EFFECT OF NON GENETIC FACTORS ON QUANTITATIVE AND QUALITATIVE FEATURES ABOUT ANGORA WOOL PRODUCTION IN FRENCH FARMS

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1 - INTRODUCTION

The general purpose is to set up a new breeding program for angora french lines. In order to evaluate its efficiency it is necessary to know the non genetic factors in relation with economic features of the coat. Till now, only quantitative traits are checked in the present French organization.

Variation factors, such as the seasonal effect, sex, the harvest rank, have already been studied on quantitative traits and we know, thanks to serious studies about coat physiology (Rougeot & Thébault 1983, Rougeot et al. 1984, Rochambeau et al. 1991) the possible variation on qualitatives traits. Some factors such as time interval between two successive harvests, the breeder, the body weight have been studied on the German line (Jadrisevic et al. 1982, Jelinek et al. 1981, Magofke et al. 1982). About the French line, we have only one study (Rochambeau & Thébault 1990) about non genetic factors on experimental station, and we know the big influence of qualitative traits such as homogeneity and structure on the sale prices. On top of that, the knowledge about the effect of environmental factors on qualitative traits is reported only from experimental rabbits.

The purpose of this study is to evaluate, from performances recorded in 4 French herds during 3 successive years, new factors such as time interval between two consecutive harvests, the year and the breeder. At the same time, we also thought to check if the observed variation in the experimental station is similar on farms.

2 - MATERIAL AND METHODS

2.1 - Harvests files

Harvests information is collected from rabbits bred on 4 different farms, members of the Syndicat National Angora Qualité, situated in 4 different areas.

The form is filled in for each animal and one harvest is summarized on one line of the form :
- area and farm identification
- animal identification
- birth date
- qualitative evaluation (grade)
- sex
- sire and dam identification

- harvest rank
- harvest date
- weight of different kind of wool following the French
    screening method for the quality :
    * 1A : clean, non felted, jarreux or bristly, down length
        over 5 cm
    * 1B : clean, non felted, woolly, down length over 5 cm
    * 2C : down length under 5 cm
    * felted clean
    * soiled
- bristle and down length in a lock picked up at hip level
- estimation of tightness with a grade in a range of 1 to 5
- reproductive condition
- date and reason of culling

6595 Harvest information papers have been analysed from 1100 different rabbits (878 male and 5717 female).

Fig.1

Number of data		
Breeders	Animals	Harvests
1	333	1954
2	126	694
3	103	534
4	538	3413
	1100	6595

After a preliminary step to check the likelihood of information when compared to limits given by litterature, some new figures have been computed from collected observations, such as time interval between date of birth and first and second harvesting date and time interval between two successive harvests. We introduced some objective quality criteria such as the structure which is defined by the ratio of down length on bristle length, homogeneity by the ratio of the weight of 1A classified wool on total coat weight, or total yield.

2.2 – Methods

2.2.1 – Evolution of total coat weight, according to the time interval between two successive harvests.

For the 1st and 2nd harvests, we compute the relation between the total weight and the rabbit age at harvest. For harvests ranked over 2, the time interval between two following harvests is considered.
So two new variables are computed called :
1 – Pds-mod = total weight + a* (Acst – Agerec) for 1st and
        2nd harvest
2 – Pds-mod = total weight + a* (Icst – intero) for harvest of
        rank 3 or more
    a   : regression coefficient
    Asct   : age of reference harvest (56 days for
        harvest 1, 154 days for harvest 2)
    Agerec   : age of the rabbit when harvested

Icst   : constant reference time interval (98 days)
Intero   : time interval between two following harvests.

2.2.2 - Seasonal effect

In order to analyse the seasonal effect of harvest and of birth,
4 levels are fixed :
- winter   : 15th January to 14th April
- spring   : 15th April   to 14th July
- Summer   : 15th July   to 14th October
- Autumn   : 15th October to 14th January

2.2.3 - Statistical analysis

Variance analysis have been computed for males and females only
on harvests one and two, then only harvests of females are
analysed. Harvests of rank 5 or over are pooled following items
are studied :
- total coat weight, corrected for time interval between
  harvests
- weight of wool sorted 1A, corrected for the same effect
- structure and homogeneity of coat.
Variance analysis have been computed with SAS software and GLM
process. Comparison between means are tested thanks to the
Duncan test.

Analysis models

The influence of different factors on the features was computed
through fixed effects variance analysis.
a) for harvest 1 and 2 :
$$Y_{ijklm} = \mu + S_i + HS_j + HY_k + B_l + I_{ijkl} + e_{ijklm}$$
where Y_{ijklm} is the studied feature for the mth harvest, μ the
general mean, S_i effect of the rabbit sex (i = 1, 2), HS_j effect
of harvest season (j = 1, 2, 3, 4), HY_k effect of the harvest
year (k = 1, 2, 3), B_l effect of breeder (l = 1, 2, 3, 4,), I
interaction of second order, e : residual.
b) for harvest 3 and 4 :
$$Y_{jklm} = \mu + HS_j + HY_k + B_l + I_{jkl} + e_{jklm}$$
c) for harvest 5 or more :
$$Y_{jklno} = \mu + HS_j + HY_k + B_l + BS_n + I_{jkln} + e_{jklno}$$
where BS is effect of season of birth (n = 1, 2, 3, 4).

2.2.4 - Repeatability between following harvests

Repeatability between harvests of rank 3 and 4, 4 and 5, 3 and 5
or more have been computed. Performance analysed is the total
coat weight corrected for time interval between harvests and
seasonal harvest effect. This last correction is done by
multiplication in order to keep the proportion after correction
between corrected weight and measured weight.

So corrected weight : (PD mod/PD season) * Pds
    PD mod   : is measured weight corrected for the time
                 interval between harvests
    PD season : is the mean weight of wool during the
                 considered season
    Pds   : is the mean weight of wool for one considered
                 rank of harvest

Repeatabilities are estimated from the ratio between Animal effect on Total variance. The repeatability can be considered as the correlation between following harvests.

2.2.5 - Study of relation between coat weight and total body weight of the rabbit

This evolution studied for harvest in a rank over 3 give us the optimum body weight for the angora rabbit. Over this optimum, the increase of wool weight is not the result of an increase of the body weight. This relation has been set up when sorting the body weight into classes from 3300 g to 4850 g every 50 g.

3 - RESULTS AND DISCUSSION

3.1 - Relation between harvests time interval and coat weight

Figure 2 shows regression coefficients of coat weight on harvesting age for the first and second harvest, on the time interval between following harvests, for the rank over 3.

Fig.2	Wool growth rate (g per day)	N.B.
Harvest 1	0,39	Regression on age
Harvest 2	0,00	Regression on age
Harvest 3 (females)	2,24 if time interval within 108 days 0,00 afterwards	Regression on time interval (2-3)
Harvest 4 (females)	0,74 if time interval within 105 days 0,00 afterwards	Regression on time interval (3-4)
Harvest 5 and more (females)	0,32 if time interval within 105 days 0,00 afterwards	Regression on time interval (4-5...)

For the first harvest, the increase of wool weight is of 0,4 g per day. This result confirms the result obtained by Magofke et al. (1982a) on the German line.
For harvest 2 we did not find any relation between the wool weight and the age. From a physiological point of view, we know that the beginning of the 2nd coat starts regardless of the time of the 1st harvest. Bearing in mind the variation of observed age when the 1st harvest is in a period of 56 to 90 days, the second coat has begun to grow before that time.
The 3rd coat starts strictly with the 2nd harvest, the former process is no longer working. Thus, the quantity of harvested wool has no relation with the rabbit age in the considered age range (21 to 25 weeks). Then, for harvest ranking 3 or more,

positive correlations with time interval of following harvests when it remains within 104 or 105 days. Afterwards no correlation is observed. So, it is not necessary to wait longer than 105 days before harvesting, since these decreases the number of harvests per year.
Means observed during year 1988 - 1989 - 1990 show no significative difference for harvests of ranks 2, 4 and 5. So during these three years no progress is registered. However we have seen very high yields (285 g per harvest). Rochambeau *et al.* (1991) on a similar sample in experimental station has shown a progress during the same period. The 4 chosen breeders are among the best as far as management is concerned.

3.2 - Influence of breeder and harvesting year on quantitative and qualitative features : total weight, 1A weight, homogeneity, structure (Fig.3)

Fig.3

	Total Yield					1AWeight		Homogeneity		Structure	
	R1	R2	R3	R4	R5 +	R3	R4 +	R 3	R4 +	R3	R4 +
Number	506	922	710	741	2 411	658	2 774	722	2 977	710	2 801
Mean	48	152	232	264	285	167	199	0,716	0,709	0,693	0,695
Breeder 1	+ 2a	+ 18a	+ 1b	- 6c	- 10c	+ 14a	+ 20a	- 0,06a	+ 0,09a	- 0,01b	- 0,03b
2	- 2b	- 5b	- 24c	- 34d	- 67d	- 50c	- 70d	- 0,16d	- 0,12d	- 0,07c	- 0,09c
3	- 2b	+ 16a	+ 25a	+ 20a	- 1b	+ 24a	+ 14b	- 0,03b	+ 0,03b	- 0,04a	- 0,05a
4		- 18c	0b	+ 9b	+ 16a	- 3b	- 1c	- 0,00c	- 0,04c	+ 0,09d	+ 0,04d
Test F	6	23	20	10	36	36	26	59	23	92	79
Crit.Prob.	0,0003	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,001	0,0001
Year 88	0		- 14			- 9		0,01 a			
89	- 2	NS	+ 8	NS	NS		NS	- 0,003ab	NS	NS	- 0,02b
90	+ 4		+ 7			+ 5		- 0,005b			+ 0,91a
Test F	5	-	5	-	-	4	-	4	-	-	22
Crit.Prob.	0,007	-	0,005	-	-	0,02	-	0,02	-	-	0,0001
Interaction	9 ++	NS	14 ++	8 ++	10,5 ++	4 ++	7 ++	10 ++	NS	3 ++	NS

R1 - R2... R5 + : Harvest rank 1 - 2... 5 +   a, b, c, d, : Statistical signification with 5 % probability

The breeder factor is highly significant for every harvest. A production gap of 70 g can be seen between them. There is still a 20 per cent productivity margin to be valorised by management equipement, feeding and breeding methods.
The 1A weight in comparison with the total weight is not strictly similar. So, a breeding strategy focussed on quality or on total wool yield will not be the same. Meanwhile, the breeders ranking on homogeneity or on 1A weight is similar.
As far as structure is concerned (the optimum value for this feature is 0,65) the breeder with an optimum structure has the same mean production and a pretty good 1A weight in the whole sample.

Similar remarks can be applied for 1A weight and homogeneity. We observe a slight decrease of structure during year 1990. This degradation is in connection with the down height.

3.3 - *Confirmation of sex effect, harvesting season, birth season, on several qualitative and quantitative features (Fig.4)*

Fig.4

	Total Yield					1A Weight		Homogeneity		Structure	
	R1	R2	R3	R4	R5 +	R3	R4 +	R3	R4 +	R3	R4 +
Number	506	922	710	741	2 411	658	2 744	722	2 971	710	2 801
Mean	48	152	232	264	285	167	199	0,716	0,709	0,693	0,695
Male	NS	- 23b									
Female	NS	+ 4a									
Test F		84									
Crit.Prob.		0,0001									
Harvest Wi	+ 4a	+ 25a	+ 15a	+ 5a	+ 8a	+ 9a	+ 7a	+ 0,00b	+ 0,01a		- 0,01 a
Season Sp	- 1c	+ 14b	+ 1b	+ 7a	+ 9a	+ 13a	+ 6a	+ 0,05a	- 0,00b	NS	- 0,01 a
Sm	- 7d	- 20c	- 24c	- 27b	- 15c	- 18c	- 13c	- 0,01b	- 0,01c		+ 0,01 b
Au	+ 1b	+ 22a	- 2b	+ 1a	- 1b	- 6b	- 1b	- 0,02b	- 0,01c		+ 0,01 b
Test F	21	48	17	10	12	9	27	4	5		3
Crit.Prob.	0,0001	0,0001	0,0001	0,0001	0,0001	0,002	0,0001	0,01	0,003		0,02
Birth Wi					+ 6a	+ 3ab					+ 0,01 b
Season Sp					+ 4bc	- 10c					- 0,00 b
Sm					- 9c	- 2b		NS			- 0,04 a
Au					- 2b	+ 6a					+ 0,00 b

R1 - R2... R5 + : Harvest rank 1 - 2... 5 +   a, b, c, d, : Statistical signification with 5 % probability

We did not see any difference between males and females on harvest 1. The well known sex difference appears as soon as harvest 2.

We confirm a favourable effect of winter period versus summer for the coat weight for every harvest. However, the gap is less important when the rank of harvest steps up (in a range of 30 % for harvest n° 2 to 8 % for harvest 5 and over). There is also a favourable effect of winter and spring season on 1A weight versus summer and autumn.

For qualitative features, homogeneity follows weight features, while structure is improved in summer and autumn versus winter and spring. J. Rougeot & R-G. Thébault (1983) pointed out that summer is a shortening period for downs. In that sample the mean height of down is specially high (70 %).

We do not confirm the observation done by Rochambeau & al. (1991) according to an improvement of the wool quantity harvested on rabbits born in autumn. There is still a slight favourable effect on 1A weight for rabbits born in autumn and winter versus spring and summer.

3.4 – *Relation between total wool weight harvested and the body weight (Fig.5)*

The coat weight increases with the body weight up to 4000 g. Then a plateau is reached at a level of 260 g per harvest. This result confirms an optimum for the body weight introduced by Rochambeau *et al.* 1991 for the French line reared in experimental station.

Fig.5

wool weight (g) vs body weight (g)
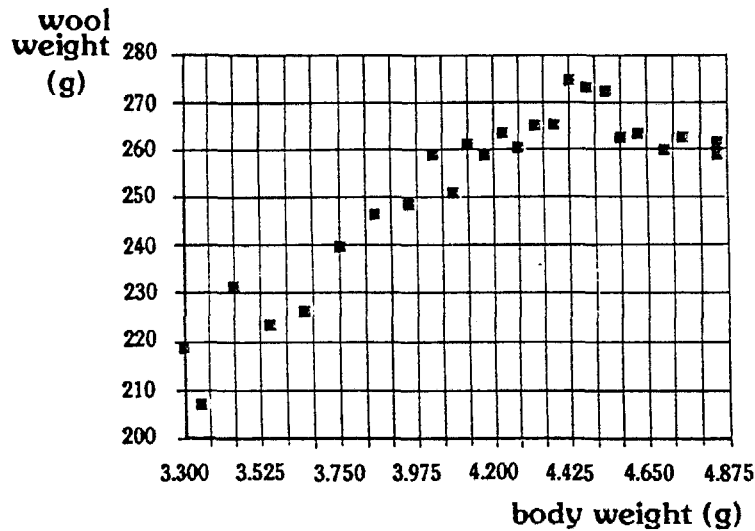
3.5 – *Repeatability (Fig.6)*

Fig.6

Harvest rank estimated Harvest rank observed	4	5	5 and +
3	0,37	0,17	
4		0,56	
5			0,62

4 – *CONCLUSION*

Production performances registered on 4 French farms are higher than the former publication on French line. This good result (700 g during the 1st year - 1140 g annual mean) is in relation with the chosen sample on the one hand, and the fact that international angora wool market is deeply depressed since *1988* on the other. The rabbit breeders culled a lot of animals and obviously kept the best ones. We confirm, on the farm, the main results collected in research station for the non genetic

factors modifying the quantitative and qualitative features of angora production.
Effect of sex is in favour of the females.
Effect of harvest rank is confirmed. The yield increases up to rank 5, then remains at the same level.
Effect of harvest season is very important and the gap between the best (winter) and the worst (summer) season is similar in farm and in station (10 to 12 per cent).
Effect of birth season is roughly confirmed. The worst birth season is summer and autumn, and winter the best season to breed the angora rabbits. On the farm the difference is significant.
Effect of harvesting time interval is analysed here for the first time. Results draw up an optimum for harvesting time interval from 100 to 105 days. This is a confirmation of traditionnal advice given in France to pluck adult rabbits every 14 weeks.
Effect of the breeder is important too, even in a group of the best rabbit managers for angora wool production. So the progress of the productivity margin is still to be considered.

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