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PRODUCTION DATA AND DEMOGRAPHIC PARAMETERS OF A FRENCH ANGORA RABBIT STRAIN

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INTRODUCTION

Variation factors of Angora wool production are numerous. Between non genetic factors there are : sex, interval between harvests, number of harvest, month of harvest, physiological condition of the doe (pregnant or not) ... However there are only a few papers in the bibliography about these variation factors. We are studing 3 variation factors (number of harvest, month of harvest, physiological condition) of 2723 harvests made by 452 does of a French Angora rabbit strain. In another connection a survey of lifes of 79 does born in 1983 is used to calculate some demographic parameters.

MATERIAL

From 01.01.1983 to 15.09.1987, 452 does have made at least one wool harvest in the INRA experimental herd. Our sample countains 452 first harvests, 442 second harvests, 370 third harvests and 1459 harvest of higher rank. Till the 05.09.1985, the does were in the experimental herd of Jouy en Josas. The population was maintened in an enclosed environmentally controlled, building. The light-dark cycle war the natural one. It was possible to heat the building. Each doe had an individual concrete rabbit hutch with a straw litter, a self-feeder, an automatic watering system. Rabbits were fed with an experimental granulated feed. There was two hutch tiers. In 1985, a new experimental herd was built in the experimental center of le Magneraud. Three hutch tiers are set on a concrete covering. A light roof is set on the hutch. Two rows of hutch made a building. The light dark cycle is the natural one. There is no heating system. Ventilation is static : at the end of the rows there is a door. This building is a good

example of the building used in France to breed Angora rabbits. We used this experimental herd to study composition and structure of Angora rabbit fleece, feeding and housing of Angora rabbits, depilatory treatments and reduction of chilling and mortality after plucking. (Rougeot and Thebault, 1984 ; Rougeot, 1986). On account of experimental programs, mortality is higher than in a commercial herd. Some variation factors, like month of harvest, can be disturbed by experiments. For example melatonin implants are made always in august !...

Does are weaned at 4 weeks. At 8 weeks, they are plucked for the first time. At 21 weeks, they are plucked for the second time. Then there is a new plucking each 14 week, that is to say each 98 days.

Performance traits collected from does were weight at 8 weeks, 20 weeks and then 9 weeks before plucking. At this time, we have a good estimation of doe weight (CHARLET - LERY et al., 1985). We collected weight of the five qualities of wool : P.P1A which is weight of long, clean and bristly wool, P.P1B wich is weight of long, clean and woolly wool, P.P2 wich is weight of short and clean wool, P.PFP wich is weight of clean felted wool, and P.PS which is weight of dirty wool. P.PTOT is harvest total weight. We collected length of bristles and downs cut off on the back (LO.JD and LO.DD) exactly over the second lumbar vertebra. We took also these two lengths from a wisp cut off 3 cm before the hipbone (LO.JH, LO.DH). We took notice of the hardness (DURETE) by giving a mark between 1 and 5. We gave one to a hard coat and five to a soft coat. We defined the coat homogeneity by

HOM.2 = 1000 * P.P1A / P.PTOT

and the coat structure by

STR.D = 1000 * LO.DD / LO.JD

and STR.H = 1000 * LO.DH / LO.JH

Management and housing of the experimental population and performance traits were presented more exactly by Rougeot and Thebault (1984).

METHODS

Data were subjected to analysis of variances according to the following mathematical model

$$Y_{ijkl} = \mu + n_i + r_j + m_k + E_{ijkl}$$

Y_{ijkl} = observation on the i^{th} puckling made in the k^{th} month by a doe which is in the j^{th} physiological condition.

μ = overall mean

n_i = number of harvest. (4, ... 11, 12 and more).

We studied the first three harvests separately.

r_j = physiological condition (3 : a doe which had one litter between the former harvest and this harvest, 2 : a doe which had been mated but which had no litter, 1 : a doe which had not been mated)

m_k = month of harvest (1, 2, ..., 12)

E_{ijkl} = random error.

All of the above effects were assumed to be fixed. Residual correlation were obtained from the same analysis. Each factor was tested for significance by F-test. Two thresholds will be used : 5 % (significant, one star), 1 % (highly significant, two stars). We used classic demographic parameters (Vu Tien Khang, 1983). If S_x is number of alive does at the x harvest, the number of casted does [d(x, x+1)] between two harvests is $d(x, x+1) = S_x - S_{x+1}$.

Thus mortality rate (q_x) is

$$q_x = \frac{d(x, x+1)}{Sx}$$

If n'(x-1, x) is number of young does weaned between two harvests, the cumulated number is D'_x

$$D'_x = \sum_{k=1}^{x} n'(x-1,x)$$

We calculate these parameters for the 79 does born in 1983. The root of the table will be 100.

RESULTS ON WOOL PRODUCTION

Means, standart deviations and coefficients of variation are provided in table 1. Fourth harvest is the first adult harvest. P.P1A is 70 % of P.PTOT, P.P1B is a bit less than 20 % and P.P2 is around 5 %. Weight of third harvest is smaller but repartition between qualities is similar.

In first harvest, we have 92 % of P.P2. For second harvest, P.P1A and P.P1B are equal to 35 % and 40 % of P.PTOT. However long, clean and bristly wool collecting at second plucking is not similar to wool collected later. Longest hairs of coat are on hipbone. The coat structure is around 600 as wanted by spinners. From table 1, it us clear that first three harvests and later harvests are four different populations.

Residual correlation between P.ANI and P.PTOT was around 0,72 for first harvest. Month of harvest had highly significant effect for P.ANI and P.PTOT for first harvest (table 2). For all others harvests, residual correlation between P.ANI and P.PTOT was around 0,3. Phenotypic correlation gave by Jelinek et al. (1980) was in the same range. However genetic correlation between doe weight and wool weight estimated by Garcia and Mogofke (1982) are higher (0,60 - 0,97 !). Weight of does used in Chile is smaller : mean is around 3500 g (Jelinek et al. 1980). Wool weights were low from july to september (-20 %) and high from november to april (+ 10 %). At second harvest month of harvest effect was significant for P.PTOT, but not for P.ANI. Wool weights were high from february to april (-10 %). Then increased slowly. On the contrary at third harvest, wool weights were low in september (- 15 %). They increased quickly till december, before going down slowly.

Later month harvest was significant for P.ANI (± 5%) (Charlet - Lery et al., 1984). For wool weights, effect was larger in former harvests. Summer fleeces are lighter (- 12 %) than winter fleeces. Seasonal variations were carefully studied by Rougeot and Thebault (1984) : hair follicle population was maximal in autumn and winter. A part of secondary follicles of downs disappeared in spring and even more in summer. Another weight components varied in the same way. Hairs were larger in winter than in summer (+ 4 mm for the awns ; table 4). As summer/winter differences in lengh were higher in awns than in bristles, coat structure was as also higher in winter (+ 5 %). Summer/winter differences studied by Rougeot and Thebault (1983) were higher than differences we observed a few year later on the same strain.

Number of harvest was significant for all variables except LO.JD, LO.JH and STR.H. P.ANI increased till 11th harvest. P.TOT increased till 7th harvest and decreased after. Awns lengths and coat structure were higher between 4th and 7th harvest than after. However it is not possible to conclude for we are studying a selected sample of does. Worse does were casted before best does. Data from bibliography are not clear : Magofke et al.

(1978) found an increasing wool production during the first three harvests. If Ricke Munoz (1984) found a lower wool production after 6 months of age, Ockiwicz and Tuckzynska (1981) showed that annual wool production was higher in the third year of life than in the second and in the first. Rougeot and Thebault (1984) said that old does produced less (180-230 g) than 4th harvest does (210-300 g).

Lactant does produced less wool (-36g - tables 3 and 4). Their fleece quality is very similar to non pregnant does.

Residual correlation between P.PTOT and DURETE is around -0,23. Residual correlations between the lenghts are between 0,24 and 0,60.

RESULTS ON REPRODUCTIVE LIFE

We studied the cohort of 79 does born in 1983. Some of these does are still alive. We studied only the firth three years of life. (table 5). Before fourth harvest 25 % of does are casted. Between 4th and 8th harvest, this percentage is still around 25 %, (27 % exactly) as between 8th and 12th harvest (28 % exactly). In a production herd mortality rate will be lower (Rougeot and Thebault, 1984). 64 % of does were mated at least one time. Mean age at first mating was 268 days. 80 % of first matings were done after 3rd harvest and before 5th. 49 % of does had at least one litter. Mean age at first litter was 356 days. 82 % of first litters were born after 3rd harvest and before 6th. 39 % of does have done are litter ; 39 % have done two ; 22 % more than 2. Mean number of litters is around 2, but one doe have done 6 litters. 80 % of litters were born before 8th litter. Harvest fertility rate (Number of does with one litter / Number of does mated between two harvests) was 0.52. Mating fertility rate (Number of litters/number of matings) was 0.25.

Mean litter size at birth was around five young rabbits : 4.90 born alive and 0.51 born dead. For suckling capacity of does is limited some young rabbits are killed at birth. Mean number of young rabbits kept with the doe is 3.18 (0.89 young buck and 2.29 yound does). Mean number of young rabbits at weaning is 2.38 (0.71 buck and 1.67 does). Mortality rate between birth and weaning is around 25 %. 18 % of litters had no rabbit alive at weaning. Mean number of young does weaned by one doe which had weaned at least one doe was 3.9. Generation length between doe and young doe in as around 600 days. In the bibliography litter sizes are in the same range. (Brockhausen et al., 1979 ; Garcia et al.,1984 ; Rougeot et Thebault, 1984).

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CONCLUSION

The three studied effects (number of harvest, reproduction, month of harvest) are significant on Angora rabbit does wool production. Our results are very close to those of Rougeot and Thebault (1983 and 1984). Demographic parameters of this strain are those of an experimental population. However they finish off those of the French Angora rabbit breed that we gave in another communication. (Rochambeau et al., 1988). However further work is needed about these topics.

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Table 1 - Mean standart deviation and coefficient of variation of weight of the doe (P.ANI), of weight of the different wool qualities (P.P1A, P.P1B, P2, P.PFP, P.P5), of total harv weight (P.TOT) the coat of homogeneity (HOM.2), of lengths of bristles and of downs c off on the back and on the hip (LO.JD, LO.DD, LO.JH, LO.DH) of the coat hardness (DUI of the coat structure (ST.R.D, ST.R.H.). Weights are in gramms, lengths are in millin N is the size of the sample. Rec 1 is 1st harvest. Rec 2 is 2nd harvest. Rec 3 is 3rc Rec 4 are others harvests.

		P.ANI	P.P1A	P.P1B	P.P2	P.PFP	P.PS	P.PTOT	HOM.2	N
Rec 1	Mean	1461			32	1.0	1.7	35		
	standard deviation	261			10	0.7	1.2	10		452
	coeff. of variation	0.18			0.31	0.70	0.71	0.29		
Rec 2	Mean	3075	52	60	22	9.2	6.8	149	348	
	standard deviation	307	44	41	14	13.1	5.3	34	279	442
	coeff. of variation	0.09	0.85	0.68	0.64	1.42	0.78	0.23	0.80	
Rec 2	Mean	3460	137	37	14	5.3	7.0	200	679	
	standard deviation	343	35	18	10	8.4	5.6	35	116	370
	coeff. of variation	0.09	0.26	0.49	0.71	1.58	0.80	0.18	0.17	
Rec 4	Mean	4063	171	43	15	3.3	9.7	242	703	
	standard deviation	420	37	17	8	4.4	7.0	41	89	1459
	coeff. of variation	0.10	0.23	0.40	0.53	1.33	0.72	0.17	0.13	
		LO.JD	LO.DD	LO.JH	LO.DH	DURETE	STR.D	STR.H		N
Rec 4	Mean	101.2	60.8	102.9	63.5	2.9	602	619		
	standard deviation	8.0	6.9	9.1	5.8	0.7	65	56		736
	coeff. of variation	0.08	0.11	0.09	0.09	0.23	0.11	0.09		

Table 2 - Variance analysis of doe weight (P.ANI), of total harvest weight with one or two f effects. The weights are in gramms. R2 is the part of the total variance explained the model (* : significant at a 5 % level ; ** : highly significant at a 1 % level N is the size of the sample.

		First harvest			Second harvest			Third harvest		
		N	P.ANI	P.PTOT	N	P.ANI	P.PTOT	N	P.ANI	P.PTOT
Mean		452	1461	35	437	3072	149	371	3461	200
Month of harvest	1	20	64	2	21	117	3	43	137	20
	2	23	109	2	33	-104	21	12	109	-20
	3	25	-1	3	58	- 19	29	13	-153	4
	4	61	50	5	20	6	31	16	-100	- 6
	5	69	-58	-1	22	88	11	32	-280	7
	6	66	-92	-3	24	51	-24	47	-225	-19
	7	51	-78	-6	58	- 4	-12	21	-132	-15
	8	9	-83	-7	67	-26	-19	20	-169	-16
	9	11	-84	-9	68	12	-14	26	121	-31
	10	22	152	-4	47	44	2	51	120	3
	11	34	52	3	8	-193	4	55	87	20
	12	61	63	4	11	-49	9	35	229	78
F test; Effect			3.7**	8.2**		0.5NS	16.2**		9.7**	9.3**
Reproduction	Nothing							320	-21	1
	Mating							32	+115	4
	Litter							19	+151	-20
	F test Effect								4.7**	4.0**
R2			0.08	0.17		0.03	0.30		0.23	0.25
Residual standart deviation			250	9		305	29		306	32

Table 3 - Variance analysis of doe weight (P.ANI), of weights of the various wool qualities (P.P1A, P.P1B, P.P2), of total harvest weight (P.PTOT) and of the coat homogeneity (HOM.2) with 3 fixed effects. Weights are in grammes. R2 is the part of variance explained by the model (* : significant at a 5 % level; ** : significant at a 1 % level) N is the size of the sample.

		N	P.ANI	P.P1A	P.P1B	P.P2	P.PTOT	HOM.2
	Mean	1460	4063	171	43	14.8	242	703
Number of harvest	4	316	-237	-8	-3	-0.7	-12	3
	5	259	- 39	5	1	-1.2	4	8
	6	206	8	7	-1	-0.5	5	16
	7	172	102	8	2	-0.9	11	0
	8	148	104	1	2	1.3	4	-8
	9	112	120	-1	0	1.8	2	-8
	10	81	152	-4	2	1.7	0	-16
	11	60	184	-6	1	3.2	- 3	-13
	12+	106	129	-8	0	0.8	- 7	-19
F test; Effect			25**	5.5**	2.2**	4.6**	7.1**	2.8**
Repro	Nothing	1127	- 39	0	1	-0.3	0	- 2
	Mating	148	31	20	-1	-2.0	18	25
	Litter	185	170	-15	-4	3.6	-18	- 9
F test; Effect			22**	37**	5.3**	24**	36**	7.8**
Month of harvest	1	140	67	18	-2	0.4	17	26
	2	118	-92	6	-5	-1.1	- 1	27
	3	99	57	4	-4	-1.5	- 2	22
	4	163	-90	0	-1	-1.1	- 2	6
	5	112	-195	-10	-2	-3.6	-12	- 5
	6	93	-92	- 4	0	-3.2	- 6	3
	7	131	-82	-23	9	2.1	-13	-62
	8	132	- 5	- 4	7	1.6	- 8	-39
	9	137	58	- 3	-2	0	- 7	6
	10	122	133	- 7	0	2.4	- 5	-13
	11	114	86	12	-1	1.6	12	13
	12	99	183	14	-3	1.2	9	30
F test; Effect			9.8**	12**	7.9**	6.9**	7.8**	13**
R2			0.21	0.15	0.08	0.10	0.12	
Residual standart deviation			377	36	17	8	38	

Table 4 - Variance analysis of lengths of bristles and of downs cut off the back and on the hip (LO.JD, LO.DD, LO.JH, LO.DH) of the coat hardness (DURETE), and of the coat structure (STR.D, STR.H). Lengths are in millimeters. N is the size of the sample. R2 is the part of variance explained by the model (* : significant at a 5 % level ; ** : significant at a 1 % level).

		N	LO.JD	LO.DD	LO.JH	LO.DH	DURETE	STR.D	STR.H
	Mean	736	101	61	103	64	2.9	602	619
Number of harvest	4	116	0	1	1	1	0.3	14	9
	5	113	0	1	-1	0	-0.0	9	5
	6	72	2	2	0	1	-0.0	12	9
	7	88	0	0	0	0	-0.1	1	-1
	8	76	-1	-1	-2	-1	-0.0	-7	1
	9	74	0	-1	-1	-1	-0.3	-12	-11
	10	60	1	-1	1	0	0.0	-17	-12
	11	41	0	-2	-1	-2	-0.1	-17	-12
	12+	96	0	-1	0	-1	-0.1	- 4	- 1
F test; Effect			0.7NS	2.9**	1.0NS	2.2*	5.0**	2.7**	1.6NS
Repro.	Nothing	575	0	0	0	0	0.1	1	3
	Mating	70	0	0	0	0	0	0	- 2
	Litter	91	1	0	2	0	-0.1	- 7	-17
F test; Effect			2.0NS	0.1NS	2.5NS	0.2NS	0.6NS	0.6NS	4.6*
Month of harvest	1	72	1	1	2	2	0.2	4	7
	2	54	2	4	4	3	0.1	25	7
	3	15	1	4	3	3	0.2	28	11
	4	65	- 3	- 1	-1	0	0.1	8	9
	5	62	- 1	1	3	1	0	12	- 4
	6	53	0	- 1	0	-1	0	-13	- 7
	7	103	- 2	- 3	-5	-3	0.1	-18	- 3
	8	82	2	- 1	0	-2	0	-18	-16
	9	70	3	- 1	0	-1	-0.3	-23	-11
	10	78	- 1	0	-1	0	-0.1	7	3
	11	73	0	2	0	1	0	21	13
	12	9	1	3	0	2	-0.3	20	21
F test; Effect			3.9**	5.7**	4.9**	7.8**	2.9**	4.6**	1.8NS
R2			0.07	0.11	0.09	0.13	0.09	0.10	0.06
Residual standart deviation			8	7	9	6	0.7	62	56

Table 5 - Demographic parameters of a cohort of 70 does bred in 1983.
As usual the root of the table is 100.

Number of harvest	1	2	3	4	5	6	7	8	9	10	11	12	13+ / Total
Age (days)	56	147	245	343	441	539	637	735	833	931	1029	1127	
Number of alive does	100	100	89	84	75	71	61	55	48	38	35	30	
Number of casted does	0	11	5	9	4	10	6	7	10	3	5	10	
Mortality rate	0.0	0.11	0.06	0.11	0.05	0.14	0.10	0.12	0.21	0.07	0.14	0.33	
Number of first mating	0	0	29	22	9	3	1	0	0	0	0	0	0 / 64
Number of first litter	0	0	6	19	15	5	0	4	0	0	0	0	0 / 49
Number of matings	0	0	29	39	38	14	24	15	8	11	4	6	9 / 197
Number of litters	0	0	6	14	25	8	14	9	4	6	4	4	9 / 103
Number of young does alive at weaning	0	0	10	38	39	9	20	10	3	13	3	8	20/ 173
Cumulated number of young does	0	0	10	48	87	96	116	126	129	142	145	153	173/ 173

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We are studying the variation factors of 2723 hair crops made by 452 does of a French Angora rabbit strain. We collect the weight of the doe 9 weeks before the hair crop (P. ANI), the weight of the various qualities of wool (P. P1A, P.P1B, P.P2), the weight of the clean felted wool (P.PFP), the weight of the dirty wool (P.PS), the hair crop total weight (P.PTOT), the length of the bristles and the downs cut off on the back (LO.JD and LO.DD). We take notice of the hardness (DURETE) by giving a mark between 1 and 5. We take notice of the coat homogeneity with HOM.2 = 1000 * P.P1A/P.PTOT and the coat structure with STR.D = 1000 * LO.DD/LO.JD. Monthly variations are greater for the 1st, 2nd and 3rd hair crops than for the others. Winter hair crops are not the same that summer hair crops :the wool production, the awn length, the coat homogeneity and the coat structure are differents. The weight of the does grows up as far as the 10th or the 11th hair crops, but the total wool production goes down af the 5th or the 6th hair crops. We use a survey of the lifes of 79 does born in 1983 to calculate some demographic parameters. The probability for a doe to be cast off is 0,25 the 1st year, 0,33 the 2nd year and 0,58 the 3rd year. 2/3 of the does are mated at least one time ; one half of the does have at least one litter. The mean age at the 1st mating is around 356 days. The reproducing does have about 2 litters. The mean number of rabbits at weaning is around 2,9.

PRODUCTION DE POILS ET PARAMETRES DEMOGRAPHIQUES DANS UNE SOUCHE DE LAPIN ANGORA FRANCAIS

Nous étudions les facteurs de variation de 2723 récoltes de poil effectuées par 452 femelles d'une souche d'Angora Français. Nous enregistrons le poids de l'animal (P.ANI) 9 semaines avant la récolte, le poids des diverses qualités de poil (P.P1A, P.P1B, P.P2), le poids du poil feutré propre (P.PFP), le poids du poil sale (P.PS), le poids total du poil récolté (P.PTOT), la longueur des jarres et des duvets d'une mèche prélevée sur le dos (LO.JD et LO.DD). Nous caractérisons la dureté (DURETE) par une note allant de 1 à 5. Nous évaluons l'homogénéité par la quantité HOM.2 = 1000 * P.P1A/P.PTOT et la structure par la quantité STR.D = 1000* LO.DD/LO/JD. L'effet du mois de récolte est surtout marqué pour les récoltes 1, 2 et 3. Les récoltes d'hiver s'opposent aux récoltes d'été, tant par les quantités collectées que par la longueur des duvets, l'homogénéité ou la structure des toisons. Si le poids des femelles augmente jusqu'à la 10ème ou 11ème récolte, les quantités de poil récolté et la qualité de la toison diminuent dès la 5ème ou 6ème récolte. Les carrières de 79 femelles nées en 1983 ont servi à calculer les paramètres démographiques. Au cours des 3 premières années de vie d'une femelles, la probabilité qu'elle soit réformée est respectivement de 0,25 - 0,33 - 0,58.2/3 des femelles sont saillies au moins une fois ; la moitié a effectué au moins une mise bas. L'âge moyen à la première mise bas est de 356 jours. Les femelles qui reproduisent font en moyenne 2 portées. La taille moyenne d'une portée au sevrage est d'un peu plus 2,9.