Textbook Animal Breeding and Genetics

Preface: prof. Johan van Arendonk, chairholder Animal Breeding and Genetics

This textbook contains teaching material on animal breeding and genetics for BSc students. The text book started as an initiative of the Dutch Universities for Applied (Agricultural) Sciences. The textbook is made available by the Animal Breeding and Genomics Centre (ABGC) of Wageningen UR (University and Research Centre) . It is written by two animal breeding scientists from Wageningen UR: Kor Oldenbroek from the Centre for Genetic Resources the Netherlands and Liesbeth van der Waaij from the Animal Breeding and Genomics Centre. Four BSc teachers contributed to this textbook by a critical review of the draft texts: Aline van Genderen from HAS-Den Bosch, Hans van Tartwijk from Van Hall-Larenstein in Wageningen, Jan van Diepen from CAH-Vilentum in Dronten en Linda Krijgsman from Inholland in Delft. Their contribution is gratefully acknowledged. Financial support for writing this textbook came from the WURKS programme of Wageningen University.

When you have questions about the text, please send an email to: kor.oldenbroek@wur.nl

When you are using parts of this textbook for publication, please read and respect the disclaimer of Wageningen UR: http://www.wageningenur.nl/en/Disclaimer.htm

I case you want to refer to material in this textbook: the proper citation is: Kor Oldenbroek and Liesbeth van der Waaij, 2015. Textbook Animal Breeding and Genetics for BSc students. Centre for Genetic Resources The Netherlands and Animal Breeding and Genomics Centre, 2015. Groen Kennisnet: https://wiki.groenkennisnet.nl/display/TAB/

What is animal breeding?

This is a book about animal breeding. But what is animal breeding? Animal breeding is about *selective breeding:* only use males and females for breeding that have passed a certain quality criterion. And with a *predefined goal* in mind: to genetically improve the population in a certain direction. So people make a plan with the *intention to select* the best animals according to a predefined list of requisites (traits), and use those selected animals for breeding the next generation so that the offspring on average will be better than the parents. In other words: selective breeding causes a shift in population average from one generation to the next. Although at first instance you may think that animal breeding involves keeping animals and making sure they reproduce, and it thus would involve optimising reproduction techniques or something along those lines, this is not the case.

> **Definition**
>
> **Animal breeding** *involves the selective breeding of domestic animals with the intention to improve desirable (and heritable) qualities in the next generation.*

Aim of this book

We start with the basics of animal breeding: the concepts of genetics necessary to understand the genetic processes used in animal breeding. Then, in the following chapters we will 'dive into the deep' and take you on a journey through all the steps that need to be taken in order to develop and run a successful breeding program (see figure 9). As animal breeder you start by defining what you want to improve in your population, collect information on the performance of the animals and their genetic relationships, determine which animals have the best genetic potential, determine what proportion you should use for breeding in order to achieve a certain genetic gain in the next generation, select the animals and mate them, and after producing the offspring evaluate whether what you set out to achieve with your breeding decisions actually happened. Each generation you breed you go through this circle of steps. So each generation you again have the opportunity to adjust these steps to some extent. You should not change the breeding goal every generation, because a single generation will not give you much genetic improvement. Breeding is more about the cumulative success of multiple generations. You can adjust the goal in response to a change in the market. You can also adjust your breeding program in response to an unwanted genetic change in your population. You should do this as soon as you find out as you don't want the cumulative effect of an undesired response to selection. In almost every chapter we will focus on a specific step in the breeding program. We will explain the main goal of that step, introduce the challenges and find out how those could be faced.
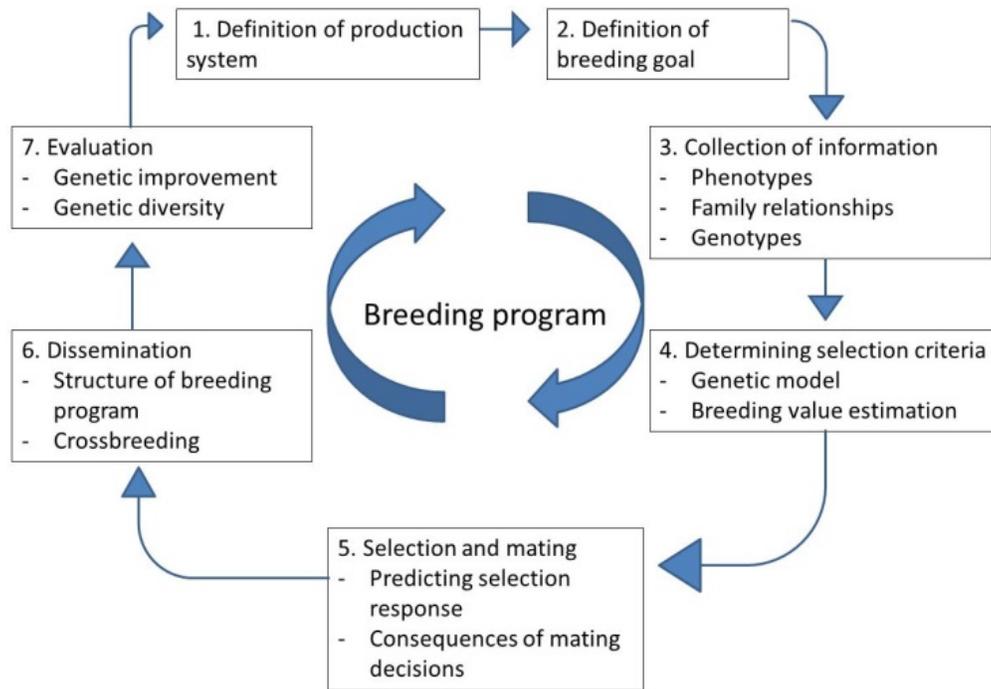
You will notice that some subjects seem to pop up in a number of chapters. That is because they are related to a number of steps and in each step they require a specific attention. That is why they are mentioned in a number of chapters instead of having one chapter just about that subject. The role of genetic relationships, for example, is such a subject. At the end of studying the book you will have gained insight in how a breeding program should be organised, what are some critical points, and what are consequences of certain breeding decisions. The book is organised such that each chapter starts with a general description of the subject, what is its role in a breeding program, and some points of attention. Then we go a bit deeper and introduce tools (formulas) that provide results to help executing the step in the breeding program accurately. We will use a few formulas to be able to do some basic calculations.