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# Genetic and phenotypic parameters of wool yield in Angora rabbits

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## Introduction

The genetic improvement of Angora rabbits is somewhat complicated by the fact that the market does not clearly indicate what properties the product should have. One reason for this may be that Angora wool is used for rather different products (underwear and fashionable articals like pullover), for which e.g. a different amount of guard hair is appropriate.

In spite of these difficulties we can identify the most important traits, which should be genetically improved. Among the many traits the traits of reproductions are in our opinion of lesser importance.
This can be made more plausible if we make the following assumptions:

- One breeding doe provides each year 16 offspring for replacement of wool producing animals (8 males and 8 females)
- For wool production females and castrates are used.
- Animals are used for wool production for three years.

If we have 1000 wool producing animals we have to replace each year 333 animals, for which we need 21 (20.8) does. If we increase by breeding the number of provided offspring to 17 then only 20 (19.6) does are needed. The resulting savings seems to be so small, that in our breeding work we need not put much emphasis on reproductive traits. The situation is somewhat different, if the length of use is lowered, or if only females are used for wool production or if a population is newly established and still expanding.

Thus for the breeding work traits of wool production are most important. Such traits are amount of wool, quality of wool and feed conversion.

In the breeding work we have to consider that the genetic gain per year is not only dependent on the selection intensity (i), the accuracy of estimating the breeding value ($r_{HI}$) and the additive genetic variability ($\sigma_A$) but also on the generation interval. Since the dependency of the genetic gain on the generation interval is reciprocally proportional, animals should be used for breeding at a young age. Thus the performance testing should be finished at the earliest possible age. The latter is even more important since the performance (amount of wool collected) of an animal, which is in the reproductive stage, is in our opinion not useful for selection. However, the early performance recording can be problematic, too, since the trait in the mature animal might be in principle a different trait and thus the genetic correlation with performance at young age could be less than unity.

It was the goal of the present paper, to estimate with the help of an existing data set all the genetic and phenotypic parameters which are needed to design and operate a breeding scheme.

## Material and Methods

For body weight gain and wool yield the following data were available:

Tab. 1: Number and averages of the data set

| | | Number of animals | age (days) | weight (g) | wool yields (g) $\hat{\mu}$ | $\hat{\sigma}$ |
|---|---|---|---|---|---|---|
| 1st shearing | male | 633 | 63 | 1655 | 32.8 | 11.1 |
| | female | 582 | 62 | 1549 | 31.7 | 12.9 |
| 2nd shearing | male | 637 | 117 | 2784 | 101.4 | 25.7 |
| | female | 583 | 118 | 2800 | 110.8 | 29.7 |
| 3rd shearing | male | 206 | 171 | 3262 | 138.5 | 34.1 |
| | female | 273 | 179 | 3371 | - | - |

The listed means are uncorrected means.

The wool yield of later shearings were standardized to an interval of 56 days according to the following formula:

56 x wool yield/shearing interval

The traits of the first two shearings were then analysed in a multivariate way, using the following statistical model:

$$y_{ijklm} = BM_i + Sex_j + sire_{(i)k} + dam_{(ik)l} + e_{ijklm}$$

BM = birth month

In this analysis only those animals could be used from which age, weight and wool yield of the first two shearings were available and their date of birth, sex and parentage were known. The dataset was thus reduced to 994 animals.

Tab. 2: Fixed effects, standard deviations and residual correlations

| | $\bar{x}$ (g) | age-effect (g/day) | Sex (g) | $\sigma_e$ (g) | correlation 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| wool yield 1st shear. | 31.5 | 1.0** | -0.85 | 5.5 | 1. | .39 | .52 | .2 |
| wool yield 2nd she. | 109.3 | 1.0** | -11.53** | 15.8 | | 1. | .37 | .4 |
| body weight 1st sh. | 1589.1 | 27.8** | 66.10** | 142.2 | | | 1. | .4 |
| body weight 2nd sh. | 2782.7 | 10.7** | -37.28 | 223.1 | | | | 1 |

age effect - regression of the trait on the age at first shearin
Sex effect - trait in male - trait in female

With the help of the sire variance component the additive genetic variance and with the sire, dam and residual components the phenotypic variance was estimated. The results are given in Tab.3.

Tab. 3: Genetic parameters of the traits of the first two shearings
(994 animals, 75 df sire, 248 df dam, 626 df residual)

| | $\sigma_P$ (g) | $h^2$ | $r_P$ 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| wool yield 1st shearing | 8.0 | 0.65 | 1. | .50 | .72 | .47 |
| wool yield 2nd shearing | 19.1 | 0.44 | | 1. | .55 | .56 |
| body weight 3rd shear. | 218.9 | 0.93 | | | 1. | .69 |
| body weight 2nd shear. | 301.1 | 0.64 | | | | 1. |

The genetic corrrelations among the four traits were all very high and were near unity.
Since in the females the 3rd shearing is already affected by the

reproduction only male records of the 3rd shearing were analysed.

Tab. 4: Analysis of the first three shearings (203 animals, 60 df sires, 56 df dams and 46 df residuals).

| | $\bar{x}$ (g) | $\sigma_a$ (g) | $\sigma_P$ (g) | $h^2$ | $r_P$ 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|
| wool yield 1st.sh. | 35.7 | 3.7 | 7.4 | 0.90 | 1. | .42 | .33 | .59 | .43 | .3 |
| wool yield 2nd.sh. | 114.9 | 16.4 | 15.6 | 0.15 | | 1. | .26 | .49 | .51 | .3 |
| wool yield 3rd.sh. | 141.0 | 15.0 | 18.3 | 0.33 | | | 1. | .24 | .29 | .4 |
| body weight 1st. | 1726.1 | 143.3 | 199.2 | 1. | | | | 1. | .66 | .6 |
| body weight 2nd. | 2858.0 | 196.6 | 248.1 | 0.73 | | | | | 1. | .7 |
| body weight 3rd. | 3264.7 | 248.5 | 280.3 | 0.10 | | | | | | 1 |

The genetic correlations between the traits of the first two shearings were all rather high, the genetic correlation between wool yields at 2nd shearing and at 3rd shearing was also very high with an estimate of 0.9.

## Discussion

For a genetic analysis one needs always a fairly large data set. The numbers of degrees of freedom which could be utilized in this study were reasonable for the first and second shearing but rather small for the traits of the third shearing. In spite of this some conclusions can be drawn.

The genetic variability and the heritabilities are sufficiently high in order to carry out breeding work with prospect of success. However, the heritabilities are not so high that we could rely only on the performance of the candidate. Taking into account the information of the relatives (full and half sibs) the efficiency of the selection and thus the genetic gain can be considerably increased.

The genetic correlation between the amount of wool at second and third shearing points to a high genetic relationship, though the correlation was not estimated with a very high precision. At least the result does not indicate that selection at a very young age is inefficient. This critical correlation will be estimated on a much larger data set in the near future.

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# Paramètres génétiques et démographiques du rendement poilier chez le lapin Angora.

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# Populationsgenetische Parameter der Wolleistung bei Angorakaninchen

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Summary

Several traits are of importance for efficiently producing wool in Angora rabbits. The most important traits are wool yield, wool quality and feed efficiency. For faster genetic improvement of these traits they should be known early in the life of the animal since otherwise the generation interval becomes long thus decreasing genetic gain per unit of time. However, the yield at a young age might be a different trait than the yield at the mature age. It was the objective of this study to estimate the genetic parameters in order to optimize a breeding scheme. From the results of the analysis it can be concluded that the heritability of wool yield is sufficiently high and that there are no indications that wool yield in third shearing is a different trait than wool yield in second shearing, thereby indicating that selection can be carried out quite early in the life of the animal.