



**AERES**  
UNIVERSITY OF  
APPLIED SCIENCES  
ALMERE

# Plant Breeding

Course Catalogue  
2024-2025

CROHO: 30009, ISCED: 0511 Biology

# TABLE OF CONTENTS

## Inhoud

<b>1 Introduction</b>	<b>3</b>
<b>2 Programme structure</b>	<b>4</b>
2.1 OVERVIEW .....	4
2.2 COURSE OUTLINE PLANT BREEDING 2022-2023 .....	5
2.3 MATRIX OF COMPETENCES AND MINORS .....	6
2.4 COURSE SCHEDULE PLANT BREEDING .....	7
<b>3 Examination and Assessment Regulations 2022-2023</b>	<b>7</b>
<b>4 Minor and module descriptors</b>	<b>8</b>
4.1 APSP – PLANT BREEDING AND SEED PRODUCTION.....	8
4.2 AMPB – ADVANCED METHODS IN PLANT BREEDING .....	8
4.3 AAFBI - WORK PLACEMENT.....	10
4.4 AAWAI - THESIS PROJECT .....	11
4.5 APL4I - PERSONAL DEVELOPMENT AND ETHICS .....	FOUT! BLADWIJZER NIET GEDEFINIEERD.
ANNEX 1: AERES UNIVERSITY OF APPLIED SCIENCES GENERIC COMPETENCIES.....	12
ANNEX 2: AERES COMPETENCIES AND INDICATORS FOR DIFFERENT LEVELS .....	13

# 1 Introduction

Before you lies the information guide for the 1 year international Bachelor of Science programme Plant Breeding (IPLB, CROHO 30009, ISCED 0511 Biology), for the academic year 2024-2025. Here you may find all official information about the programme. During the course, detailed information will be presented in Canvas, our online learning environment. The entire programme is taught in English.

This first cycle, full-time, 1-year, 60 ECTS credits, BSc. programme has been developed aiming at a wide range of future careers in the main themes of plant breeding and seed production. To ensure that students are well prepared for the professional practice the programme takes the challenges into account that a present day assistant breeder has to deal with.

The world population and demand for food is growing. In combination with loss and deterioration of arable land this leads to increased pressure on crop production. Furthermore, there is increased demand for sustainable production and local growers have to deal with climate change and growing importance of water management. Therefore the agricultural and horticultural sector need cultivars with higher yield, with resistance to pests and diseases, with high production with low energy input as well as tolerance to abiotic factors like salt, temperature and drought.

New cultivars are mainly developed at seed companies worldwide. The seed companies have been able to develop high-quality food, feed, ornamental and industrial crop varieties. Dutch companies and research institutes play an important role in this development, especially in the areas of vegetable seed, seed potatoes, bulbs, propagation material for (fruit)trees, and ornamentals. Conventional breeding techniques such as crossing and selection are supplemented by new plant breeding techniques such as marker assisted selection and genetic modification. Although improved plants obtained by these new techniques can be obtained by conventional techniques, time and effort needed to produce new cultivars is reduced.

After successfully completing this programme, you will be able to design, organize and implement a breeding programme under supervision of the head breeder. You will be able to determine the aims of the breeding program, based on analysis of crop production and market data, introduce genetic variation, assess selection trials and design selection experiments for desired traits, while including disease tests. You will be able to understand and discuss a variety of advanced plant breeding techniques, and choose appropriate methods for a given set of breeding aims. For the long term perspectives of a program you will be able to find germ plasm resources and markers for a trait, as well as the best methods to enhance different stages of the breeding program: variation, recombination, selection and propagation.

During the first semester, the programme consists of two minors (15 ECTS credits each). One minor focuses on conventional plant breeding and seed production, while the second minor is about advanced breeding techniques. Each minor includes a professional task, the acquisition of knowledge and practical skills, and field visits. You will apply all this expertise during an individual internship and a thesis in the second semester.

The quality of the programme is continuously being monitored and the modules may be revised yearly if needed. In addition we have a board of advisors with professionals from the professional work field to ensure that the programme keeps on meeting the needs of the world of work.

## 2 Programme structure

### 2.1 Overview

The following section deals with the contents of the course in more detail. One ECTS credit corresponds with a study load of 28 hours, so 15 ECTS credits correspond with 420 hours of study load. The study load is what an average student should spend on the module in time. Therefore, the student is expected to work 28 hours/credit in total, including seminars, trainings, meetings and study or research time.

For clarity about the terms we are using at Aeres University of Applied Sciences:

- The programme outlined here is the major *Plant Breeding*, and covers the whole one-year Bachelor of Science study programme;
- A *minor* comprises 15 ECTS credits and consists of various smaller units;
- This section provides an overview of the course/major programme, the minors and the modules.

Sem. 1	week 36 2023 – week 5 2023		EC
1	Plant Breeding and Seed Production	APSP	15
2	Advanced Methods in Plant Breeding	AMBP	15
Sem. 2	week 6 2023 – week 28 2023		
3	Work Placement	AAFBi	17
4	Thesis project	AAWAi	10
5	Personal development and ethics	AP4Ai	3
	<b>Total ECTS credits</b>		<b>60</b>

**2.2 Course outline Plant Breeding 2024-2025**

<b>1<sup>st</sup> semester</b>	<b>week 36 2024 – week 3 2025</b>	<b>code</b>	<b>ECTS credits</b>
1	<p><b>Plant Breeding and Seed Production (APSP)</b></p> <p>This minor focuses mainly on conventional plant breeding techniques. You will design a breeding program and execute the different steps in developing new cultivars:</p> <ol style="list-style-type: none"> <li>1. determine the goals/aim of the breeding program based on the analysis of crop production and market data;</li> <li>2. introduce genetic variation;</li> <li>3. assess selection trials;</li> <li>4. design selection experiments for desired traits, while including disease tests.</li> </ol> <p>In order to do this, you will follow courses on genetic variation and breeding methods, biology of seed production, breeding for resistance, experimental design and analysis of field trial data. You will work on a project in which you will further develop your organisation as well as your presentation skills.</p>	APSP	15
2	<p><b>Advanced methods in plant breeding (AMBP)</b></p> <p>This minor focuses on the advanced methods used in plant breeding. You will formulate an advice to a seed company on how a given advanced breeding method can best be used in the context of an existing breeding program. Specifically, your tasks in this module are to:</p> <ol style="list-style-type: none"> <li>1. Describe the general functioning of the advanced breeding method</li> <li>2. Describe how the advanced breeding method could be used to achieve the given breeding aims</li> <li>3. Make a detailed plan for application</li> </ol> <p>Courses on molecular breeding, as well as training in data analysis and clonal propagation are offered. Through your assessment you will be able to develop your research, innovation, introspection and globalisation skills.</p>	AMBP	15
<b>2<sup>nd</sup> semester</b>	<b>week 4 2025 – week 28 2025</b>		
3	<p><b>Work placement</b></p> <p>Internship at a seed company or plant breeding institute, with the aim of training professional tasks in the field of plant breeding.</p>		17
4	<p><b>Thesis project</b></p> <p>Execution of a problem-solving research related to current or future practice in the field of plant breeding and / or seed production.</p>		10
5	<p><b>Personal development and ethics</b></p> <p>You will not only develop expertise in the field of plant breeding, but also develop the needed professional skills and attitudes to manage a project, organise your work, work within an international context and in a team, present to different target groups, perform applied research and innovate in your daily work. These professional skills and attitudes will be assessed at the end of the programme.</p> <p>As a graduated Bachelor of Science you have to be able to deal responsibly with ethical aspects in general and breeding techniques in particular. You will develop your own code of behaviour based on your personal values and standards.</p>		3
<b>Total ECTS credits for the program</b>			<b>60</b>

### 2.3 Matrix of competencies and minors

The following matrix gives you an overview of how different competencies and qualifications link to each other. After completing the minors of this course you are expected to reach level 3 in the named competencies and to be able to fulfil professional tasks.

Applied Biology – Major Plant Breeding	2023-2024				
	APSP	AMBP	AAFBi	AAWai	AP4Ai
<b>Final qualifications</b>					
1.Design, execute and report biological applied research from the perspective of organism- and population level.	x	x	x	x	
2. Communicate results of the biological research in an appropriate way to the target audience.	x	x	x	x	
3. Appreciate knowledge of biological specialisation, apply latest developments and obtain new knowledge.		x	x	x	
4. Being able to work on a biological problem in a project-based approach.	x		x	x	
5. Have insight in own functioning within the biological field, show sustainable behaviour and be able to justify one's actions within this field.		x	x	x	x
<b>Aeres-competencies</b>					
1: To show leadership capabilities/ to (project) manage	*		*)	*	
2: To cooperate	*		*	*	
3: To present	*		*	*	
4: To research	*	*	*	*	
5: To innovate		*	*	*	
6: To organize	*		*	*	
7: To introspect/ to be self driven		*	*	*	
8: To enterprise/ to identify and pursue opportunities			*	*	
9: To endorse sustainable behaviour			*	*	*
10: To appreciate the global perspective/ to globalize		*	*	*	

\*) The student may choose the competencies for the Work Placement and the Thesis in such a way that at the end of the year 8 of the 10 Aeres competencies are developed at level 3.

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## 2.4 Course schedule Plant Breeding

### To be inserted

## 3 Examination and Assessment Regulations 2024-2025

The current course regulations are in conformity with the *Examenregeling Aeres University of Applied Sciences Almere* and they represent the distinguishing features of the international courses at Aeres UAS. All courses comply with the key study and qualification objectives of the curricula from which they stem. These qualifications are assumed in the courses in addition to what is Bachelor generic.

The course regulations are published online. It can be found on the intranet website (<https://hbo.aeres.nl/>), select "International Students" and thereafter select the button "Student charter".

## 4 Minor and module descriptors

### 4.1 APSP – Plant Breeding and Seed Production

Minor Plant Breeding and seed production – APSP					
<b>Coordinator:</b>		HEW		<b>Credits:</b>	15
Elements	ECTS	Name	Mode of exam	Exam Period	Literature
APSP01	4	Assessment	Assessment	T2	Recommended: Acquaah, G. (2012) Principles of Plant genetics and breeding. Wiley-Blackwell. Reader Applied Plant Breeding
APSP02	4	Genetic variation and breeding methods	Written exam	T2	
APSP03	3	Biology of seed production	Written exam	T1	
APSP04	2	Breeding for resistance	Written exam	T2	
APSP08	2	Experimental design and field trials	Assignment (O/V/G)	T1	
<b>Entrance requirements:</b>	Knowledge of plant physiology, Mendelian genetics, crop production and protection, basic statistics. Standard requirements for all international students (min. 180 EC background in relevant field of study, appropriate level of English)				
<b>Professional task:</b>	As an assistant breeder of smaller crops, your task is to design, organize and implement a breeding program. In cooperation with the main breeder you will need to make germ plasm choices based on crop production and market analysis and set up a detailed plan for the planting/sowing, crossing and selection.				
<b>Role:</b>	Assistant Breeder/ Research assistant				
<b>Methods:</b>	Lectures, trainings, assignments, excursions, fieldwork, team work and self-study.				
<b>Fields of expertise:</b>	<b>Learning objectives (the student is able to):</b>				
Genetic variation and breeding methods	Choose the most appropriate breeding method for different crops and their traits; Assess selection trails and select plants based on the genetic background of the traits.				
Biology of seed production	Explain the reproduction cycle and the process of seed production in plant breeding. Describe the role of the seed companies in the agricultural chain in the Netherlands.				
Breeding for resistance	Apply the biology and genetic basis of pests and disease resistance in resistance breeding approaches.				
Experimental design and analysis	Design field trails for a breeding program and analyze data using MS Excel and other statistical programs.				
<b>Aeres competencies</b>					
<ol style="list-style-type: none"> <li>1. To (project)manage</li> <li>2. To cooperate</li> <li>3. To present</li> <li>4. To research</li> <li>5. To organize</li> </ol>					
<b>Final qualifications</b>					
This minor meets the following final qualifications from the Bachelor programme of Applied Biology: <ol style="list-style-type: none"> <li>1.Design, execute and report biological applied research from the perspective of organism- and population level.</li> <li>2.Communicate the results of biological research in a manner suitable to the target audience.</li> <li>4.Work on a biological problem in a project-based approach.</li> </ol>					



**4.2 AMPB – Advanced Methods in Plant Breeding**

<b>Minor Advanced methods in Plant Breeding – AMPB</b>					
<b>Coordinator:</b>	KNB		<b>Credits:</b>	15	
<b>Elements</b>	<b>ECTS</b>	<b>Name</b>	<b>Mode of exam</b>	<b>Exam Period</b>	<b>Literature</b>
AMBP01	6	Assessment	Assessment	T2	Recommended: Acquaah, G. (2012) Principles of Plant genetics and breeding. Wiley-Blackwell.
AMBP02	2	Training Data Analysis	Assignment (O/V/G)	T2	
AMBP03	2	Molecular Breeding 1	Written exam	T1	
AMBP04	2	Molecular Breeding 2	Written exam	T2	
AMBP05	3	Training Clonal Propagation	Assignment (O/V/G)	T2	
<b>Entrance requirements:</b>	This minor can only be followed together with the minor Plant breeding and seed production (APSP). Standard requirements for all international students (min. 180 EC background in relevant field of study, appropriate level of English)				
<b>Professional task:</b>	As an assistant breeder working on a major crop, you are requested by the main breeder to work out different aspects of the breeding program. The aims of the program are set, but you have to decide which germ plasm resources and (novel) breeding tools should be used and how.				
<b>Role:</b>	Assistant Breeder, Research Assistant				
<b>Methods:</b>	Lectures, trainings, assignments, excursions, fieldwork, teamwork and self-study.				
<b>Fields of expertise:</b>	<b>Learning objectives (the student is able to):</b>				
Molecular Breeding	Describe the most important molecular tools to enhance the breeding process;  Discuss laws and regulations regarding genetic modification.				
Training data analysis	Use mixed models, multivariate analysis and spatial analysis to analyse data from novel data collection from field trials.				
Training Clonal propagation and in vitro	Discuss the importance of cell and tissue culture in plant breeding;  Apply the most important methods for clonal propagation and tissue culture.				
Plant Breeding in international context	Mention the most important players and developments in the worldwide sector of Plant Breeding.				
<b>Aeres competencies</b>					
<ol style="list-style-type: none"> <li>1. To research</li> <li>2. To innovate</li> <li>3. To be self-driven</li> <li>4. To globalize</li> </ol>					
<b>Final qualifications</b>					
<p>This minor meets the following final qualifications from the bachelor programme of Applied Biology:</p> <ol style="list-style-type: none"> <li>1. Design, execute and report biological applied research from the perspective of organism- and population level.</li> <li>2. Communicate the results of biological research in a manner suitable to the target audience.</li> <li>3. Appreciate knowledge of biological specialisation, apply latest developments and obtain new knowledge.</li> <li>5. Have insight in own functioning within the biological field, show sustainable behaviour and be able to justify one's actions within this field.</li> </ol>					

**4.3 AAFBi – Work Placement**

<b>Graduation Work Placement (AAFBi)</b>			
<b>4th Year Placement</b>			
<b>Coordinator:</b>	Yolanda Maas (MAY) (4PB)	<b>Credits:</b>	<b>17</b>

<b>Module Element</b>	<b>ECTS</b>	<b>Name</b>	<b>Mode of Exam</b>	<b>Exam in period</b>	<b>Literature</b>
AAFBi01	14	Graduation Work Placement	Report	1234	• Information on CANVAS
AAFBi02	3	Graduation Work Presentation	Presentation	1234	• Information on CANVAS

<b>Entrance requirements:</b>	Permission to enter the 4 <sup>th</sup> year of the education program is granted
<b>Professional task:</b>	Based on own choice
<b>Role:</b>	Junior professional
<b>Methods:</b>	Work placement for 476 hours at applied university level The student organizes a company presentation of his / her assignment The student writes a reflection report of his / her functioning during the work placement in light of the chosen competencies, based on documentary evidence.
<b>Fields of expertise:</b>	<b>Learning objectives (the student...):</b>
Based on own choice	<ul style="list-style-type: none"> <li>• is prepared for the future work environment in which the student will work on professional tasks.</li> <li>• becomes acquainted with different companies and job profiles.</li> <li>• is able to practise and show proof of at least 3 selected Aeres competencies, based on the student's own choice, on level 3 in a professional setting.</li> </ul>
<b>Aeres Competencies:</b>	
Based on own choice at level 3	
<b>Final Qualifications:</b>	
Check curriculum overview and programme profile.	

**4.4 AAWAi – Thesis Project**

<b>Graduation Project (AAWAi)</b>					
<b>Coördinator:</b>		Y. Maas (MAY) – 4IPB, 4IAQ		<b>Studiepunten:</b>	
				<b>10</b>	
<b>Module element</b>	<b>ECTS</b>	<b>Name</b>	<b>Mode of Examination</b>	<b>Examination in period</b>	<b>Literature</b>
AAWAi01	10	Bachelor thesis	Report	1234	• Information on CANVAS
<b>Entrance requirements:</b>		Permission to enter the 4th year of the education program is granted			
<b>Professional task:</b>		Based on own choice			
<b>Role:</b>		Junior professional			
<b>Methods:</b>		Independently working on the graduation project			
<b>Field of expertise:</b>		<b>Learning objectives (the student):</b>			
Based on own choice		<ul style="list-style-type: none"> <li>researches and reports on an important topic related to the future work environment</li> <li>is able to practice and show proof of selected Aeres competencies on level 3, based on the student's own choice</li> </ul>			
<b>Aeres competencies:</b>		Based on own choice at level 3			
<b>Final Qualifications:</b>		Check curriculum overview and programme profile.			

**4.5 AP4Ai – Personal Development and Ethics**

<b>Personal Learning Phase (AP4Ai)</b>					
<b>Coordinator:</b>		Y. Maas (MAY) (4IPB, 4IAQ)		<b>credits:</b>	
				<b>3</b>	
<b>Module elements</b>	<b>EC</b>	<b>Name</b>	<b>Exam</b>	<b>Period</b>	<b>Literature</b>
AP4Ai-01	1	CMP	Interviews and 2 assignments	1,2,3,4	Information on Canvas
AP4Ai-02*	2	Professional ethics	Presentation	2,4	Information on Canvas
AP4Ai-03		Final interview	Presentation and interview	1,2,3,4	Information on Canvas
<b>Entrance requirements:</b>		To enter the 4 <sup>th</sup> year, Aeres students should have obtained a minimum of 165 ECTS credits from the first three years of their studies. International students and students from non-Aeres educational programmes can find admission requirements on the website: <a href="https://www.aeresuas.com/programmes/bachelor-programmes/plant-breeding">https://www.aeresuas.com/programmes/bachelor-programmes/plant-breeding</a>			
<b>Professional task:</b>		Personal Development and self-reflection			
<b>Role:</b>		Junior professional			
<b>Methods:</b>		Training, class discussions, individual assignments.			
<b>Fields of expertise:</b>		<b>Learning objectives (the student ....):</b>			
Personal development		<ul style="list-style-type: none"> <li>..... reflects constantly on his or her own personal- and competency development, part of the lifelong learning paradigm.</li> </ul>			
Ethics		<ul style="list-style-type: none"> <li>..... the student shows he or she is able to formulate an opinion on important and current ethical aspects of the professional work environment, based on own experience and norms and values or that of others, while he or she is able to separate opinion from facts. The student shows that he or she can and is willing to openly discuss and exchange ideas with others on these kinds of topics.</li> </ul>			
<b>Aeres competencies:</b>		<ul style="list-style-type: none"> <li>8 out of 10 Aeres competences must be at level 3 (highest level). The competence development will be assessed by means of a final presentation in which students present situations showing examples and proof of their improved mastery of the chosen 8 competences followed by an interview with the assessors. The examples given are based on the goals students set at the beginning of the year and halfway through the</li> </ul>			

fourth year. Goals are formulated according to the SMART method. Using the STARR-method can help the student structure the presentation of examples and proof of his competence development.

**Final qualifications:**

- Management and development of own professional and personal attitude and skills
- Effective cooperation and communication in a multi-disciplinary, intercultural environment.

\*The ethics course can be taken during the 1<sup>st</sup> OR 2<sup>nd</sup> semester. The student can choose based on his/her graduation programme

## ***Annex 1: Aeres University of Applied Sciences generic Competencies***

### **Competency 1: To show leadership capabilities**

Coaches the development of employees and shows exemplary behaviour; retains overview in complex situations, takes initiative at key strategic moments to administer processes of change and applies an appropriate leadership style.

### **Competency 2: To cooperate**

Creates a good atmosphere, handles the interests of others with care, is able to conquer resistance and conflict and utilizes the qualities of all individual team members to collectively reach the predetermined goals.

### **Competency 3: To present**

Is able to communicate messages about complex topics in an understandable and persuasive manner to a critical target audience, thereby consciously choosing the most effective form of communication.

### **Competency 4: To research**

Identifies and describes a problem or a development, formulates a practice-based research question and answers this using a suitable research method.

### **Competency 5: To innovate**

Uses creativity to develop new products, services and applications that are of use in practice.

### **Competency 6: To organize**

Plans and executes activities, brings both employees and resources effectively into action, supervises progress, adjusts when necessary and achieves the desired results.

### **Competency 7: To introspect**

Has a clear understanding of one's own behaviour and directs one's own development with the purpose of matching one's functioning with one's work environment.

### **Competency 8: To enterprise**

Seizes chances and opportunities and turns these into desired results at one's own risk.

### **Competency 9: To endorse sustainable behaviour**

Justifies one's actions while showing respect for values and norms and with a focus on a balanced use of available resources.

### **Competency 10: To appreciate the global perspective**

Considers the world one's playing field and functions well in an international environment

## Annex 2: Aeres Competencies and indicators for different levels

	1	2	3	4	5	6	7	8	9	10
<b>Competencies →</b>	To show leadership capabilities	To cooperate	To present	To research	To innovate	To organise	To introspect	To entrepreise	To endorse sustainable behaviour	To appreciate the Global perspective
<b>Growth indicators ↓</b>										
<b>1 Roles</b>		x								
<b>2 Responsibility</b>	x					x	x		x	
<b>3 Independence</b>	x	x		x			x	x		
<b>4 Public</b>	x		x							x
<b>5 Time limit</b>		x			x	x		x	x	
<b>6 Work</b>						x				
<b>7 Procedures</b>				x						
<b>8 Knowledge and insight</b>			x	x	x					
<b>9 Insecurity</b>							x	x		x
<b>10 Change</b>	x				x		x			x
<b>11 Scope</b>			x			x		x	x	

	<b>Level 1 (year 1)</b>	<b>Level 2 (main phase)</b>	<b>Level 3 (BSc)</b>
<b>1 Roles</b>	skilled worker manager	specialist operational manager	researcher adviser strategic manager
<b>2 Responsibility</b>	small business entrepreneur delegated responsible	entrepreneur co-responsible	innovative manager final responsible
<b>3 Independence</b>	external control	own risk and initiative	own risk, own initiative
<b>4 Public</b>	familiar colleagues and contacts within the own field of work	new target group within the own sector	unfamiliar or expert target groups domestic or abroad
<b>5 Time limit</b>	1 year	1-5 years	5-10 years
<b>6 Work</b>	singular task	several tasks	combined tasks
<b>7 Procedures</b>	adjust and improve	develop	continuous innovation
<b>8 Knowledge + insight</b>	facts, methods, principles	background, explanation	integration and discussion
<b>9 Insecurity</b>	situations with unknown factors	situations with unpredictable	continuously changing circumstances
<b>10 Change</b>	introduce, initiate, direct	control, direct, form	pro-active behaviour, innovate, design
<b>11 Scope</b>	transfer within the sector	transfer within adjoining sectors	transfer across sectors



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