated pest management. The integration courses, finally, focus on academic and research skills, and aim to integrate disciplinary knowledge with analysis and study of the issues in the broad domain of plant sciences.

The panel appreciates that the programme offers students opportunities for further specialisation and pursuing their own interests and ambitions. In the second year, students choose between two majors (Plant Genomics and Health; Plant Production and Ecology), which consist of more advanced courses in the designated field. The final half of the third year is reserved for free choice. Students can either select one of WU's 55 minors (6 of whom are related to the domain of Plant Sciences), make their own selection of optional courses or follow minor/elective courses at another Dutch university or international partner institution. To ensure the quality and coherence of individual study paths, these need to be approved by the Examining Board.

During the site visit the panel studied a number of sample courses including the first-year domain specific course *Fundamentals of Genetics and Molecular Biology*, the second-year integration course *Research Methodology in Plant Sciences* and the major-specific courses *Plant Biotechnology* (major Plant Genomics and Health) and *Soil Plant Relations* (major Plant Production and Ecology). The panel is pleased with the level and content of these courses. The study material (textbooks, syllabuses, scientific articles) is sufficiently up-to-date, although the panel also found some older versions of textbooks (on Plant Biotechnology and Statistics) being used. Course specific learning goals for students are appropriate and match the teaching methods used. A curriculum matrix shows that the programme as a whole covers all of the ILOs. Even so, the programme is currently in the process of mapping both its 'knowledge' and 'skills' curriculum to gain a more detailed and complete overview of what is taught where in the form of a 'Course Library'. This is an initiative that the panel supports. The panel is of the opinion that all of the relevant (sub- and adjacent) disciplines are sufficiently covered in the curriculum as a whole, resulting in a multidisciplinary (rather than interdisciplinary) study programme. The profile of the programme, moreover, is adequately translated into the curriculum: the systems approach of addressing all spatial levels is apparent from the documentation that the panel studied.

Like the panel, students are very positive about the content of the curriculum, which scored a 4.2/5 in the national student survey (*Nationale Studenten Enquête,* NSE) of 2018. The panel established that they particularly appreciate the setup of the programme, which first establishes a broad knowledge base that is later built on with more specialized courses, as well as its flexibility, which allows students to adapt the programme to their own interests. A suggestion for further improvement made by some students is to pay more attention to chemical crop protection, thereby creating a more equal focus on both organic and conventional agriculture. Students furthermore attach great value to the programme staying in tune with new developments in science and society by continuously updating and broadening course content. According to the panel, the programme is sufficiently sensitive to this last point, as was demonstrated recently when a major-specific course on bioinformatics (*Introduction to Bioinformatics*) was changed to include programming skills and data analytical skills.

The panel notes that the curriculum does not contain explicit learning lines that develop a specific theme throughout (parts of) the programme. One topic that may benefit from such a systematic approach are societal/ethical aspects of Plant Sciences, which are designated as an important theme in the ILOs. While the panel established that societal and ethical debates are indeed a recurring theme in the courses, it also notes that the topic as such is not clearly recognizable to students. Developing a learning line on ethics – based on the information gathered in the Course Library – may help to increase visibility.

From the documentation and interviews it is sufficiently clear that the bachelor's programme is an inherently academic programme, which nurtures a close relation between the ongoing research of the WU Chair Groups and the teaching. A primary aim of the programme is to train students in

conducting academic research. The panel was pleased to find that this starts at an early stage, by including research projects in the first-year's integration course *Orientation Plant Sciences* and the second-year's integration course *Research Methodology in Plant Sciences*. Studied material from the latter course confirms the thoroughness of the training that students receive. One topic that could, however, receive more structural attention within these courses is research integrity. Even so, students are satisfied with the academic training they receive.

During the interview, students indicated to the panel that they feel very well prepared for (and supervised during) their thesis project. Over the course of three months in the third year of the programme, students design a research project, identify a theoretical framework, perform experimental research, interpret results and write and present an academic report. The panel notes that all of these steps are elaborately discussed in an excellent thesis manual that is provided to students. As a rule, all theses are part of larger ongoing research projects. Not all theses require experimental work; students are also allowed to conduct a data analysis or write a literature-based study. Because of the limited scope of the research project, students who do experimental work are usually limited to the use of one or two different techniques. This seems like a sensible approach to the panel. It would like the programme to investigate the possibility of giving all students the opportunity to do experimental work.

Although bachelor's graduates are not expected to directly enter the labour market, the programme is aware of the need to prepare students for practice. Lecturers indicated to the panel that BPW is a rather applied programme, especially when compared to the more fundamental WU bachelor's programme in Biology. The labour market asks for students with practical skills, which is why experiments feature prominently in the bachelor's curriculum. So-called soft skills (communication, cooperation, the ability to self reflect etc.) have also been given a notable place in the ILOs and are trained in a number of courses. A good example is that the Study Guide Thesis provides guidelines for reflecting on one's own strengths and weaknesses. Even so, students indicated that they do not experience a strong connection between the programme and the daily practice of the professional field. They would prefer to have more excursions, guest lecturers from practice and short internships, which would create insight into potential career opportunities.

Unlike some other WU bachelor's programmes, the bachelor's programme Plant Sciences has not adopted English as its language of instruction. The management informed the panel that there is a strong domestic labour market in Plant Sciences and student numbers are healthy as is, which means that there is no direct necessity to internationalize. Furthermore, it is feared that switching to English may put off Dutch students who are hesitant to choose an international programme. Instead, bachelor's students are gradually familiarized with the use of spoken and written English in order to facilitate their transition to an English-taught master's programme. The panel agrees that this is an appropriate strategy and established that students are pleased with the current build-up towards writing an English bachelor's thesis.

Curriculum master's programme

The master's programme Plant Sciences has doubled its annual intake since the previous assessment, with 150 students entering the programme in 2017. Students enter the programme from a variety of (inter)national bachelor's programmes and are admitted based on the match between their pre-existing knowledge and the content of the master's programme. Furthermore, the WU-wide admission criteria for master's programmes apply: students need a GPA of 70/100 and a sufficient level of English to qualify for admission. Students with deficiencies are required to take a relevant WU minor or combination of optional courses as part of their bachelor's programme or as a linkage programme after graduation. Alternatively, students can fill knowledge gaps by including up to two restricted optional courses ('harmonization courses') in their master's programme.

The two-year master's curriculum (120 EC, see appendix 2) includes one year of courses (60 EC) and a second year that is filled with a thesis (36 EC) and an academic internship or second

('minor') thesis (24 EC). The panel established that study paths are to a large extent tailored to the individual student. There is no domain-specific common core for all students. Instead, students choose one of seven specializations right from the start of the programme. Within the specializations, further choices can be made depending on the prior education of the student and her/his interests. In most specializations, students take up to two harmonization courses, at least one core specialization course and one course that prepares them for the thesis in the chosen field. Besides going in-depth as part of the specialization, students are also encouraged to broaden their scope by way of the free choice component (24-36 EC) of the curriculum. The final building block of the programme is the WU-wide Academic Master Cluster (12 EC), during which students either participate in the course *Academic Consultancy Training* and the *Modular Skills Training* or opt for the *Research Master Cluster: Proposal Writing*.

The panel feels that there are important upsides to the flexible curriculum design. It notes that students can choose from a large variety of specialisations and a high number of courses in the domain of Plant Sciences, which adds to the general attractiveness of the programme. Students informed the panel that the flexibility of the programme is in their opinion one of its major strengths. Furthermore, the panel acknowledges that the flexibility of the curriculum is an adequate response to the heterogeneity of the student population, as deficiencies can be dealt with at the level of the individual student. Nonetheless, the flexibility and large number of courses also seem to create certain challenges in terms of planning and keeping an overview of everything that is on offer: students indicated that there is quite a bit of overlap between courses. The panel agrees with their suggestion to better monitor the topics that are dealt with. Mapping the curriculum by way of the new Course Library may prove beneficial in this sense. Finally, the panel notes that because of the flexibility, it is difficult to assess the overall coherence of the curriculum and to check whether all students meet the ILOs. However, it is sufficiently convinced that students are well advised in their choices and that mechanisms are in place to check that individual curricula meet the ILOs. Study advisors play a crucial role in this process. The panel does advise the programme to consider introducing a common core. This would be beneficial for the coherence of the programme and the job market profile of graduates. Furthermore, it would facilitate cohort building.

One particular issue that came up several times during the interviews is related to the harmonization courses that master's students of a majority of specializations are required to take in order to deal with deficiencies and prepare for the chosen specialization. As these restricted optional courses (with the course code RO0) are courses at bachelor's level, this results in a mixed population of bachelor's and master's students. A notable example is the bachelor's course *Plant Biotechnology*, for which the panel established that 51% of recent course participants are actually master's students, not just of the master's programme Plant Sciences but also of the master's programme Plant Biotechnology. Understandably, this practice is rather unpopular with bachelor's students, who observe that the inclusion of master's students has consequences for the level of the course. While the level of lectures is believed to go up, the level of practicals, by contrast, goes down: some non-European master's students lack practical skills that Dutch bachelor's students have already mastered and therefore slow down the learning process. Moreover, the panel established that the learning goals at course level are the same for bachelor's and master's students, which is somewhat problematic as there is supposed to be a hard separation between bachelor's and master's levels.

During the site visit the panel studied material from a number of sample courses, including a core course from the Greenhouse Horticulture specialization (*Research methods in Crop Science*), an advanced course from the Plant Breeding and Genetic Resources specialization (*Design of Plant Breeding Programmes*) and an advanced course from the Plant Pathology and Entomology specialization (*Plant-Microbe Interaction*). The panel concluded that the content of these courses is a good reflection of the current state of affairs in the domain of Plant Sciences. The level of the courses is clearly academic and course-specific learning goals match the ILOs and teaching methods. When considering the curriculum as a whole, the panel notes that an opportunity for

further improvement is to pay more structural attention to societal and ethical aspects. It also repeats the recent recommendation by the EAC and graduates of the programme to put more emphasis on bioinformatics, quantitative analytical skills and handling big data in general. All in all, students are positive about the content of the curriculum, which received a score of 4.1/5 in the 2018 NSE. A particular strength that was mentioned during the site visit is the topicality of the curriculum.

The final dedicated piece of work in the programme is the thesis, an individual research project that is usually part of a larger research project at one of the 17 Chair Groups involved in the programme. As a rule, the thesis is connected to the domain of the chosen specialization. Students can find information on thesis topics by attending the thesis market, or consulting an online database, or Chair Group websites. The panel notes that the programme provides sufficient opportunities for students to prepare for an academic career, notably by offering the course *Research Master Cluster: Proposal Writing* in which students acquire or improve their writing skills and learn to defend a scientific research proposal. Additionally, students can opt to replace the internship with a second ('minor') thesis, which further sharpens their research skills.

Students pointed out to the panel that they feel better equipped for academic careers than for non-academic careers. They fear that the programme does not optimally connect with the labour market and would prefer more direct contact with the professional field, for instance by organising visits to companies and career events in which potential employers present themselves and by including more academic consultancy training projects with direct involvement of societal stakeholders. This last suggestion also ties in with a recommendation by the EAC to pay attention to skills such as management and communication, for example by appointing dedicated skills trainers. According to the panel, this is a valuable piece of advice that the programme should look into.

During the site visit, the panel has also studied the curriculum of the Online Master Plant Breeding (OMPB), which consists of a dedicated set of online courses (60 EC), an academic internship (24 EC) and a thesis (36 EC). Completion of this part-time programme usually takes 3 to 4 years. The programme is open to students from a range of different (professional as well as academic) bachelor's programmes, both from the Netherlands and abroad, who may need to follow an individually designed linkage programme prior to entering the programme or deal with deficiencies by self-study. Unlike students of the regular master's programme, online students follow a clearly defined curriculum of fifteen courses that were specially developed for OMPB, as well as an online version of the Academic Master Cluster. The programme is designed to cover relevant knowledge on genetics, plant breeding, plant pathology, biotechnology, genomics, bioinformatics and combine this with a practice-oriented approach. During the first two years of courses, students are expected to spend two weeks per year on campus in order to receive training in practical and laboratory skills. The thesis work is preferably done at a WU Chair Group but in individual cases it is possible to involve the company that employs the student. Students who already work at a breeding company may be able to get an exemption for part of the internship. During the site visit the panel studied a number of dedicated OMPB courses. It concludes that these are of a satisfactory level and address topics that are relevant for prospective plant breeders. Students of the programme indicated to the panel that the fixed curriculum is not problematic for them, as they specifically entered the programme with the intention of becoming a plant breeder. Although the students are generally pleased with the programme, they did object to the rather basic level of the first three to four courses and signalled that it was somewhat difficult for them to find a thesis topic and supervisor because of their physical distance to the campus, Chair Groups and staff.

Teaching-learning environment
Both the bachelor's and the master's programmes are medium-sized programmes with a preference for small-scale education. According to students this is a major strength, as it allows for personal connections between staff and students and close supervision of students by study advisors and teachers.

The panel established that the programmes describe their educational philosophy as 'research-based education'. It is not sure, however, whether this is intended to mean that the curriculum structure and learning activities are shaped according to the outcomes of educational research, or whether it just signifies that teachers themselves are researchers and that the teaching therefore follows research in the domain of Plant Sciences. The panel supposes the latter. Overall, it would have liked to see an explicitly described epistemological approach to teaching and learning, which currently does not seem present. With respect to the principle of international classroom teaching, the panel observed a similar practice- rather than theory-based approach. In order to fully exploit the benefits of having an international classroom, the panel suggests that the master's programme considers some of the theoretical principles on dealing with intercultural sensitivities, etc.

The panel established that the programmes use a variety of teaching methods. Although there are some courses that consist mainly of lectures, a typical course in the bachelor's programme includes a combination of two or more different teaching methods that match the course specific learning outcomes. Common forms of instruction are (lab)practicals (52%), tutorials (22%) and lectures (19%). In the documentation the panel has seen a number of good examples of appropriately combined teaching methods, such as plenary lectures with supervised ICT modules, group work on case studies and laboratory practicals on topics related to these cases (in the first year's *Cell Biology* course, shared with the Biology bachelor's programme). The master's programme also subscribes to the principle of combining teaching methods at course level. The distribution of teaching methods is the same as in the bachelor's programme, with many courses relying on lectures, tutorials and practicals, including field-, greenhouse-, computer- and laboratory work. Some courses also include group work, but this is less common. The panel concludes that these teaching methods are sufficiently interactive and activating. It especially appreciates that the programmes are increasingly incorporating innovative, digital teaching methods (knowledge clips, LabBuddy) that help students to prepare for classes and thereby facilitate a more meaningful interaction in class. Some of these are derived from the teaching in the OMPB. For the sample courses that were studied during the site visit, the panel concludes that the digital learning environment on BlackBoard is well used. It contains a multitude of learning tools, such as short clips and quizzes, and offers means for communication between teachers and students.

Both programmes have an adequate number of weekly contact hours. The average in the bachelor's programme is 22 contact hours, while in the master's programme this is 18. Bachelor's and master's students confirmed that the programmes are sufficiently feasible. Students spend up to 40 hours a week on campus and rarely have to do extra work in the evening or during weekends. Even so, the panel established that a large part of the student population does not complete the programmes within the appropriate time frame, for example because they wish to extend the (master's) internship or thesis. The success rate of the bachelor's programme narrowly meets the faculty-wide target of 75% completions after four years of study, while the success rate of the master's programme is just under the target of 90% completions after three years.

A primary principle in the guidance offered to students is that students themselves are in the lead: they are responsible for and in charge of their study programme and study progress. Study advisers are available to advise and coach, but the initiative (mostly) has to come from the students themselves. The panel appreciates this principle and inferred from the interview with the programme management that (notwithstanding that the student is in the lead) study advisers will act proactively where needed regarding the adjustment of non-European students to the Dutch system. The panel does, however, wonder whether this is clear to all starting students. It would like to encourage the programme to monitor overall student awareness of the indicated policy. Students themselves seem generally pleased with the quality of study guidance. A promising new phenomenon is the thesis ring, in which a group of 7 to 10 students discuss their thesis proposals and progress under supervision of a staff member. The panel would recommend to introduce this practice university-wide.

The excellent facilities that the programmes offer students are a major strength. The programmes (and most of the participating Chair Groups) are housed in the Radix building, which offers specialized, well-equipped lab facilities. Additionally, students can use the state-of-the-art greenhouse and climate room facilities at Unifarm and the experimental fields at the Droevendaal Experimental and Training Farm, which is a 50-hectare multifunctional farm. During the site visit, the panel toured the greenhouse facilities, which are amongst the best that are on offer at universities worldwide.

A concern is the rapidly increasing number of students at WU. Even if student numbers at programme level are manageable for now, both bachelor's and master's students made clear to the panel that they perceive continuous growth as a threat to the traditional small-scale education, high-quality facilities and personalised supervision of students. Students confirmed that the quality of the education is (still) high, but they do notice that there is already a lack of interesting projects in the Academic Consultancy Training course, that library facilities are stretched, classes are at full capacity and that the number of workspaces is no longer sufficient. Furthermore, master's students mentioned that the quality of supervision during (lab)practicals is under pressure, as part of the responsibilities is transferred to teaching assistants, who are not always capable of providing useful answers to students who run into problems. Also, students now frequently use data generated by the WU greenhouses rather than going into the greenhouses to do experiments themselves. The panel feels that these are signals that need to be taken seriously by the management.

From the interviews, the panel established that the programme management and the Board of the University are well aware of the negative side effects of growth. It was pleased to learn that the strategic plan for the coming years stresses the necessity to preserve the small-scale education that is considered typical for WU. This involves hiring additional staff and extending the number of courses. With respect to the latter, the panel feels that it is perhaps more helpful to split up/rerun existing courses than to add a variety of new courses, which would take up a lot of time and resources and may perhaps negatively impact the coherence of the programmes. Offering the same courses twice a year instead of just once could help solve current scheduling issues, particularly for students who enter the programme in February instead of September and have to follow the advanced courses before the more basic core courses, which may cause problems for them. Splitting up existing courses, as is already happening in some cases (e.g. the bachelor's course *Concepts in Environmental Plant Physiology)*, would also make it easier to cater to the needs of particular groups of students. A specific recommendation that the panel would like to offer, is to put an end to the practice of master's students participating in bachelor's classes (and vice versa) by creating two versions of the course, a regular version for bachelor's students and a fast-track version with more advanced learning outcomes (and therefore more advanced assessment) for master's students.

After studying the online teaching methods and facilities for the online master's programme Plant Breeding, the panel concludes that the teaching-learning environment for this specialisation is a best practice. The distance-learning programme uses a broad variety of activating teaching methods (e-learning, tutorials, knowledge clips, distance group work, etc.) in which ample online contact between students and between staff and students is embedded. The panel particularly appreciates that the OMPB functions as a 'laboratory' for innovative teaching. Many of the special features that were developed for the OMPB are currently also being implemented in the on-campus teaching.

Teaching staff
The panel is pleased with the quality of the teaching staff. It established that lecturers are active and internationally visible researchers, most of whom are members of the Experimental Plant Sciences (EPS) or Production Ecology & Resource Conservation (PE & RC) graduate schools. Nearly all lecturers have obtained a PhD (100% of bachelor's lecturers and 96% of master's lecturers). On the whole, diversity is an issue. The panel established that the current composition of the staff does not (yet) reflect the increasing internationalisation. A large part of the staff has been trained

at WU and is of Dutch origin. Men (far) outnumber women. This is something to remedy via the Chair Group recruitment strategies.

Students indicated that they are satisfied with the motivated and inspiring teaching staff, who are experts in their fields and sufficiently able to convey their knowledge. English proficiency is sometimes perceived as less than optimal, particularly by international master's students who sometimes find the phrasing of exam questions confusing.
The panel notes that didactic skills are considered important. Obtaining a University Teaching Qualification (UTQ) is required for staff members on a tenure track position. Currently, 61% of lecturers in the bachelor's and 57% of master's lecturers currently have a UTQ, which is in accordance with the performance agreements (*prestatieafspraken*) between WU and the ministry of Education, Culture and Science (OCW). Staff members are also encouraged to obtain other qualifications that benefit their teaching. Those who teach courses in the OMPB, for example, are offered a tailor-made course on online teaching. PhD students who supervise thesis students are given a training to do so and the same goes for master's students who assist during lab practicals.

A promising development is that university-wide there seems to be a growing awareness that the current model of building careers on research rather than teaching needs reconsideration. The panel fully supports initiatives to fit teaching into the career development plan for staff, for example by creating positions for so-called Principle Educators (PEs) as a counterpart to Principle Investigators (PIs). This would not just benefit individual staff members with a particular interest in teaching, but also give more prominence to the importance of didactics across the board. The panel was also pleased to find that the central university level offers some financial support for educational innovation initiatives and that 'teacher of the year awards' are given out to stimulate teaching efforts.

A topic that was discussed during the site visit is the workload of staff members. Growing numbers of students at WU mean that many staff members experience an increasing teaching burden. From the interviews the panel gathered that some Chair Groups – particularly the groups that supervise many thesis students – are more affected by this issue than others. Furthermore, different Chair Groups have developed different strategies for coping with the increased teaching load. Some Groups, for example, have hired dedicated teachers without research time. It is also common that part of the supervision burden is delegated to PhD students, who operate under the supervision of a tenured staff member. The panel established that the issue of increasing teaching-loads has the attention of the programme management and Executive Board of the university. A positive sign is that funds are being made available to hire additional staff. To date, student-staff ratios for the bachelor's programme (11:1) and the master's programme (17:1) are favourable. The panel hopes that these ratios can be maintained in the coming years.

Master's programme Plant Biotechnology
Curriculum
Since the previous assessment, the student intake in the master's programme Plant Biotechnology has doubled, from 26 students in 2012 to 51 in 2017. Students enter the programme from many different bachelor's programmes (including the WU bachelor's programme Plant Sciences) and have to meet the general WU admission criteria for master's programmes. Students with deficiencies are required to take a relevant WU minor (e.g. Experimental Plant Sciences, Plant Breeding, Plant Biotechnology) or combination of optional courses as part of their bachelor's programme or as a linkage programme after completion. Alternatively, students can fill knowledge gaps by including up to two restricted optional courses ('harmonization courses') in their master's programme.

The master's curriculum (120 EC, see appendix 2) spans two years. In the first year, students take courses (60 EC), while in the second they complete a thesis (36 EC) and an academic internship (24 EC). The course phase of the programme consists of harmonization courses (0-12 EC), a common part (12 EC), specialization courses (12 EC, including a core course and an advanced course), the Academic Master Cluster (12 EC) and free choice courses (12-24 EC).

The panel established that the curriculum was adjusted since the previous assessment, with the intention to increase its specificity and introduce the recently established dual focus on technology and societal aspects into the courses. These changes mostly relate to the common part of the programme, which was redesigned. A significant addition is the course *Current Topics in Plant Biotechnology* that links overarching themes in the field of plant biotechnology and addresses societal debates on new technologies. This course runs throughout the entire programme and consists of symposium style sessions on subjects related to what is possible within plant biotechnology, what is allowed by law and what will be accepted by society. Students themselves are (partly) responsible for preparing these sessions. The second part of the common core of the programme consists of a cluster of four courses that place technology in a societal context (*Intellectual Property Rights*; *New Venture Creation*; *Communication & Persuasion*; *Dilemma's in Food Safety and Security*). Students choose one of these skills-oriented courses. The programme offers a further choice of three specialisations (Functional Plant Genomics; Plants for Human and Animal Health; Molecular Plant Breeding and Pathology), each with their own restricted optional courses. The thesis is closely connected to the domain of the chosen specialization and as a rule takes place at one of the 12 WU Chair Groups that contribute to the programme. In addition, students choose up to 24 EC of free choice courses, by which they can either aim for more depth or breadth. Finally, as part of the WU-wide Academic Master Cluster, students either follow an *Academic Consultancy Training* combined with *Modular Skills Training* or a newly added *Research Master Cluster: Proposal Writing.* The former offers students real-life training of professional skills, while the latter deals with writing and defending academic research proposals.

The panel concludes that the master's programme Plant Biotechnology, like the master's programme Plant Sciences, provides students with considerable flexibility: study paths are to a large extent tailored to the individual student. As was discussed for Plant Sciences, this has a number of benefits, but it also poses certain challenges. One particular problem that was also signalled by the previous panel, is that the highly personalized and therefore widely varying learning paths of students do not seem to justify that the master's programme Plant Biotechnology is a separate programme rather than a specialization of the master's programme Plant Sciences. The panel appreciates that the programme has tried to deal with this critique by translating its sharpened profile and objectives to a programme-specific core. From the interviews and documentation, however, it concludes that the common part of the programme needs further improvement in order to be truly effective. The new *Current Topics in Plant Biotechnology* course has an interesting format, but is, according the self-evaluation report, perceived as 'suboptimal' by staff and students, mostly because of scheduling issues. Students, moreover, indicate that choosing an appropriate set of subjects that follow a content progression and do not overlap excessively can be rather difficult. While they certainly value the freedom of choice and flexibility, they also mentioned to the panel that study paths of different students diverge so much that the small MPB student population does not really feel like a community, especially since students of the MPS and MPB programmes follow many of the same courses. In response to these observations, the panel suggests to further strengthen the common core of the programme in order to create a clear programme identity and labour market profile for graduates and to facilitate cohort building.

The panel further notes that, to some extent, the lack of distinction also affects the specializations, notably the Molecular Plant Breeding and Pathology specialization which overlaps with two specializations of the master's programme Plant Sciences (Plant Breeding and Genetic Resources/Plant Pathology and Entomology). Students indicated to the panel that this particular specialization is very broad and could in their opinion be split into two more focused specializations on molecular breeding/molecular aspects of plant pathology. The panel suggests that the programme management considers this option. A separate issue is that the programme management feels that the focus of the specialization Plants for Human and Animal Health is relatively narrow. In the coming period, the management plans to re-develop this specialization. The panel wonders whether aspects of this specialization could not be covered under the other two.

The panel notes that students are generally positive about the content of the curriculum, which received a score of 4.1/5 in the 2018 NSE. However, students that the panel spoke with also signal some opportunities for further improvement. To begin with, they mentioned that the level of some of the courses is rather low, also because of the large overlap between basic level courses. Secondly, students observe that some of the courses could do with an update of their content, which is perceived as somewhat outdated and not entirely representative of the cutting-edge research that takes place at the WU Chair Groups. According to the panel, the programme management should look into these observations to determine whether they are indicative of the opinion of the full student population. With respect to the comments on the overlap and (low) level of basic courses, it suggests to critically assess the current admission criteria, which may need to be sharpened further in order to avoid wide variations in the starting level of students. Currently, there seems to be a rather wide gap between European and non-European students, especially in terms of practical skills. With respect to the perceived disconnect between the course content and innovative research taking place at WU, the panel notes that stakeholders of the programme, including the External Advisory Committee, recently advised the management to pay more attention to bioinformatics as an essential tool in genomics and breeding research and to big data in general, which seems an appropriate suggestion.

To form an opinion on the level and content of the curriculum, the panel studied material from a number of sample courses, namely the optional core course *Dilemma's in Food Safety and Security*, the specialization course *Introduction to Bioinformatics* (specialization Functional Plant Genomics) and the specialization course *Plants and Health* (specialization Plants for Human and Animal Health). Based on this material, the panel is sufficiently satisfied that the curriculum is at master's level and suitably in-depth. It was pleased to find that the concept of 'New Biology' is a prominent part of the programme. Furthermore, at curriculum and at course level there clearly is attention for the constructive alignment of ILOs, course-specific learning outcomes, teaching methods and assessment methods.

Like the master's programme Plant Sciences, the programme is geared towards scientific research. Notably, students have the option to take the course *Research Master Cluster: Proposal Writing* as part of the Academic Master Cluster and to replace the external internship with a second ('minor') thesis. These are good options, but the panel does recommend to further clarify the position of the second thesis, which in its opinion should be done at a different Chair Group to the first thesis and aim at progressive learning. The culmination of the academic training of students is the master's thesis, an individual research project, which helps students to develop their own area of interest and ambition. Students usually work on a subproject of a larger research project of one of the contributing Chair Groups, which means that students also participate in seminars, colloquia and other activities that are organized at the Chair Group level. According to students the thesis project forms the core of the programme and it is widely perceived as the most valuable and instructive part, not least because students are taken serious as researchers. Students indicated that they feel sufficiently prepared for writing the thesis. One aspect that could – in the panel's opinion – do with more attention is research integrity, which is an important concept for all prospective researchers. While the programme is academic in character, there is also quite a bit of attention for professional skills. Specifically, the *Academic Consultancy Training* (part of the Academic Master Cluster) and the internship at a company, public institution, consultancy firm, research organization or (non-) governmental organization help students to prepare for future employment outside of academia.

Teaching-learning environment

With respect to the teaching-learning environment, many of the conclusions on the programmes in Plant Sciences also apply to the master's programme Plant Biotechnology. Like their fellow students from the bachelor's and master's programmes Plant Sciences, students of the master's programme Plant Biotechnology consider the small-scale character, stimulating/supportive environment and personal contact between staff and students as major strengths of the programme. Again, the growing number of students is seen as a threat to all of these accomplishments. Students notice that classes are getting bigger, which results in diminishing

individual feedback and guidance. Specifically mentioned were the full capacity (80 students) computer practicals in the course *Genomics* (specialization Functional Plant Genomics), which are co-supervised by four PhD students/master's students and two lecturers. According to students it can be hard to obtain useful feedback in this setting. In response to these and other comments, the panel repeats the abovementioned recommendations with respect to splitting up courses, separating bachelor's and master's students and hiring more teaching staff to more evenly spread the teaching burden.

The programme believes in combining teaching methods at course level in order to ensure that all course-specific learning outcomes are appropriately addressed. Common forms of instruction are practicals including lab work and computer practicals (45%), lectures (23%) and tutorials (22%). Group work (8%) and excursions (2%) complete the picture. The panel established that teaching methods are sufficiently interactive and activating, with growing use of innovative, digital applications. In some courses the digital learning environment (Blackboard) is used to its full potential, but students indicated that other courses could do a with more systematically organised digital environment. Some students, moreover, feel that the way that classes are structured is rather scholastic, with some lecturers referring to self-study as 'homework' and checking students' preparation at the start of the class.

The number of contact hours (an average of 16 per week) is similar to that of other WU master's programmes. Students mostly spend full days on campus, which means that there is little need to study at home. While some students clearly appreciate this system, others seem to find it a bit oppressive and less suitable for a master's programme. Students confirmed that the study load is manageable and that the programme is therefore sufficiently feasible. The panel learned that the success rate of the master's programme is close to the Faculty target of 90% completions after three years. Scheduling issues are a rather common phenomenon. Many courses are programmed parallel to each other, which restricts students' options. (International) students who start the programme in February, moreover, have a less smooth transition into the programme than those that start in September. From the interviews, the panel concludes that the so-called 'extended daytime scheduling', which was launched recently as the solution to persistent scheduling issues, is less than popular amongst staff and students and therefore needs further adjusting.

Similarly to the bachelor's and master's programme Plant Sciences, students are expected to take the lead in developing a suitable study path, although study advisers are available to assist and advise. After an initial intake session, which takes place in groups, students can make individual appointment if necessary. Study advisers monitor student progress and contact underperforming students. Thesis rings are a promising addition to the system of thesis guidance and supervision that should be introduced university-wide.

MPB students have access to the same excellent facilities as BPW/MPS students, notably the state-of-the-art greenhouses at Unifarm, which offer opportunities for growing transgenic plants.

Teaching staff

The panel has established that the skilled and knowledgeable teaching staff is an asset to the programme. All but one of the 90 academic staff members involved in the programme have obtained a PhD and most are members of the Experimental Plant Sciences (EPS) graduate school. 55% of master's lecturers currently have a UTQ, which conforms to the WU-wide norm. The student-staff ratio (18:1) is adequate, but all the same the panel has some concerns about the increasing workload of staff members. The panel was informed that in some Chair Groups this is addressed by hiring dedicated teachers whose involvement in research is limited to educational research. Also, PhD students and master's students assist in practicals. While the panel appreciates that specific training is available for these teaching assistants, it is not generally in favour of master's students instructing other master's students, unless these are significantly further along in the programme.

During the site visit, students indicated that lecturers are seen as encouraging and stimulating. An opportunity for improvement mentioned in the student chapter is that students would like to get more access to the (international) networks of staff members, which may open up new internship and thesis opportunities. As in the Plant Sciences programmes, the teaching staff of the master's programme Plant Biotechnology is currently not very diverse in terms of national or cultural background and gender.

Master's programme Organic Agriculture

Curriculum

MOA has a healthy and highly international student intake that has more than doubled since the previous assessment, from 37 students in 2012 to 87 students in 2017. Students enter the programme from a wide variety of bachelor's programmes, not just in scientific fields related to the agronomic dimension of agriculture but also from the social sciences. They have to meet the general WU admission criteria for master's programmes in terms of GPA and English language proficiency. To deal with deficiencies in relevant knowledge of some students, the programme offers harmonizing courses that introduce students to the domain of the programme and to the relevant research methodology. Additionally there are a number of relevant MOOCs in the domain, which help students to reinforce their existing knowledge. Unlike the other two master's programmes in the Plant Sciences domain, MOA no longer offers the option of entering the programme in February, thereby addressing the issue that February entrants had to take advanced courses before the basic courses. The panel is pleased with this improvement.

The panel notes that the integrated, interdisciplinary MOA curriculum (120 EC, see appendix 2) has been designed to provide a balance between fundamental knowledge on the one hand, and its application in agroecology and the wider food systems on the other. Students have a choice of three specialisations: 1) Agroecology, 2) Sustainable Food Systems (which replaced the previous specialization in Consumer and Market in 2016-2017) and 3) the Double Degree Agroecology that is offered in cooperation with ISARA Lyon. The curriculum is flexible, with possibilities for students to adapt the programme to their own interests. The first year of the 2-year curriculum consists of courses (60 EC, including harmonization courses, common courses, specialization courses, free choice courses and the Academic Master Cluster), while the second consists of a thesis (36 EC) and an internship (24 EC), which are preferably supervised by different Chair Groups in order to underline the systemic approach. Students who opt for the Double Degree programme take common courses at both WU and ISARA Lyon, as well as a modified version of the Academic Master Cluster. Unlike students of the other two specializations they complete their internship in the first year.

A strong aspect of the programme is its common core that provides all students with a knowledge base in management of natural resources in organic agriculture, involving ecology, landscape, health and welfare, and aspects of worldwide dynamics and diversity in food systems, including governance, transformative capacity, social impact, sustainable development, and economic feasibility. This core consists of two compulsory courses (*Integrated Natural Resource Management in Organic Agriculture* and *Social Transformations towards Sustainable Food Systems*). A third course, the *Masterclass Organic Agriculture* functions as the glue that holds all of the individual study paths of students together and builds a strong MOA community. It runs throughout the entire programme and includes thematic *MOA Cafés*, organised by students themselves, as well as sessions that focus on critical thinking, discussing current issues in agriculture and food systems, planning for future careers, and engaging with peers.

The panel notes that the diversity of the student population is both an asset to the programme and a challenge. Interviews with students and staff made it clear that both groups experience the benefits of the different inputs of students from various disciplinary and national backgrounds. At the same time, an important criticism expressed by students is that the programme content is a delicate balancing act between breadth and depth. Some courses are challenging for certain students and too superficial for others. Staff pointed out that the harmonization courses are

designed to smooth over major differences between students, as there is both a course that introduces students with a background in the natural sciences to social sciences perspectives (i.e. *Organic Agriculture and Society*) as well as a course that prepares social sciences students for the more technical aspects of MOA (i.e. *Introduction to Organic Production Systems*). In practice, however, students seem to prefer sticking to what they already know. The panel encourages the programme to reflect on whether the harmonization courses (and available MOOCs) sufficiently serve their purpose or whether stricter admission criteria are necessary.

Students are generally positive about the content of the curriculum, which they described to the panel as interdisciplinary and internationally oriented. Students particularly appreciate that they gain hands-on experience in the field and study real-life cases. This means that they do not just learn about the theory (e.g. on nitrogen and carbon cycles), but also acquire valuable insights in the realities for the farmer, including an understanding of why the implementation of theory is not always a straightforward process. Furthermore, students appreciate that the programme is committed to sustainable food production and encourages students to live by the underlying principles of such an approach. In the 2018 NSE, the content scored a 3.7/5. Possible improvements that were signalled by students include diversifying the content and encouraging students to find their own niche, more thoroughly promoting systems thinking at course level and widening the opportunities available for gaining experience in developing countries. Sample courses that the panel studied during the site visit reinforced the impression of an interdisciplinary curriculum with a strong focus on innovation. These included the compulsory courses *Social Transformations towards Sustainable Food Systems* and *Integrated Natural Resource Management in Organic Agriculture*, as well as the specialization course *Analysis and Design of Organic Farming Systems* (Agroecology specialization). The material that the panel studied confirms that the curriculum is at master's level and that there is sufficient attention for the constructive alignment of ILOs, course-specific learning outcomes, teaching methods and assessment methods. The courses make use of various student-centred teaching methods and relevant literature, consisting of scientific papers rather than textbooks, save for some in the field of agro-ecology.

While the internship allows students to prepare for their prospective careers by learning to integrate their knowledge and skills in the context of an organisation, the master's thesis tests and perfects the research skills of students. Internships are always conducted outside of WU – and frequently outside of the Netherlands – but the thesis usually takes place at a WU Chair Group, which has the benefit of submerging students in a high-quality research environment. Career preparation also takes place within the Academic Master Cluster that is a fixed component of all WU master curricula. This usually consists either of a combination of *Academic Consultancy Training* and *Modular Skills Training*, or of the *Research Master Cluster: Proposal Writing,* depending on whether students intend to pursue a professional or an academic career. The panel established that the important topic of professional ethics/research integrity is addressed in the *MOA Master Class* as well as in the reflection that is part of the internship and the thesis. Students indicated to the panel that they would appreciate stronger external connections, for example by involving representatives of the field in the curriculum.

Unlike the other master's programmes, MOA offers students the opportunity to combine their thesis and internship into a single interdisciplinary 'action research project' (60 EC) that is co-supervised by two different Chair Groups. The panel considers this an interesting option that corresponds with the profile of the programme. As the programme is aware, this setup requires further elaboration and popularization. Not all students are aware of the option, while some Chair Groups do not appear to favour the setup as they believe that the different learning processes involved in thesis and internship should be separated. During the site visit, however, the panel also learned of highly successful internship/thesis combo's, such as an ambitious project on the implementation of the Paris Agreement in three developing countries (Colombia, Ethiopia, India) that was conducted in cooperation with CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS). According to the panel, such high profile projects provide talented students with a unique learning experience that is (potentially) highly beneficial to their prospective career.

Teaching-learning environment
The panel is very pleased with the teaching-learning environment that MOA offers its students. It established that, even more so than in the other Plant Sciences programmes, students and staff form a vibrant, tight-knit and highly committed community, which was lovingly referred to during the site visit as a 'MOA bubble'. Staff members are described by students as approachable and easily accessible, while staff members applaud the diversity, maturity, reflectiveness and dedication of the student population. Like in the other programmes, WU-wide growth is seen as a threat to small-scale and personalized education. Staff members that the panel spoke with indicated that, in their opinion, MOA has reached the limits of its capacity. Further growth is believed to carry major implications for the teaching.

The panel established that MOA incorporates many elements of a didactically rich and engaging learning environment. There is ample room for educational innovation, as exemplified by courses which flip the classroom, include real-life case studies or even virtual reality and augmented reality, and ask students to take charge of the course content (i.e., the *MOA Cafés*, in which students produced an original and very informative periodical, the 'Organic Times'). Typical MOA courses use a combination of different teaching methods, including (lab)practicals, lectures and tutorials. Excursions and group work are more frequently used than in the other programmes discussed in this report, which reflects MOA's action-oriented approach. During the site visit students mentioned the ten-day camping trip as part of the *Analysis and Design of Organic Farming Systems* course as a very helpful experience that influenced their thinking. While students acknowledge that group work helps with cohort building and the operationalization of intercultural learning – and indeed often produces very valuable results – they conclude that there is rather a lot of it, perhaps more than is fitting for an academic master's programme. In some courses more than half of the study load consists of 'rather generic' group work, which – according to students – takes up a lot of time and energy and comes at the cost of more in-depth individual work. Furthermore, students indicated that in most courses group work dynamics are not guided. Even though the panel supports group work as a potentially valuable teaching method, it emphasizes that explicit learning goals (e.g. with respect to communication, group processes, leadership) should be phrased for this type of work and that these should be part of the assessment. It also agrees with the observation made by staff members that it is better to avoid scheduling parallel courses that both rely on group work. In the course phase there is an average of 18 contact hours per week, a number which some students consider too high.

Students confirmed that the programme is sufficiently feasible. The success rates seem to vary quite a bit, with some (but not all) cohorts approaching the WU target of 90% completions after three years. According to the management, this may be due to the broad interests of MOA students, who engage in many side-activities during their studies. Like elsewhere, scheduling issues are a persistent problem, especially with respect to the MOA Master Class that depends on (previously prohibited) evening-meetings in order to enable all students to attend. The new 'extended daytime scheduling' was introduced as a solution to capacity issues (and also promised a solution for the MOA Master Class) but appears to be widely unpopular amongst students and staff, who indicate that it negatively impacts their work-life balance.

As part of MOA's philosophy, students are responsible for and in charge of their study path. Study advisers advise and coach students. After an initial Master Study Day in August, students meet their study adviser in a group meeting, followed by optional individual sessions. Students that the panel spoke with indicated that the study advisers are not sufficiently present and that there could be more intensive guidance in designing the individual study paths, especially since the master's programme is so broad and interdisciplinary. Prerequisites for courses and course levels are, furthermore, not always clear. These are signals that the programme should follow up on. A positive aspect is that the Chair Groups involved in the programme are starting to embrace the use of peer review during the thesis process, in the form of thesis circles. MOA students have access to the excellent facilities at Unifarm and the Droevendaal Experimental and Training Farm.

Teaching staff
MOA is taught by a skilled and highly motivated team of 92 academic staff members from a wide array of Chair Groups in both the natural and social sciences. About 95% of them have a PhD and 59% have obtained a UTQ, which conforms to the WU-wide norm. The staff, moreover, is highly international, which is fitting for a programme that attracts a large number of foreign students and has an international outlook on the field of sustainable food production. While the current student-staff ratio (22:1) seems adequate, there are worrying signals that staff members are under increasing pressure. The panel feels that these need to be taken seriously by making funds available to hire additional staff.

Students indicated to the panel that the teaching staff is a major strength of the programme. Staff members are especially appreciated because of their involvement and broad knowledge, but according to students they are less informed on specific facts. The panel notes that this matches the interdisciplinary profile of the programme: staff members are systems-thinkers rather than experts in highly specialized sub-fields.

Considerations
The panel concludes that the curriculum, teaching-learning environment and staff of all four programmes in the Plant Sciences domain enable students to realise the ILOs. With respect to the Dutch taught bachelor's programme *Plantenwetenschappen* (Plant Sciences), the panel found the curriculum to be clear and coherent, with attractive options for students to pursue their own interests. All of the relevant disciplines are sufficiently covered in the curriculum as a whole, resulting in a multidisciplinary study programme that reflects the systems-approach of addressing all spatial levels. The level of the courses is appropriate for an academic bachelor's programme. A recommendation is to pay more structural attention to societal and ethical aspects. To ensure that these issues are more clearly recognizable to students throughout the courses, the programme could consider developing a dedicated learning line.

The master's programme Plant Sciences spans a wide variety of specialisations on different spatial levels (including the online specialization Plant Breeding) that start directly in the first period of the first year. This setup guarantees that students enjoy maximum freedom of choice, but at the same time the flexibility and large number of courses also seem to pose challenges in terms of scheduling and keeping an overview of everything that is on offer. The panel supports the current initiative to map the (knowledge and skills) curriculum in an attempt to minimize overlap between courses and between the bachelor's and master's programme Plant Sciences. The content of the curriculum ties in with the research of the WU Chair Groups and is topical and sufficiently innovative. Even so, the connection with the labour market could be strengthened. The panel supports the recommendation of the EAC to put more emphasis on 'soft skills', which are considered important by future employers, and to increase the attention for bioinformatics, quantitative analytical skills and handling big data in general.

The panel was pleased to find that the core curriculum of the master's programme Plant Biotechnology was redesigned since the previous assessment, with the intention to increase its specificity and introduce the recently established dual focus on technology and societal aspects into the courses. Nonetheless, the panel believes that further action is needed in order to make the common core truly effective in building a recognisable cohort of MPB students. At present, the considerable flexibility in the programme seems to lead to some fragmentation. After studying material from a number of sample courses, the panel is satisfied with the level and content of the curriculum, which is clearly academic in orientation. Even so, it is worth looking into the opinion expressed by some students that the course content is sometimes too basic and not entirely representative of the cutting-edge research that takes place at the relevant WU Chair Groups.

The panel is generally contented with the level and content of the integrated, interdisciplinary MOA curriculum that was designed to strike a balance between fundamental knowledge on the one

hand, and its application in agro-ecology and sustainable for systems on the other. It particularly notes the international outlook of the curriculum, including the option for students to complete a double degree from WU and ISARA Lyon. A major factor in successful cohort building is the *MOA Masterclass* that runs throughout the programme. Nevertheless, the panel notes that the diversity of the student population does provide somewhat of a challenge in terms of determining the right level and content for courses.

A general comment that applies to all four curricula is that there is a close relation between the ongoing research of the WU Chair Groups and the teaching. One topic that could, however, receive more structural attention is research integrity.

The panel established that students are satisfied with the teaching-learning environment, especially with the close interaction between staff and students and the open atmosphere. The programmes use a variety of teaching methods that match the ILOs and learning goals at course level. The panel concludes that these teaching methods are sufficiently interactive and activating. It especially appreciates the innovative online teaching in the Online Master Plant Breeding, which is a specialization of the Plant Sciences master's programme and to a certain extent functions as a 'laboratory' for innovative teaching from which the other programmes also benefit. A specific remark that was made with respect to the master's programme Plant Biotechnology is that some students perceive the teaching as rather scholastic, with too little recognition of the level of student responsibility that could be expected at master's level. Characteristic of the master's programme Organic Agriculture is the large share of group work, which is both an asset and somewhat of a liability. All programmes have an adequate number of weekly contact hours and are sufficiently feasible. Important to note is the demand-driven system of student guidance, in which study advisers play an important role. While the panel appreciates the principle of leaving much of the initiative to the student, it wonders whether this works for all parts of the student community. Finally, the panel established that the programmes offer excellent facilities, including the state-of-the-art greenhouse facilities at Unifarm and experimental fields at the Droevendaal Experimental and Training Farm.

A concern is that the current level of WU-wide growth appears to put pressure on facilities and teaching. The panel hopes that the current level of small-scale education can be maintained, preferably by rerunning/splitting up larger courses rather than adding a variety of new courses, which would take up a lot of time and resources. Offering the same courses twice a year could help solve current scheduling issues, particularly for students who enter the programme in February instead of September, while splitting up courses offers the opportunity to cater to the needs of particular groups of students. A specific recommendation is to put an end to the practice of master's students participating in bachelor's classes by creating two versions of the course, a regular version for bachelor's students and a fast-track version with more advanced learning outcomes for master's students.

The teaching staff of the programmes is motivated and qualified. Lecturers are experts in their fields and participate in relevant international networks. On the whole, diversity is somewhat of an issue in the bachelor's and master's programme Plant Sciences and the master's programme Plant Biotechnology: the gender-balance and balance between different national/cultural backgrounds could be improved. The staff of the master's programme Organic Agriculture stands out in a positive way because many staff members are from non-Dutch backgrounds. The increasing workload of staff members requires intensive monitoring. The panel strongly feels that staff numbers should reflect the growing student numbers.

Conclusion
Bachelor's programme Plant Sciences: the panel assesses Standard 2 as 'good'.
Master's programme Plant Sciences: the panel assesses Standard 2 as 'good'.
Master's programme Plant Biotechnology: the panel assesses Standard 2 as 'satisfactory'.
Master's programme Organic Agriculture: the panel assesses Standard 2 as 'good'.

Standard 3: Student assessment
The programme has an adequate system of student assessment in place.

Findings

System of assessment
The panel established that WU has a sound assessment policy. In 2017, WU renewed its vision on education alongside its education assessment policy. This assessment policy defines why and how WU assesses and how the roles and responsibilities are distributed. Its goal is to generalise assessment rules and policies and to make them transparent to both lecturers and students.

The system of assessment that is in use within the bachelor's and master's programme Plant Sciences, the master's programme Plant Biotechnology and the master's programme Organic Agriculture takes the WU-wide policy as a starting point. To ensure that tests are valid, an assessment strategy is drawn up for each course, generally linking the course specific learning outcomes to assessment methods. The assessment strategies make clear how and when a learning outcome is assessed, who is involved in assessing students and how the final grade is determined. By publishing the assessment strategies in the study guide of individual courses, the programmes ensure that students are well aware of what is expected of them. During the annual Education Modification Cycle, the programme director checks that examinations at course level match the course-specific learning outcomes, content and setup of the courses. Course examiners are responsible for test design and checking test results. Following grading, students are enabled to inspect their exam results and receive individual feedback, which helps them learn from mistakes. Overall, the panel finds that there is sufficient attention for the validity, reliability and transparency of assessment. One question that was not addressed in the documentation and interviews is whether there is always peer review of design-tests. The panel feels that the four-eye-principle is an important instrument for assuring the reliability of examinations.

The panel has established for all four programmes that the combined assessment of all courses covers the full range of intended learning outcomes. It is common that courses use a range of assessment methods. In the bachelor's programme Plant Sciences these include written exams, papers, essays, reports, oral presentations and poster presentations. Some assignments are assessed at group level, whereas others are assessed individually. The panel established that bachelor's students are generally satisfied with the quality of assessment, which received a score of 4.1 in the 2018 NSE. During the site visit, students also signalled a number of possible improvements with respect to assessment. They, for example, mentioned that it is important to pay (more) attention to the assessment of soft skills. The panel notes that the management is currently looking into this, as part of its efforts to map the knowledge and skills curriculum. An opportunity for improvement that was brought up by the programme management is that formative assessment could be emphasized more. In courses that do include formative assessment this usually takes the shape of peer assessment.

Assessment methods in the master's programme Plant Sciences include (individual and group) papers, essays, reports, oral presentations, poster presentations and written examinations. The online master's programme Plant Breeding, alternatively, almost exclusively uses online assessment methods. This is facilitated by the use of Question Mark Perception, which offers the exam questions to the students, and Remote Procter Now, which takes care of online supervision of the exam by creating a shield around the exam environment of Question Mark Perception. After speaking to distance learning-students, the panel concludes that this system functions properly. Master's students Plant Sciences scored assessment a 4.0/5 in the 2018 NSE.

The master's programme Plant Biotechnology includes a similar range of (individual and group) assessment methods; i.e. papers, essays, reports, oral presentations, poster presentations and

written examinations. Students are generally positive about the system of assessment and assessment methods, which scored a 4.1/5 in the 2018 NSE. In the student chapter, however, some MPB students indicated that the level of assessment is in some cases (too) low. The panel advises the programme to look into this remark.

The master's programme Organic Agriculture also uses an appropriate mix of written examinations, oral presentations and papers/reports. A difference with the other master's programmes is that there is a larger share of group work, which is assessed either collectively or individually. With respect to assessing group work, the panel notes that clear learning goals should be set for this type of work (in terms of communication, cooperation, leadership etc.) and that these goals should be part of the assessment. At the moment it is not clear to the panel that this is always the case. A further specific element is that MOA courses are designed to deal with interdisciplinary content, which means that the assessment has to reflect this interdisciplinarity. The programme is aware that integrated assessment needs further improvement. The panel established that the intention is to develop rubrics at course level. At programme level, the implementation of an assessment portfolio is considered. A related issue is that students feel that the broadness of the courses sometimes makes it difficult for them to predict what knowledge is expected during the exam. MOA students scored assessment a 3.8/5 in the 2018 NSE.

A general issue that results from growing student numbers is that in all four programmes, and particularly in some Chair Groups, there seems to be a tendency to switch to less labour-intensive forms of assessment, such as group papers instead of individual papers and multiple-choice questions instead of open-ended questions. Bachelor's students touched upon this issue during the site visit by stressing that they prefer open-ended questions, as multiple-choice questions are seen as less in-depth. The panel does not necessarily support this position but does believe that this is a signal that the programme could follow up on, as the design of multiple-choice questions could perhaps be enhanced. The panel also notes that both bachelor's and master's students feel that there could be more individual feedback to written assignments. This was particularly emphasized by students of the online master's programme Plant Breeding, who indicated that feedback is only given when students specifically ask for it. The panel advises the programmes to monitor closely that growth does not compromise the quality and variety of assessment.

During the site visit, the panel studied assessments and answer models of sample courses of all four programmes. It found that these tests are generally well aligned with the learning goals and teaching methods. The overall level of the exams is adequate. The assessment reflects the content that was discussed during the course and sufficiently addresses all of the relevant cognitive levels.

Thesis assessment

The final product of the bachelor's programme Plant Sciences is a three-month research project resulting in an 18 EC thesis, in which students demonstrate that they have achieved the majority (8 out of 11) of the ILOs. Two assessors are involved in the assessment of the thesis: the supervisor(s) and an independent examiner (second reader). To ensure continuity, the Examining Board has appointed two examiners who are present during all thesis presentations. The panel was informed that, in order to cope with the growing number of theses, a third bachelor's thesis examiner will shortly be appointed. After the plagiarism check and final assessment, the two assessors jointly fill out a standardised assessment form, which covers six different aspects: research competencies (20-55% of the final mark), experimental skills (up to 50% of the final mark), self-reflection report (up to 5% of the final mark), thesis report (10-60% of the final mark), final presentation (up to 15% of the final mark) and final discussion (up to 10% of the final mark. Rubrics help assessors to score these aspects appropriately. In cases where students do not conduct experimental work, the criterion of experimental skills is disregarded. The panel established that students are generally satisfied with the assessment procedure. They mentioned that they received useful feedback on the final product from both the first and second readers.

The master's programme Plant Sciences (including the OMPB) is concluded with both an internship and a thesis. The thesis (rather than the internship) is seen as central to the successful completion of the programme and covers 8 out of a total of 12 ILOs. The thesis is checked for plagiarism and subsequently assessed by the supervisor(s) involved, in deliberation with an independent examiner (second reader), and in accordance with the thesis rubric. Most of the Chair Groups have appointed one examiner that carries the final responsibility for the quality of all theses projects. The different components that are scored on the standardised assessment form are: research competence (30-60% of the final grade), thesis report (30-60% of the final grade), presentation (5%-10% of the final grade) and defence (5%-10% of the final grade). Students that the panel spoke with are generally satisfied with the design of the thesis process, although some students indicated that they struggled a bit with the level of self-reliance and responsibility that was expected of them.

The thesis is also the central accomplishment of students of the master's programme Plant Biotechnology, which, again, delegates thesis assessment to two staff members, who use a rubric to determine the score on the different criteria, i.e. research competence (30-60% of the final grade), thesis report (30-60% of the final grade), colloquium (5%-10% of the final grade) and final examination (5%-10% of the final grade). According to students, the thesis procedures are sufficiently transparent and the assessment is considered just.

The master's programme Organic Agriculture has similar thesis (assessment) procedures. Due to the interdisciplinary nature of the programme, however, co-supervision of theses by two staff members from different Chair Groups and with different disciplinary backgrounds is rather common. In the Double Degree Agroecology specialization, co-supervision is the norm: both a WU-supervisor and an ISARA-supervisor are involved in the project. Assessors use the centrally provided MSc Thesis Assessment Form and a rubric for scoring students' performance on the research competence (30-60% of the final grade), thesis report (30-60% of the final grade), colloquium (5%-10% of the final grade) and final examination (5%-10% of the final grade). Students that the panel spoke with are pleased with the thesis procedures. Generally, they seem to consider the thesis as a good exercise in integrally approaching a domain-related subject.

The panel positively assesses the (procedures for) thesis assessment and the assessment forms and rubrics that are in use. While the general outlines of the assessment are standardised, some of the specifics are determined at Chair Group level. Within a general range set by the Examining Board, Chair Groups are at liberty to define the weight they wish to attach to the different components of the assessment. This makes it possible for the assessment to reflect the particular nature of the research topic and methodology. While the panel understands the need for variety in some respects, it does advocate more standardisation in other aspects. A prominent example of practices that vary across Chair Groups is that of offering thesis rings, in which students discuss their experiences and progress with their peers. The panel notes that such thesis rings are popular amongst students and it would recommend introducing them in all Chair Groups. Another instrument that all Chair Groups may wish to adopt, is the use of a Go/No Go moment, which makes it easier to monitor progress and signal potential problems at an early stage.

After studying a sample of theses and associated assessment forms, the panel concludes that the prescribed assessment procedures are not always followed. Signatures from second and third assessors are often missing on the forms and there is substantial variation in the level of qualitative feedback on the assessment forms. First assessors often leave feedback fields empty and second assessors do not seem to give qualitative feedback at all. While this does not mean that student do not receive feedback – the panel was informed that it is customary to give oral feedback during the final meeting – it does make it harder for external reviewers to validate the grade that was given, as there are no written records of what is said during the examination. Another issue that needs to be addressed is the fact that the assessments of both assessors are recorded on a single assessment form. To enable external reviewers to establish that both readers have independently phrased their assessment, it is preferable to have each assessor fill out a separate form and administrate both forms. A general recommendation that the panel would like to

make is to further streamline the thesis process by digitalisation. This would make it possible to automatically reject forms with insufficient qualitative feedback, missing signatures etc. A positive conclusion is that the panel largely agreed with the assessments and grades given by the assessors.

Examining Board
At WU there are four Examining Boards (EBs), each responsible for the assurance of the quality of examination of a group of related degree programmes. The Executive Board appoints EB members and at least one member is independent (not affiliated to the programmes). The panel established that the EB that is responsible for the Chair Groups in the Plant Sciences domain has five members, including a chair (0.1 fte) and secretary (0.6 fte).

The EB has a number of responsibilities with respect to the quality assurance of assessment. The first of these is to appoint an examiner for each course, who is responsible for the assessment strategy of the course. Furthermore, the Examining Board gives final approval to descriptions of the examination at course level. Also part of the responsibilities of the EB is to check whether individual study programmes of students (which can vary widely because of the many different specialisations and ample elective space) cover all of the ILOs, thereby assuring that students have achieved the intended end level upon graduation. A final instrument of the Examining Board is the Chair Group visit: to ensure the quality of assessment, the EB periodically visits the Chair Groups that are involved in the teaching. Prior to these visits, which generally take place every five years, a delegation of EB members accompanied by an external assessment expert check a sample of theses and internship assessments, whose validity, reliability and transparency they later discuss with representatives of the Chair Groups. Where necessary, the EB proposes improvements. The panel established that the most recent Chair Group visit in the Plant Sciences domain was to the Plant Physiology Chair Group (2018). Overall, the EB was satisfied with the quality of assessment in this group, although it did make some specific observations regarding course assessment strategies and the alignment of assessment items and learning outcomes. After speaking to representatives of the Examining Board, the panel concludes that the EB that is responsible for a substantial part of the Chair Groups in the Plant Sciences domain performs these tasks to its best abilities, but is limited by a number of factors.

Although the panel has no particular reasons for concern with respect to the quality of assessment in all four Plant Sciences programmes, it does note that the current university-wide system of quality assurance poses some challenges. To start with, there is considerable distance between the EB and the Chair Groups, which operate with a large measure of autonomy. The limited means that were available to the EB over the reporting period meant that these may lack agency in properly streamlining procedures across Chair Groups and following up on prior recommendations. Because of limitations to its resources (which are based on outdated data on student numbers) the EB has not been able to adhere to the five-year cycle of Chair Group visits, which means that not all Chair Groups involved in the programmes have recently been visited. An additional issue for WU to consider is that the current system does not seem to allow for taking a snapshot of the assessment quality in a certain programme at a certain moment. Programmes such as those in Plant Sciences rely on a large number of Chair Groups, which are all visited at different times and (often) by different Examining Boards. The panel was very pleased to learn that the Executive Board of WU is doubling the resources for Chair Groups as of 2019. Even so, it does advise the university to carefully consider how these resources can be used to their optimal effect.

Considerations
All four programmes have developed a solid system of assessment, which is based on the WU-wide assessment policy. Sufficient attention is paid to the validity, reliability and transparency of examinations, but it is not entirely clear to the panel that internal peer review in the design phase of examinations is always part of the assessment cycle. The design of sample tests studied by the panel is adequate: the examinations sufficiently match the course specific learning goals and teaching methods. The level and content of the examinations is appropriate.

The procedures for assessing the final product of the programmes, the thesis, are clear and the assessment itself is sound. To further increase the transparency and comparability of thesis assessment, the panel recommends further streamlining thesis procedures, including the use of a Go/No Go assessment, across Chair Groups and introducing separate assessment forms for both assessors. Furthermore, the panel advocates the university-wide implementation of a digital assessment system in which the subsequent steps in the thesis process are fully automated. This should help to prevent the submission of incomplete assessment forms, which currently seems to be a widespread problem.

Finally, the panel established that the Examining Board safeguards the overall level of assessment in the programmes to the best of its abilities. Increasing the capacity of the EB, as is the intention of the Executive Board, could help to strengthen its agency in relation to the rather autonomous Chair Groups. Nonetheless, the panel feels that the central university should also critically reconsider whether the design of the current quality assurance system optimally suits its purposes.

Conclusion
Bachelor's programme Plant Sciences: the panel assesses Standard 3 as 'satisfactory'.
Master's programme Plant Biotechnology: the panel assesses Standard 3 as 'satisfactory'.
Master's programme Plant Sciences: the panel assesses Standard 3 as 'satisfactory'.
Master's programme Organic Agriculture: the panel assesses Standard 3 as 'satisfactory'.

Standard 4: Achieved learning outcomes
The programme demonstrates that the intended learning outcomes are achieved.

Findings

Bachelor's programme Plant Sciences
Prior to the site visit, the panel studied a sample of fifteen recently completed bachelor's theses. From this sample, the panel concluded that students achieve the ILOs. The level of the theses is generally high and the content matches the profile of the programme. While bachelor's theses – understandably – do not arrive at a fully integrated outlook on the topic in question (i.e. 'from the molecular level to the level of the ecosystem'), the panel was pleased to find that there is some integration of different spatial levels, which is an important achievement. Compared to the theses of other bachelor's programmes the theses were of superior scientific quality in terms of reflection and discussion. Moreover, all of the theses that the panel studied included experimental work, which is commendable. Especially the stronger theses in the sample pose relevant and interesting research questions, which are supported by a solid theoretical framework and lead to appropriate data collection and interpretation. Some of the weaker theses revealed flaws in the research design, but this was adequately reflected in the marking. An interesting aspect of the thesis project is that it also includes a self-reflection report, in which the student phrases personal learning goals for the thesis. This means that the thesis also contributes to the achievement of ILO 11 ('reflect on personal knowledge, skills, attitudes and functioning').

Presently, it is not customary for bachelor's graduates to directly enter the labour market. From its conversations with the EAC and other stakeholders, the programme established that career possibilities for bachelor's alumni are very limited, especially since the programme is geared to the Dutch labour market, which is not used to academic bachelor's graduates. Only graduates that have specifically chosen to complete an educational minor as part of their bachelor's free choice space have a somewhat clearer job perspective, as they are qualified to teach in the first three years of secondary education.

Statistics from the 2010–2015 period show that a large majority of alumni continue their studies, mostly in the WU master's programmes Plant Sciences (chosen by 97 out of a total of 164 alumni)

and Plant Biotechnology (chosen by 41 out of 164 graduates). A third WU programme that offers direct enrolment, the master's programme Organic Agriculture (chosen by 3 out of 164 alumni), is clearly not a popular choice amongst BPW alumni. Similarly, students hardly ever opt to enrol in master's programmes (within or outside of WU) for which additional criteria apply. During the site visit, students, for example, highlighted that it is much easier to directly enrol in the Plant Biotechnology programme than to continue with the more generic WU master's programme Biotechnology, which would involve completing a linkage programme that deals with deficiencies in chemistry and physics. Students indicated to the panel that they are generally satisfied with the options available to them, although some students find it difficult to make a reasoned decision for a master's programme.

Master's programme Plant Sciences

In order to assess the end level of the master's programme Plant Sciences, the panel studied a sample of fifteen recently completed theses, including three theses written by students of the online master Plant Breeding. The panel was pleased with the quality of the work. The subjects that students deal with are relevant and logically result from the broad, integrated domain of the programme and the research expertise of the WU Chair Groups. The theses in the sample reflect the full range of marks given and some are therefore better than others, but the panel is convinced that all of these theses meet the ILOs and are of above-average, often publishable, quality. The strong theses include clearly defined research objectives, use relevant methods to collect and analyse data, and arrive at valuable conclusions and recommendations. Weaker theses are generally less in-depth, lack critical reflection or would have benefitted from a stronger theoretical underpinning. In terms of quality, the panel did not find significant differences between the work of distance-learning students and that of on-campus students, and therefore concludes that both groups achieve the learning outcomes.

The position of graduates on the labour market gives cause for satisfaction. Alumni research shows that graduates quickly find employment in a wide variety of jobs as plant scientists, crop production specialists, or in consultancy or management in agribusiness, the plant breeding industry, and in governmental and non-governmental organisations. While the demand for MPS graduates is high and graduates end up in jobs and sectors that are a good match with the programme's profile, students indicated in the student chapter that they experience a gap between the programme and industry/business. Students that the panel spoke with believe that the programme could be more proactive in highlighting the options that are open to graduates and bringing in more representatives from the professional field, who can share their own experiences with students. The panel agrees that this is something for the programme to consider.

Master's programme Plant Biotechnology

For the master's programme Plant Biotechnology, the panel studied a sample of ten recently completed theses. All of these theses involve lab work, often in combination with bioinformatics for data analysis. The panel found that the topics of the theses are interesting and clearly match the domain of the programme and underlying specialisations. The level of the theses is above average, with good research design, a clear choice of methodology and appropriate use of literature. Results are generally well interpreted. Some of the high-end theses that the panel read were of publishable quality. However, the link between technology and society, that is part of the MPB profile, is only briefly (if at all) addressed in the sample theses. All in all, the panel concludes that the sample theses emphasize that students achieve the intended learning outcomes.

The position of graduates on the labour market is strong, with alumni finding employment at universities, research institutes, breeding companies, in industry/trade and agricultural business. The demand for graduates is high and most of them quickly find a job at academic level. Compared to the master's programme in Plant Sciences, more graduates (roughly 20%) opt for a research career, starting with a PhD position, often in an international setting.

Master's programme Organic Agriculture
The ten MOA theses that the panel studied confirm that students achieve the ILOs. Frequently, theses involve field studies or field trials, case studies and (questionnaire-based) stakeholder analysis, often in combination with modelling for data analysis and/or scenario development. While the panel is very pleased with the thesis subjects and content (which includes solid research questions, good use of methodology and interesting conclusions), it concludes that the theses are disciplinary rather than interdisciplinary in orientation, broadly following the lines of the Chair Groups in which the work was conducted. The panel recommends that the programme builds up the necessary supervision capacity to enable students to apply the integrated methodology that is characteristic for the programme in their thesis projects.

MOA graduates find employment in universities and research institutes, (non-)governmental organisations, agricultural business, industry/trade, consultancy and other sectors. Some alumni start their own business, sometimes already during the master's programme. One example of this was provided by a student who told the panel that she owns a vertical agricultural systems business. On average MOA students seem a bit less satisfied with the labour market preparation they received than students of the other programmes discussed in this report. Students explained to the panel that they find it difficult to pinpoint the specific MOA skill set, which means that finding a good fit in the professional field can take a bit of effort.

Alumni relations
A general observation that the panel would like to make for all four programmes is that efforts could be made to establish alumni policies at programme level. From the interviews, the panel established that initiatives in this respect are currently limited to the central university level. Existing alumni relations at programme level are mostly informal, which means that the possibilities that alumni have to offer are not optimally used.

Considerations
Both the sample theses that were studied by the panel and the position of graduates indicate that students achieve the intended learning outcomes of the programmes. The general level of the final projects is high: the work is of good academic quality when compared to the international standard and adequately reflects the domain of Plant Sciences. Theses are often of publishable quality.

Graduates of the bachelor's programme are successful in associated master's programmes, while graduates of both of the master's programme find employment in relevant positions at companies, non-profit organisations and research institutes/universities.

Conclusion
Bachelor's programme Plant Sciences: the panel assesses Standard 4 as 'good'.
Master's programme Plant Biotechnology: the panel assesses Standard 4 as 'good'.
Master's programme Plant Sciences: the panel assesses Standard 4 as 'good'.
Master's programme Organic Agriculture: the panel assesses Standard 4 as 'good'.

GENERAL CONCLUSION

The panel notes that the programmes in the Plant Sciences domain are robust programmes that capitalise on the strong research reputation of WU in the domain. Students and staff are generally very contented to be part of the WU community and are dedicated to further improving the programme quality. A widely shared concern is the university-wide growth, which is perceived to threaten traditional small-scale education. In order to successfully deal with growth and internationalisation, the panel believes that careful planning is required. Also, of vital importance is to critically assess the current course catalogue and to rationalise courses. This will help the programmes deal with some of the current issues, such as the perceived overlap between courses, the apparently rather fluid border between bachelor's and master's level and the sometimes feeble

coherence at curriculum level. The panel is confident that the programmes are sufficiently equipped to take on these challenges.

Conclusion
The panel assesses the *bachelor's programme Plant Sciences* as 'good'.
The panel assesses the *master's programme Plant Biotechnology* as 'good'.
The panel assesses the *master's programme Plant Sciences* as 'good'.
The panel assesses the *master's programme Organic Agriculture* as 'good'.

APPENDICES

APPENDIX 1: PROFILE AND OBJECTIVE

Bachelor's programme Plant Sciences

Central to the domain of plant sciences are the relations between plants and environmental factors, with a fundamental and applied perspective on the sustainable production of healthy food and renewable resources, human health, global food security, and climate change mitigation. The leading role of the Netherlands, and WU in particular, in this domain is globally recognised and acknowledged, and at the same time contributes to maintaining and strengthening the strong international position of the Dutch top sectors Agri & Food and Horticulture & Propagation Materials. Producing twice as much food using half as many resources is the main driver for agricultural developments, including reduced dependency on water, increased resource use efficiency and control of biological pests and diseases to diminish or eliminate the use of chemicals in greenhouses and fields. Technological developments in molecular breeding have enabled rapid selection of high yielding pest and disease resistant crop varieties with added favourable quality characteristics, including crops for the organic market. Ecological research is unravelling the role of biodiversity in agroecosystem functioning, thus providing options for more nature-inclusive sustainable agriculture.

This is the only academic bachelor programme in the Netherlands that focuses specifically on plants. Its location at Wageningen University, recognised as 'the' Life Sciences University of the Netherlands, is obvious. The programme combines fundamental knowledge on plant molecular biology, physiology, genetics and (agro-)ecology with the application of this knowledge for food production, plant-based medicines, bio-based raw materials, and a green environment.

Within the Netherlands, the programme is most closely related to the general Biology bachelor programmes taught at seven Dutch universities. The specific focus on plants and applications of plants and plant-based products ("understand to apply") of the programme contrasts with the more fundamental focus on theories and concepts to understand life in relation to environmental factors ("understand why") of the other Biology programmes. Our programme and the Biology bachelor share a common basis in cell and molecular biology, genetics, plant physiology and ecology, and supporting disciplines such as mathematics, statistics, chemistry, physics and environmental sciences. However, our programme makes the additional explicit connection to the applied fields of biotechnology, plant breeding and agriculture that are less apparent in the general biology programmes.

Internationally, our programme can be compared with bachelor programmes offered by UC Davis, Cornell University, and partner universities within the Euro League for Life Sciences (ELLS). Several of these focus on agriculture in the broad sense, combining plant and animal production, whereas the bachelor "Agrarbiologie" at the University of Hohenheim, for example, links biology and agricultural sciences in a way that is comparable to our programme.

More than ever, studying plant sciences requires the ability to deal with dynamics and complexity at the different organisation levels, from molecules, cells, organisms, and populations, up to complete ecosystems. Therefore, the courses in the programme's common core introduce plant biology related disciplines such as physiology, genetics, molecular biology, biodiversity, agroecology, breeding and pathology, in combination with supporting disciplines such as mathematics, chemistry, physics, computer science, and statistics. The broad common core prepares students for a well-considered choice between the programme's two majors. Plant Genomics and Health focuses on processes that occur within the plant at the cell and molecular level, whereas the Plant Production and Ecology major aims at the interactions between plants and environmental factors. Students are also taught how to apply this knowledge. Further broadening or deepening is facilitated on an individual basis by the free choice semester, which can be done either at Wageningen University, for example by choosing a minor on a specific theme or linked to a follow-up master, at another university in the Netherlands, or abroad.

Our programme has a research-oriented approach. This is not only because research skills are indispensable for those students that choose an academic career at a university or a research career at a public institute or an agribusiness company, but also because research is a very good context to learn academic skills that are applicable in a much broader range of professions. This includes skills such as information literacy, writing and presentation skills, research and experimental design, scientific argumentation, critical self-reflection, and teamwork skills. In conclusion, our programme offers a broad and solid foundation to the domain described above, with opportunities for deepening in different majors, and for academic personalisation in the free choice options.

Master's programme Plant Sciences

Plants form the basis of life, as they convert sunlight into an inexhaustible source of food and renewable resources. Moreover, plants have a stabilising effect in (agro-) ecosystems and climate, a landscape function, and ornamental value. Central to the domain of plant sciences are the relations between plants and environmental factors, with a fundamental and applied perspective on the sustainable production of food and renewable resources, human health, global food security, and climate change mitigation. The leading role of the Netherlands in this domain is recognised and acknowledged globally, and at the same time contributes to maintaining and strengthening the strong international position of the Dutch Agri & Food and Horticulture & Propagation Materials top sectors. Agricultural innovations involve a wide array of strategies including plant breeding, urban agriculture, horticulture, precision farming, closing energy and nutrient cycles, and the increased use of ecological non-chemical crop protection based on natural biodiversity. Producing twice as much food using half as many resources is the main driver for agricultural developments such as reduced dependency on water, increased resource use efficiency, and biological pest and disease control to eliminate pesticide use in greenhouses. The size and nature of these challenges differ greatly between different food-producing regions around the world.

Technological developments in molecular breeding have enabled rapid selection of high yielding, climate resilient, and pest and disease resistant crop varieties with added favourable quality characteristics, including crops for the organic market. In turn, increased ecological knowledge provides novel opportunities for more nature-inclusive sustainable agriculture.

The academic domain of Plant Sciences is linked to a professional sector that is of great importance to the global economy. In particular, the rapidly expanding Dutch plant breeding and propagation industry has an increasing need for qualified personnel. Therefore, we participated in the WU pilot to initiate online masters programmes: the online master Plant Breeding is now one of the MPS specialisations. Details of this specialisation can be found in chapter 2 of the self-evaluation.

The master Plant Sciences is the only master's programme in the Netherlands that specifically addresses the full domain of applied plant sciences, ranging from molecules to agro-ecosystems, at an academic level. Within WU, the master Plant Sciences shares its focus on optimising crops with the Plant Biotechnology master, and its ecosystem focus with, for example, the masters' programmes in Organic Agriculture, International Land and Water Management, and Climate Studies. When compared to the Plant Biotechnology master's programme that zooms in on cellular and molecular processes that occur inside plants, the Plant Sciences master's programme focuses on the ecological, physiological and technological aspects of crop production and applying scientific knowledge to design breeding programmes, plant growth models or cropping systems, and to address issues of regional and global food security. In the Netherlands, the master Plant Sciences is most closely related to the general master Biology. The specific focus on plants, and applications of plants and plant-based products ("understand to apply") of the master Plant Sciences contrasts with the more fundamental focus on theories and concepts to understand life in relation to environmental factors ("understand why") of the general master Biology programmes. Internationally, the master Plant Sciences has similarities with master programmes offered by UC Davis, Cornell University, and the partner universities within the Euro League for Life Sciences

(ELLS). Compared to these programmes, the master Plant Sciences in Wageningen has a broader focus and a stronger international orientation. This is also due to the close linkage of the WU education and research with the Wageningen Plant Research institutes.

Studying plant sciences requires an ability to deal with the dynamics and complexity of plant production at the different organisation levels, from molecules, cells, organisms, and populations up to ecosystems and production systems. Therefore, a multidisciplinary approach involving mathematics (crop modelling), biochemistry, environmental physics, bioinformatics, and/or environmental sciences (soil biology, agroecology) is indispensable. To add focus to this broad perspective, students specialise in one of the disciplines of the Master: Crop Sciences, Greenhouse Horticulture, Natural Resource Management, Plant Breeding and Genetic Resources, Plant Pathology and Entomology, or Biomass Production and Carbon Capture. In addition, the programme offers various free choice courses to allow students to make well-considered academic personalisation based on their professional perspective. The programme has a strong technological orientation based in research, with a keen eye for developments in the global professional field. During their scientific master thesis, students are trained for a career in academic research. In combination with the academic internship and Academic Master Cluster, students receive a realistic training in being a business-related R&D professional, 10 Self Evaluation 2018 | MSc Plant Sciences technological expert, consultant, or entrepreneur in the global agricultural sector.

Master's Programme Plant Biotechnology

The programme focuses on the development of biotechnological and molecular tools for the analysis of plant genomes to enhance and speed up the selection process in plant breeding and to elucidate plant-pathogen interactions at the molecular level. A further aim is to develop crops that produce biopharmaceuticals, bio-fortified food, or bio-based resources. While it has a strong technological basis, the programme also keenly addresses the societal connotations of biotechnology.

In recent years, there has been an impressive increase in the availability and applicability of biotechnological tools. Conventional tissue culture and Agrobacterium-mediated transformation have been followed up by genome editing techniques, with the relatively new and widely adopted CRISPR-Cas technique now being used as a high impact tool for versatile site-specific genome modification. Omicstechnologies (genomics, transcriptomics, epigenomics, proteomics, metabolomics) enable researchers to analyse the regulation of genetic and epigenetic processes that underlie plant growth and development in response to environmental factors. Next Generation Sequencing (NGS) has accelerated molecular breeding towards genome mapping, Quantitative Trait Loci (QTL)-analysis, and techniques such as Genome Wide Association Studies (GWAS), thus linking phenotypes and genotypes for trait discovery. Clearly, the importance of bioinformatics to current developments in plant biotechnology cannot be underestimated.

With its dedicated focus on cellular and molecular plant processes, the domain of plant biotechnology contributes to the sustainable production of food and renewable resources, human health, global food security, and climate change mitigation in the broad context of the plant sciences domain. Following discussions in the Programme Committee, we combined the technological approach with a link to social sciences to address societal aspects, public engagement and responsible governance, and to involve diverse perspectives and scientific disciplines in decision making in the field of plant biotechnology. As proposed by the last accreditation panel, the successful concept of the *Masterclass Organic Agriculture* was adapted for and introduced in the programme as the course *Current Topics in Plant Biotechnology*, which has been woven into the two years of the programme.

Plant Biotechnology is the only academic Master in this field in the Netherlands, and unique in its focus on the application of biotechnological tools and concepts to study and improve plant characteristics and traits. The technological perspective is combined with the societal perspective

regarding intellectual property rights, entrepreneurship, risk communication, and consumer acceptance. The programme has a clear position within the Wageningen University life sciences domain, and connects to several strategic research themes, like Global One Health, Resource Use Efficiency and Resilience. The programme can be compared with the Master Biology (with a fundamental focus on understanding of biological systems), or the Masters in Biotechnology, Bioinform atics, Molecular Life Sciences, or Life Science and Technology (often with a dedicated biomedical or pharmaceutical orientation, and/ or a specific focus on single cell organisms).

The Molecular Plant Breeding and Pathology specialisation links with the specialisations *Plant Breeding and Genetic Resources/ Plant Pathology and Entomology* of the Plant Sciences master. While the latter focuses on studying plant breeding and pathology mainly at the crop level (see the Plant Sciences master Self Evaluation Report), the Plant Biotechnology master has a strong technological orientation, and zooms in specifically at the molecular and cellular level by combining genomics and bioinformatics to gain a better understanding of and to optimise plant processes related to (amongst others) growth, development, disease resistance and nutritional value.

Internationally, the Euro League for Life Sciences (ELLS) partner universities look closely at several aspects of plant biotechnology, most often as part of master programmes that focus on biology and biotechnology, food science and biotechnology, medical biotechnology, or general plant sciences. An example of a related European programme is the master's programme in Plant and Forest Biotechnology offered by Umea University in Sweden.

Finally, research-based learning characterises the educational profile of the Master Plant Biotechnology curriculum, with courses that address experimental work in the lab and in research projects, culminating in the MSc thesis. This strong focus on research and experimental skills is often the main reason given by students to continue their academic education by choosing this master programme. Upon completion, students will be able to start a PhD, or get a job at, for example, a breeding company.

Master's Programme Organic Agriculture

The domain of Organic Agriculture has gradually evolved from conscious food production in relation to ecology and health, through globally established organic agriculture with associated standards, regulations and certification protocols, to a broader perspective on sustainability issues around the global food system (Markus, A., Gould, D., Stopes, C., 2016, Organic 3.0 – for truly sustainable farming and consumption, IFOAM Organics International, Bonn and SOAAN, Bonn). This perspective promotes innovation along the food and farming value chain with regards to ecology, economy and society.

In this dynamic context, the Master Organic Agriculture explores (agro-)ecosystems, sustainable food systems, and multi-functional land use from the viewpoint of various disciplines (i.e. plant, soil, animal, social and environmental sciences), multiple perspectives (i.e. sustainability, health, and ethics) and different geographical scales (local, regional, and global). A systems approach characterizes both the research and education domains in the master. Our programme highly values the integration of theory and practice by focusing on action learning and action research. Ecological concepts are applied in various domains such as agroecology, organic agriculture, permaculture, conservation agriculture, and are connected to the societal and sociological context. The agricultural systems discussed in the programme are not limited to farms with an organic certification; it includes agricultural systems that are conventional, beyond organic, or organic by default. The programme prepares students for a wide range of positions in consultancy, policy, (social) entrepreneurship, or research & development that are related to multiple land use, agroecology, and sustainable value chains for food production.

The didactic approach implemented in 2007 is still current, with incremental adaptations to the specialisations and several courses to facilitate continuous improvement of the programme. For

example, the Agroecology double degree, in cooperation with ISARA-Lyon (France), was added as a third specialisation. In addition, the philosophy of the programme, experiential (learning by doing), authentic (departing from real-world issues and utilising real-life case studies), interactive (involving multiple stakeholders and social learning), and interdisciplinary (spanning a range of disciplines), is demonstrated in two ways. Firstly, courses of the compulsory core focus on an integrated approach towards organic food production and consumption. Secondly, students form a community of learners in which interactions between students are stimulated, and where they share their academic and professional expertise and, thanks to an international classroom, international experiences. To support this process, the programme contains the Masterclass Organic Agriculture, which is woven into the two years of the programme.

When focussing on its position in the Netherlands, the Organic Agriculture master is related to the general Biology master's programmes as taught at Dutch universities. The specific focus on (agro-) ecology and sustainable production of food and renewable resources and the interdisciplinary approach ("understand to apply") of the master Organic Agriculture contrast with the more fundamental focus on theories and concepts to understand life in relation to environmental factors ("understand why") of Biology master programmes. Whereas the Biology master enables students to specialise in a specific integration level or domain, the Organic Agriculture master specifically teaches students an interdisciplinary approach by integrating natural science and social sciences, and a transdisciplinary approach through action learning.

The Organic Agriculture master relates to the Plant Sciences master at the level of sustainable crop production in relation to environmental factors, including nutrient management and nutrient cycling. This link is visible between the Agroecology specialisation of the MOA-A and the Natural Resource Management specialisation of the master Plant Sciences (MPS-C). In MOA-A this is connected to the multidisciplinary approach that also involves social sciences (sociology, entrepreneurship, management, consumer studies, and innovation studies). In MPS-C the agroecology perspective is extended towards general ecology, soil biology, and environmental sciences.

When focussing on the international positioning of MOA, the programme has similarities with master programmes offered by partner universities within the Euro League for Life Sciences (ELLS), or at other universities in Germany, Spain, Italy and the UK. Compared to these programmes, the Organic Agriculture master in Wageningen has parallels regarding the interdisciplinary approach of developing sustainable agricultural and food systems by integrating social sciences and natural sciences.

APPENDIX 2: INTENDED LEARNING OUTCOMES

Bachelor's programme Plant Sciences

After successful completion of this BSc Plant Sciences, graduates are expected to be able to:

Domain-specific knowledge, understanding and experimental skills
1. explain the biology of plants in their environment, both at a fundamental level and in terms of the various functions of plants for people, animals and the environment, based on knowledge of plant physiology, morphology and taxonomy, biochemistry, organic and physical chemistry, molecular and cell biology, mathematics, statistics, genetics and ecology;
2. apply the knowledge of fundamental processes taking place in plants at the molecular and cellular level in order to analyse the development of novel varieties, the interactions between plants and their pests and pathogens, and the use of plants and plant products for food and health purposes (Major A - Plant Genomics and Health);
3. apply the knowledge of the role of natural resources and environmental factors on plant and (agro) system development in order to analyse open and protected plant production systems, and the interactions between agriculture and its environment in a wide range of agro-ecological systems (Major B - Plant Production and Ecology);
4. apply laboratory techniques, analytical measurements, mathematical and statistical methods for the collection, processing and analysis of experimental data in plant science, and to judge their suitability in solving specific research questions.

Scientific skills
5. translate a scientific problem in plant sciences into research questions and develop a scientifically relevant research plan in which problem definition, hypothesis, experimental set-up and data analysis are described in relation to the existing literature (under supervision);
6. perform (under supervision) simple scientific experiments and analyse and interpret experimental data, in order to develop or design a novel solution, system, model or product;
7. establish a scientific approach by:
– retrieving and critically selecting relevant literature from bibliographic databases;
– combining new knowledge with previously obtained knowledge;
– demonstrating an understanding of the process of testing hypotheses, theories and models through experiments.

General academic skills
8. communicate verbally and in writing about the results of learning, experiments and project work with specialists and non-specialists, both in Dutch and in English;
9. cooperate in an international team of students and staff to perform a research project
10. understand the international, socio-economic, ethical, cultural and temporal context of new developments in plant sciences;
11. reflect (under supervision) on personal knowledge, skills, attitudes and functioning, both individually and in discussions with others, and design and plan a personal learning path.

Master's programme Plant Sciences

After successful completion of the MSc Plant Sciences, graduates are expected to be able to:

Domain-specific knowledge, understanding and experimental skills
1. explain and exemplify theories, methods and techniques that are relevant to the selected specialization, and stay informed about recent developments in their field of specialisation as well as related fields;
2a. apply knowledge of the physical, chemical and physiological aspects of crop growth and production, and of modelling and simulation to analyse yield constraints and develop appropriate

crop management practices to sustain, and, where possible, improve food production (Specialisation A – Crop Science);
2b. apply the knowledge of (environmental) plant physiology, crop ecology and post-harvest physiology in order to analyse plant growth in a protected environment, and develop technological approaches to optimise yield, control abiotic and biotic factors and improve post-harvest quality (Specialisation B – Greenhouse Horticulture);
2c. apply the knowledge of soil quality, crop growth, nutrient dynamics, ecology and bio-interactions to analyse interactions between agriculture and the biotic and a-biotic environment, for conservation of (agro-) biodiversity and to improve the sustainability of agricultural land use (production of food and bio-resources) (Specialisation C – Natural Resources Management)
2d. apply the knowledge of classical, molecular, population and quantitative genetics, plant physiology, statistics, genomics and bioinformatics to design, develop and select varieties with improved yield, disease resistance, quality characteristics and suitability for sustainable plant production systems (Specialisation D – Plant Breeding and Genetic Resources; Specialisation F – Plant Breeding (Distance Learning));
2e. apply the knowledge of plant-insect, plant-pathogen and crop-weed relationships, both at ecological and molecular level to analyse and design strategies for integrated pest management by integrating genetic plant resistance, cultural practices and biological control (Specialisation E – Plant Pathology and Entomology);
2f. apply the knowledge of plant physiology and development, breeding and biotechnology for biomass production to design novel bio-based concepts, products or processes in an international context (Specialisation G – Biomass Production and Carbon Capture);
3. independently select and apply suitable laboratory techniques, analytical measurements, surveys, mathematical and statistical methods for the collection, processing and analysis of experimental data in plant science;

Scientific skills
4. independently resolve a scientific problem in plant sciences into research questions and develop a scientifically relevant research plan in which problem definition, research question, hypothesis, experimental set-up and data analysis are described in relation to relevant literature;
5. independently perform scientific experiments and analyse and interpret experimental data, in order to develop or design a novel solution, system, model or product;
6. translate research data and scientific knowledge in the field of specialisation into relevant solutions to complex problems;
7. select relevant scientific literature to critically analyse current concepts, theories, techniques and debates as a basis for defining research questions and testing hypotheses in order to draw conclusions and develop recommendations;

General academic learning
8. communicate in professional English with specialists and non-specialists about research and solutions to problems related to the field of specialisation, both verbally (in presentations and debates) and in writing;
9. experience the institutional, entrepreneurial and professional reality of a potential junior academic working environment and determine a personal professional perspective;
10. co-operate in a multi-disciplinary intercultural team in different team roles, including the role of team leader to plan, perform and manage project-based work;
11. analyse and evaluate the socio-economic, ethical and environmental aspects related to the academic field of specialization and integrate these in scientific work in an international context;
12. reflect on personal knowledge, skills, attitudes and functioning, both individually and by giving and receiving feedback, and design a personal learning path.

Master's programme Plant Biotechnology

After successful completion of the MSc Plant Biotechnology, graduates are expect to be able to:

Domain-specific knowledge, understanding and experimental skills

1. Explain and exemplify theories, methods and techniques that are relevant to the selected specialisation, and remain informed about recent developments in the field of specialisation as well as related domains;

2a. Apply knowledge of genomics, molecular biology, genetics and bioinformatics in order to improve understanding of fundamental processes in plants and interactions between genes and gene products (Specialisation A - Functional Plant Genomics) ;

2b. Apply the knowledge of plant molecular biology, genomics, metabolomics and biomedical science in order to analyse and design plant-based systems for the production of health-promoting compounds (proteins and secondary metabolites) (Specialisation B - Plants for Human and Animal Health);

2c. Apply the knowledge of molecular markers, genomics and bioinformatics to explore genetic variation and to develop novel plant varieties; Apply knowledge on plant-insect, plant-pathogen, crop-weed interactions at the molecular level to design strategies for integrated plant health-management and develop disease resistant crops (Specialisation C - Molecular Plant Breeding and Pathology);

3. Independently select and apply suitable laboratory techniques, analytical measurements, mathematical and statistical methods for the collection, processing and analysis of experimental data in plant biotechnology.

Scientific skills

4. Independently formulate a scientific problem in plant biotechnology in terms of research questions, and develop a scientifically relevant research plan in which problem definition, hypothesis, experimental set-up and data analysis are described in relation to relevant literature;

5. Independently perform scientific experiments and analyse and interpret experimental data, in order to develop or design a novel solution, system, model or product;

6. Translate research data and scientific knowledge in the field of specialisation into relevant solutions to complex problems;

7. Select relevant scientific literature to critically analyse current concepts, theories, techniques and debates as a basis for defining research questions and testing hypotheses in order to draw conclusions and develop recommendations;

General academic skills

8. Communicate in professional English with specialists and non-specialists about research and solutions to problems related to the field of specialisation, both verbally (in presentations and debates) and in writing;

9. Experience the institutional, entrepreneurial and professional reality of a potential junior academic working environment and determine a personal professional perspective;

10. Cooperate in a multi-disciplinary intercultural team in different team roles, including the role of team leader, to plan, perform and manage project-based work;

11. Analyse and evaluate the socio-economic, ethical and environmental aspects related to the academic field of specialisation and integrate these in scientific work in an intercultural context;

12 Reflect on personal knowledge, skills, attitudes and functioning, both individually and by giving and receiving feedback, and design a personal learning path.

Master's programme Organic Agriculture

After successful completion of the MSc Organic Agriculture, graduates are expected to be able to:

Domain-specific knowledge, understanding and experimental skills

1. Integrate knowledge of value chains, legislation and certification, marketing, societal context, education, plant and animal production, environmental sciences and social sciences to analyse the main components of complex farming systems and to explore the principles of food production, consumption, natural resource management, multi-functional land use and the social environment; Describe the available research orientations, from empirical analytical (quantitative) to interpretative (qualitative) to participatory research, and explain the merits of each orientation depending on the purpose pursued and the research question at stake.

2a. Specialisation A (Agro Ecology)

Integrate and apply the knowledge of plant and animal production and soil and environmental science in the context of organic agriculture; Explain the key differences between organic and conventional agricultural systems, as well as between other emerging agricultural systems (low input, sustainable agriculture), and analyse agro-ecological processes and management systems.

2b. Specialisation B (Consumer and Market)

Explain the involvement of diverse stakeholders in food systems and the multidisciplinarity of sustainable production chains and value chains, and explain the trade-offs between these diverse stakeholders and chain actors; Integrate various aspects of farming and food systems and their societal and ecological embedding: sociological and intercultural aspects, valorisation and markets, business models and knowledge and innovation;

2c. Specialisation C (Double Degree Agroecology)

Understand the structure and function of complex agroecosystems; Apply systems approaches in studying, designing and evaluating agricultural systems and food production chains, and to develop creative solutions for sustainable farming, landscape management and marketing of organic products;

3. Apply a systems approach in analysing, evaluating and designing complex agricultural systems and (food) production chains by using suitable analytical measurements, surveys and mathematical end statistical methods;

Scientific skills

4. Independently design a research proposal in which problem definition, research orientation and details of corresponding methodology or experimental set up, research design and data analysis are described in relation to relevant literature;

5. Independently perform a research project and analyse and interpret experimental data, in order to develop or design a novel solution, system, model or product;

6. Translate (action) research data and scientific knowledge in organic agriculture into relevant solutions to complex problems;

7. Select relevant scientific literature to critically analyse current concepts, theories, techniques and debates as a basis for defining research questions and testing hypotheses in order to draw conclusions and develop recommendations.

Societal awareness

8. Contribute scientific knowledge and understanding in interactive multi-stakeholder change processes (e.g. action research) aimed at innovating and improving the organic sector, both strategically and practically; Shift between different perspectives in time (past, present & future), space (local, regional & global), culture and discipline;

9. Analyse and evaluate the ethical, environmental, and socio-economic consequences of research and reflect on the different roles of the scientist in agricultural transition processes.

General academic skills

10. Co-operate in a multi-disciplinary international team in different team roles, including the role of team leader, to plan, perform and manage project-based work;
11. Communicate effectively and with an open mind for new ideas about creative alternatives in organic agriculture with specialists and non-specialists, both verbally (in presentations and debates) and in writing; Act as an intermediary between science experts on the one hand, and policy makers and the wider public on the other;
12. Reflect on personal knowledge, skills, attitudes and performance, both individually and by giving and receiving feedback, and design and plan a personal learning path;
13. Reflect on the consequences of values, perspectives and actions, for others (empathic understanding), and for larger societal systems in which students are involved.

APPENDIX 3: OVERVIEW OF THE CURRICULUM

Bachelor's programme Plant Sciences

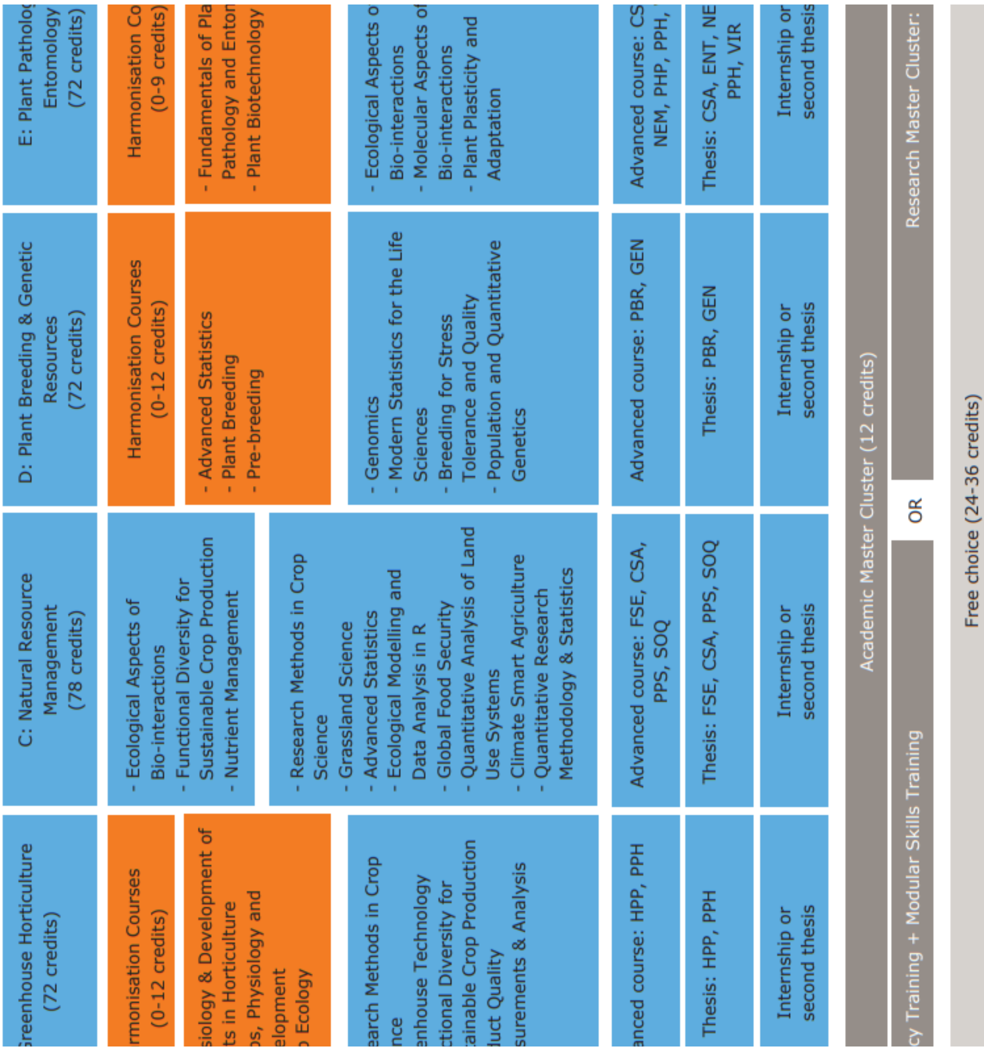
Course name	Credits	Year - period	Lecture	Tutorial	Practical	Other	Type of course
Common Part							
Introduction Plant Sciences	6	Y1 – P1		33	31	12	CS
General Chemistry for the Life Sciences	3	Y1 – P1	7	12	24		CS
Statistics 2	3	Y1 – P2		26	12		CS
Bio-organic Chemistry for Life Sciences	3	Y1 – P2	7	14	20		CS
Cell Biology	6	Y1 – P2	12	7	34	6	CS
Fundamentals of Genetics and Molecular Biology	6	Y1 – P3	16	28	40		CS
Practical Biological Chemistry	6	Y1 – P4	10	6	90		CS
Introduction Quantitative Agroecology	6	Y1 – P5	16	18	32	7	CS
Structure and Function of Plants	6	Y1 – P5	28	3	55		CS
Ecology I	3	Y1 – P6	14		20	10	CS
Ecology II	3	Y1 – P6		9	24	5	CS
Orientation Plant Sciences	6	Y1 – P6	2		49	52	CS
Reproduction of Plants	3	Y2 – P1	8		40	4	CS
Concepts in Environmental Plant Physiology	3	Y2 – P1	10		33	1	CS
Plant Breeding	3	Y2 – P1	14	16	8		CS
Fundamentals of Plant Pathology and Entomology	3	Y2 – P1	8	15	13		CS
Mathematics 2	3	Y2 – P2		32	6		CS
Mathematics 3	3	Y2 – P2		32	6		CS
Biosystematics, Evolution and Agrobiodiversity	6	Y2 – P4	28	34		4	CS
Introduction to Business Economics, Management and Marketing	6	Y2 – P5	20			20	CS
Integrated Pest Management	6	Y2 – P6	24		66		CS
Research Methodology in Plant Sciences	6	Y2 – P6	6		39	8	CS
Advanced Statistics	6	Y2 – P5 or Y3 – P1	24	14	24		CS
BSc Thesis Plant Sciences	18	Y3 - all				80*	CS
Mathematics 1	3	Y1 – P1		32			RO1
Statistics 1	3	Y1 – P1		26	12		RO1
Major A - Plant Genomics and Health							
Plant Biotechnology	6	Y2 – P2	17	10	27	9	CS
Cell Biology and Health	6	Y2 – P3	20		36	6	CS
Genetic Analysis Trends and Concepts	6	Y3 – P1	12	17	77		CS
Introduction to Bioinformatics	6	Y3 – P1	12	21	60		CS
Major B - Plant Production and Ecology							
Systems Analysis, Simulation and Systems Management	6	Y2 – P2	24	24	48		CS
Soil-Plant Relations	6	Y2 – P3	18	14	38	3	CS
Crop Ecology	6	Y2 – P5	6	11	68	1	CS
Physiology and Development of Plants in Horticulture	6	Y3 – P1	20	9	46	10	CS

* Individual supervision during thesis (contact hours for daily supervision differ)

CS: compulsory course

RO: restricted optional course

Master's programme Plant Sciences



Specialisation A Crop Science: Harmonisation	Crops, Physiology and Environment	6	Year 1	Max. 12 credits depending on pre-education
	Systems Analysis, Simulation and Systems Management	6	Year 1	
	Crop Ecology	6	Year 1	
Core	Research Methods in Crop Science	6	Year 1	Choose at least 1 course
	Grassland Science	6	Year 1	
	Ecological Modelling and Data Analysis in R	6	Year 1	
	Functional Diversity for Sustainable Crop Production	6	Year 1	
	Analysing Sustainability of Farming Systems	6	Year 1	
Advanced course	Agroecology	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Functional Diversity for Sustainable Crop Production	6	Year 1	
	Advanced Crop Physiology	6	Year 1	
	Quantitative Analysis of Land Use Systems (QUALUS)	6	Year 1	
MSc Thesis	MSc Thesis Farming Systems Ecology	36	Year 2	Choose at least 36 credits
	MSc Thesis Crop and Weed Ecology	36	Year 2	
	MSc Thesis Crop Physiology	36	Year 2	
	MSc Thesis Plant Production Systems	36	Year 2	
Internship or minor thesis		24	Year 1 or 2	Choose at least 24 credits
Specialisation B Greenhouse Horticulture: Harmonisation	Crops, Physiology and Environment	6	Year 1	Max. 12 credits depending on pre-education
	Systems Analysis, Simulation and Systems Management	6	Year 1	
	Crop Ecology	6	Year 1	
Core	Research Methods in Crop Science	6	Year 1	Choose at least 1 course
	Greenhouse Technology	6	Year 1	
	Functional Diversity for Sustainable Crop Production	6	Year 1	
	Product Quality Measurements & Analysis	6	Year 1	
Advanced course	Postharvest Physiology	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Product Quality Measurements & Analysis	6	Year 1	
	Advanced Methods for Plant-Climate Research in Controlled Environments	6	Year 1	
	Plant Cell and Tissue Culture	6	Year 1	
	Plant Plasticity and Adaptation	6	Year 1	
MSc Thesis	MSc Thesis Horticulture and Product Physiology	36	Year 2	Choose at least 36 credits
	MSc Thesis Plant Physiology	36	Year 2	
Internship or minor thesis		24	Year 1 or 2	Choose at least 24 credits
Specialisation C Natural Resource Management: Core 1	Ecological Aspects of Bio-interactions	6	Year 1	Choose at least 1 course
	Functional Diversity for Sustainable Crop Production	6	Year 1	
	Nutrient Management	6	Year 1	
Core 2	Research Methods in Crop Science	6	Year 1	Choose at least 1 course
	Grassland Science	6	Year 1	
	Advanced Statistics	6	Year 1	
	Ecological Modelling and Data Analysis in R	6	Year 1	
	Global Food Security	6	Year 1	

	Quantitative Analysis of Land Use Systems (QUALUS)	6	Year 1	
	Analysing Sustainability of Farming Systems	6	Year 1	
	Biological Interactions in Soils	6	Year 1	
	The Carbon Dilemma	6	Year 1	
MSc Thesis	MSc Thesis Farming Systems Ecology	36	Year 2	Choose at least 36 credits
	MSc Thesis Crop and Weed Ecology	36	Year 2	
	MSc Thesis Crop Physiology	36	Year 2	
	MSc Thesis Plant Production Systems	36	Year 2	
	MSc Thesis Soil Biology and Biological Soil Quality	36	Year 2	
Internship or minor thesis		24	Year 1 or 2	Choose at least 24 credits
Specialisation D Plant Breeding and Genetic Resources: Harmonisation	Advanced Statistics	6	Year 1	Max. 12 credits depending on pre-education
	Plant Breeding	6	Year 1	
	Pre-breeding	6	Year 1	
Core	Genomics	6	Year 1	Choose at least 1 course
	Modern Statistics for the Life Sciences	6	Year 1	
	Data Management	6	Year 1	
	Breeding for Stress Tolerance and Quality	6	Year 1	
	Population and Quantitative Genetics	6	Year 1	
Advanced course	Design of Plant Breeding Programmes	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Genetic Analysis Trends and Concepts	6	Year 1	
	Population and Quantitative Genetics	6	Year 1	
MSc Thesis	MSc Thesis Plant Breeding	36	Year 2	Choose at least 36 credits
	MSc Thesis Genetics	36	Year 2	
Internship or minor thesis		24	Year 1 or 2	Choose at least 24 credits
Specialisation E Plant Pathology and Entomology: Harmonisation	Fundamentals of Plant Pathology and Entomology	6	Year 1	Max. 12 credits depending on pre-education
	Plant Biotechnology	6	Year 1	
Core	Ecological Aspects of Bio-interactions	6	Year 1	Choose at least 1 course
	Molecular Aspects of Bio-interactions	6	Year 1	
	Plant Plasticity and Adaptation	6	Year 1	
Advanced course	Functional Diversity for Sustainable Crop Production	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Fundamental and Applied Aspects of the Biology of Insects	6	Year 1	
	Host-Parasite Interactions	6	Year 1	
	Plant-Microbe Interactions	6	Year 1	
	Plant Cell and Tissue Culture	6	Year 1	
	Plant Plasticity and Adaptation	6	Year 1	
	Fundamental and Applied Virology	6	Year 1	
MSc Thesis	MSc Thesis Crop and Weed Ecology	36	Year 2	Choose at least 36 credits
	MSc Thesis Entomology	36	Year 2	
	MSc Thesis Nematology	36	Year 2	
	MSc Thesis Phytopathology	36	Year 2	
	MSc Thesis Plant Physiology	36	Year 2	
	MSc Thesis Virology	36	Year 2	
Internship or minor thesis		24	Year 1 or 2	Choose at least 24 credits
Specialisation F Plant Breeding (Distance Learning) parttime: Core year 1	Principles of Plant Breeding (DL)	3	Year 1	Compulsory
	Population Genetics (DL)	2	Year 1	
	Genetics (DL)	3	Year 1	
	Plant Pathology and Disease Epidemiology (DL)	3	Year 1	
	Plant Biotechnology (DL)	3	Year 1	

	Course name	Credits	Year - period	Type of course
Core year 2	Breeding for Abiotic Stress Tolerance (DL)	2	Year 2	Compulsory
	Germplasm and Seed Technology (DL)	3	Year 2	
	Breeding for Resistance (DL)	2	Year 2	
	Genomics and Bioinformatics (DL)	3	Year 2	
	Experimental Design and Data Analysis of Breeding Trials (DL)	3	Year 2	
	Breeding for Quality (DL)	2	Year 2	
	Wageningen Weeks Part 2 (DL)	3	Year 2	
	New Trends in Plant Breeding (DL)	3	Year 2	
Academic Master Cluster	Plant Breeding Design Cluster (DL)	15	Year 1 and 2	Compulsory
MSc Thesis	MSc Thesis Plant Breeding	36	Year 3 and 4	Choose at least 36 credits
Internship		24	Year 3 and 4	Choose at least 24 credits
Specialisation G Biomass Production and Carbon Capture: Core	Modelling of Biobased Production Systems	6	Year 1	Choose 2 courses
	Seagriculture: Seaweed Biology and Cultivation	6	Year 1	
	Resource Dynamics and Sustainable Utilization	6	Year 1	
	Quantitative Analysis of Land Use Systems (QUALUS)	6	Year 1	
	Bioresources	6	Year 1	
	Microalgae Biotechnology	6	Year 1	
Advanced course	Advanced Crop Physiology	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Breeding for Stress Tolerance and Quality	6	Year 1	
	Plant Plasticity and Adaptation	6	Year 1	
MSc Thesis	MSc Thesis Crop Physiology	36	Year 2	Choose at least 36 credits
	MSc Thesis Plant Breeding	36	Year 2	
	MSc Thesis Plant Physiology	36	Year 2	
Internship or minor thesis		24	Year 1 or 2	Choose at least 24 credits

Harmonisation Courses (0-12 credits)

Gene Technology	Plant Biotechnology	Advanced Statistics

Common Part (12 credits)

Current Topics in Plant Biotechnology

Intellectual Property Rights	OR	New Venture Creation: from Idea to Business Plan	OR	Communication and Persuasion	OR	Dilemmas in Food Safety and Security

A: Functional Plant Genomics (72 credits)	B: Plants for Human and Animal Health (72 credits)	C: Molecular Plant Breeding and Pathology (72 credits)
– Programming in Python – Introduction to Bioinformatics – Data Management – Genomics – Molecular Systems Biology – Regulation of Plant Development	– Plants and Health – Immunotechnology	– Molecular Aspects of Bio-interactions – Genomics – Bioresources – Breeding for Stress Tolerance and Quality
Advanced course: GEN, CLB, PPH, MOB, BIF, BIC	Advanced course: NEM, VIR, ENT, PPH	Advanced course: GEN, PBR, ENT, NEM, PHP, PPH, VIR
Thesis: GEN, CLB, PPH, MOB, BIF, BIC	Thesis: NEM, VIR, ENT, PPH	Thesis: GEN, PBR, ENT, NEM, PHP, PPH, VIR
Internship or second thesis	Internship or second thesis	Internship or second thesis

Academic Master Cluster (12 credits)

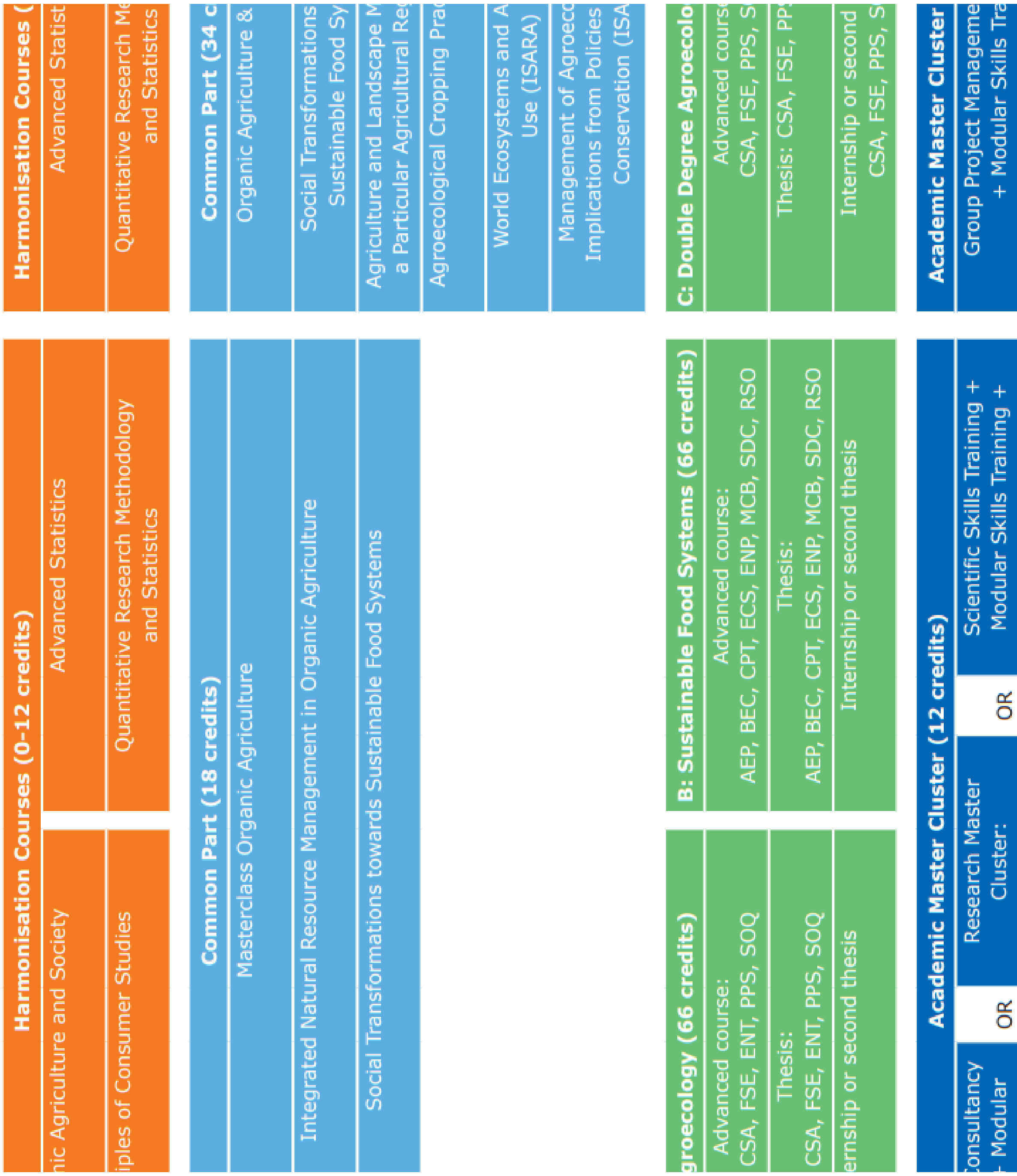
Academic Master Cluster (12 credits)	OR	Research Master Cluster: Proposal Writing

Free choice (12-24 credits)

	Dilemmas in Food Safety and Security	6	Year 1	
	New Venture Creation: from Idea to Business Plan	6	Year 1	
Harmonisation courses	Advanced Statistics	6	Year 1	Max. 12 credits depending on pre-education
	Gene Technology	6	Year 1	
	Plant Biotechnology	6	Year 1	
Academic Master Cluster	Modular Skills Training (A)	3	Year 1 or 2	Choose either A or B
	Academic Consultancy Training (A)	9	Year 1 or 2	
	Research Master Cluster: Proposal Writing (B)	12	Year 2	
Specialisation A Functional Plant Genomics: Core	Programming in Python	6	Year 1	Choose at least 1 course
	Introduction to Bioinformatics	6	Year 1	
	Data Management	6	Year 1	
	Genomics	6	Year 1	
	Molecular Systems Biology	6	Year 1	
	Regulation of Plant Development	6	Year 1	
Advanced course	Genomics	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Cell Biology and Advanced Imaging Technologies	6	Year 1	
	Regulation of Plant Development	6	Year 1	
	Plant Cell and Tissue Culture	6	Year 1	
	Plant Plasticity and Adaptation	6	Year 1	
	Regulation of Plant Development	6	Year 1	
	Advanced Bioinformatics	6	Year 1	
	Regulation of Plant Development	6	Year 1	
MSc Thesis	MSc Thesis Genetics	36	Year 2	Choose at least 36 credits
	MSc Thesis Cell Biology	36	Year 2	
	MSc Thesis Plant Physiology	36	Year 2	
	MSc Thesis Molecular Biology	36	Year 2	
	MSc Thesis Bioinformatics	36	Year 2	
	MSc Thesis Biochemistry	36	Year 2	
Internship or minor thesis		24	Year 1 or 2	Choose at least 24 credits
Specialisation B Plants for Human and Animal Health: Core	Plants and Health	6	Year 1	Choose at least 1 course
	Immunotechnology	6	Year 1	
Advanced course	Host-Parasite Interactions	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Fundamental and Applied Virology	6	Year 1	
	Fundamental and Applied Aspects of the Biology of Insects	6	Year 1	
	Plant Cell and Tissue Culture	6	Year 1	
	Plant Plasticity and Adaptation	6	Year 1	
MSc Thesis	MSc Thesis Nematology	36	Year 2	Choose at least 36 credits

	Course name	Credits	Year - period	Type of course
Specialisation C Molecular Plant Breeding and Pathology: Linkage	Fundamentals of Plant Pathology and Entomology	3	Year 1	Compulsory depending on pre-education
	Plant Breeding	3	Year 1	
	Pre-breeding	3	Year 1	
Core	Molecular Aspects of Bio-interactions	6	Year 1	Choose at least 1 course
	Genomics	6	Year 1	
	Bioresources	6	Year 1	
	Breeding for Stress Tolerance and Quality	6	Year 1	
Advanced course	Genetic Analysis Trends and Concepts	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Population and Quantitative Genetics	6	Year 1	
	Breeding for Stress Tolerance and Quality	6	Year 1	
	Fundamental and Applied Aspects of the Biology of Insects	6	Year 1	
	Host-Parasite Interactions	6	Year 1	
	Plant-Microbe Interactions	6	Year 1	
	Fundamental and Applied Virology	6	Year 1	
	Plant Cell and Tissue Culture	6	Year 1	
	Plant Plasticity and Adaptation	6	Year 1	
MSc Thesis	MSc Thesis Genetics	36	Year 2	Choose at least 36 credits
	MSc Thesis Plant Breeding	36	Year 2	
	MSc Thesis Entomology	36	Year 2	
	MSc Thesis Nematology	36	Year 2	
	MSc Thesis Phytopathology	36	Year 2	
	MSc Thesis Virology	36	Year 2	
	MSc Thesis Plant Physiology	36	Year 2	
Internship or minor thesis		24	Year 1 or 2	Choose at least 24 credits

Master's programme Organic Agriculture



Students have to extend the programme to at least 120 credits by adding optional courses selected on an individual basis.

	Course name	Credits	Year - period	Type of course
Common Part for specialisations A and B	Masterclass Organic Agriculture	6	Year 1 and 2	Compulsory
	Integrated Natural Resource Management in Organic Agriculture	6	Year 1	
	Social Transformations towards Sustainable Food Systems	6	Year 1	
Harmonisation courses	Advanced Statistics	6	Year 1	Max. 12 credits depending on pre-education
	Principles of Consumer Studies	6	Year 1	
	Organic Agriculture and Society	6	Year 1	
	Quantitative Research Methodology and Statistics	6	Year 1	
Academic Master Cluster	Modular Skills Training (A, C)	3	Year 1 or 2	Choose A, B or C
	Academic Consultancy Training (A)	9	Year 1 or 2	
	Research Master Cluster: Proposal Writing (B)	12	Year 2	
	Scientific Skills Training (C)	3	Year 1	
Specialisation A Agroecology: Advanced course	Sustainability Assessment of Animal Systems	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Analysis and Design of Organic Farming Systems	6	Year 1	
	Organic Animal Production	6	Year 1	
	Agroecology	6	Year 1	
	Research methods in Crop Science	6	Year 1	
	Grassland Science	6	Year 1	
	Functional Diversity for Sustainable Crop Production	6	Year 1	
	Advanced Crop Physiology	6	Year 1	
	Ecological Aspects of Bio-interactions	6	Year 1	
	Quantitative Analysis of Land Use Systems (QUALUS)	6	Year 1	
	Analysing Sustainability of Farming Systems	6	Year 1	
	Nutrient Management	6	Year 1	
MSc Thesis	MSc Thesis Animal Production Systems	36	Year 2	Choose at least 36 credits
	MSc Thesis Farming Systems Ecology	36	Year 2	
	MSc Thesis Crop and Weed Ecology	36	Year 2	
	MSc Thesis Crop Physiology	36	Year 2	
	MSc Thesis Entomology	36	Year 2	
	MSc Thesis Plant Production Systems	36	Year 2	
	MSc Thesis Soil Biology and Biological Soil Quality	36	Year 2	
MSc Internship		24	Year 2	Choose at least 24 credits
Specialisation B Sustainable Food Systems: Advanced course	Economics of Agribusiness	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	The Economics and Politics of European Integration: Agricultural, Trade and Foreign Policy Analysis	6	Year 1	
	Advanced Business Economics	6	Year 1	
	Researching Socio-Technical Practices, Innovation and Responsible Futures	6	Year 1	
	Environmental Education and Learning for Sustainability	6	Year 1	
	Globalization and Sustainability of Food Production and Consumption	6	Year 1	
	Advanced Management and Marketing	6	Year 1	
	Consumer Behaviour: Concepts and Research Methods	6	Year 1	
	Creating Frameworks for Marketing and Consumer Behaviour	6	Year 1	
	Political Ecologies of Natural Resource Distribution	6	Year 1	
	The Sociology of Farming and Rural Life	6	Year 1	
	Sociology of Food and Place	6	Year 1	

	Course name	Credits	Year - period	Type of course
MSc Thesis	MSc Thesis Agricultural Economics and Rural Policy	36	Year 2	Choose at least 36 credits
	MSc Thesis Business Economics	36	Year 2	
	MSc Thesis Knowledge, Technology and Innovation	36	Year 2	
	MSc Thesis Education and Competence Studies	36	Year 2	
	MSc Thesis Environmental Policy	36	Year 2	
	MSc Thesis Marketing and Consumer Behaviour	36	Year 2	
	MSc Thesis Sociology of Development and Change	36	Year 2	
	MSc Thesis Rural Sociology	36	Year 2	
MSc Internship		24	Year 2	Choose at least 24 credits
Specialisation C Double Degree Agroecology: Harmonisation courses	Advanced Statistics	6	Year 1	Max. 6 credits depending on pre-education
	Quantitative Research Methodology and Statistics	6	Year 1	
Compulsory courses @WU	Modular Skills Training	3	Year 1	Compulsory
	Organic Agriculture and Society	6	Year 1	
	Social Transformations towards Sustainable Food Systems	6	Year 1	
Compulsory courses @ISARA Lyon	Agriculture and Landscape Management in a Particular Agricultural Region	4	Year 2	Compulsory
	Agroecological Cropping Practices	7	Year 2	
	World Ecosystems and Agricultural Use	5	Year 2	
	Management of Agroecosystems: Implications from Policies and Nature Conservation	6	Year 2	
	Group Project Management	8	Year 2	
Advanced course	Integrated Natural Resource Management in Organic Agriculture	6	Year 1	Choose 1 course connected to the selected MSc Thesis
	Quantitative Analysis of Land Use Systems (QUALUS)	6	Year 1	
	Functional Diversity for Sustainable Crop Production	6	Year 1	
	Analysis and Design of Organic Farming Systems	6	Year 1	
	Agroecology	6	Year 1	
MSc Internship or minor Thesis		24	Year 1	Choose 24 credits
MSc Thesis	MSc Thesis Crop and Weed Ecology	30	Year 2	Choose 30 credits
	MSc Thesis Farming Systems Ecology	30	Year 2	
	MSc Thesis Plant Production Systems	30	Year 2	
	MSc Thesis Soil Biology and Biological Soil Quality	30	Year 2	

APPENDIX 4: PROGRAMME OF THE SITE VISIT

21 November BSc BPW and MSc MPB, MPS en MOA		
8.45	11.15	Arrival of the panel, Preparation, documentation review
11.15	12.00	Interview with management (including Programme Committee)
12.00	13.00	Visiting Greenhouses
13.00	14.00	Lunch and deliberations panel
14.00	14.30	Students BSc
14.30	14.35	Mini break
14.35	15.20	Teaching staff BSc
15.20	15.30	Break
15.30	16.15	Students MSc MPS Deeltijd (via Skype)
16.15	16.45	Alumni
16.45	17.15	Internal deliberation panel, short recap day 1
22 November BSc BPW and MSc MPB, MPS en MOA		
8.45	10.00	Deliberations panel and documentation review
10.00	10.45	Students MSc MPS
10.45	10.50	Minibreak
10:50	11.35	Students MSc MPB
11.35	11.45	Break
11.45	12.30	Teaching staff MSc MPS
12.30	13.30	Lunch and deliberations panel
13:30	14:15	Teaching staff MSc MPB
14.15	14.20	Minibreak
14.20	15.05	Students MSc MOA
15.05	15.20	Break
15.20	16.05	Teaching Staff MSc MOA
16.05	16.10	Minibreak
16.10	16.40	Examining Board and Study Advisors
16.40	17.15	Internal deliberation panel, short recap day 2
23 November BSc BPW and MSc MPB, MPS en MOA		
8.30	10.00	Deliberations panel and documentation review
10.00	10.45	Final interview with management
10.45	12.45	Deliberations panel and formulating preliminary findings and conclusions + **lunch**
12.45	13.15	Feedback of preliminary findings and conclusions

APPENDIX 5: THESES AND DOCUMENTS STUDIED BY THE PANEL

Prior to the site visit, the panel studied fifteen theses of the bachelor's programme Plant Sciences, fifteen theses of the master's programme Plant Sciences, ten theses of the master's programme Plant Biotechnology and ten theses of the master's programme Organic Agriculture. Information on the selected theses is available from QANU upon request.

During the site visit, the panel studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

Programme	*Title*
BPW	Fundamentals of Genetics and Molecular Biology
	Plant Biotechnology
	Soil-Plant Relations
	Research Methodology in Plant Sciences
MPS	Research Methods in Crop Science
	Design of Plant Breeding Programmes
	Plant-Microbe Interactions
OMPB	Principles of Plant Breeding (online)
	Advanced Statistics (online)
	Breeding for Resistance (online)
	Experimental Design and Data Analysis of Breeding Trials (online)
MPB	Dilemmas in Food Safety and Security
	Introduction to Bioinformatics
	Plants and Health
MOA	Social Transformations towards Sustainable Food Systems
	Integrated Natural Resource Management in Organic Agriculture
	Analysis and Design of Organic Farming Systems