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## **PROCEEDINGS**

### **Genetics – Short papers**

#### **GENETIC VARIABILITY OF THE RESISTANCE FOR THREE TYPES OF ENTEROPATHY IN THE GROWING RABBIT.**

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## GENETIC VARIABILITY OF THE RESISTANCE FOR THREE TYPES OF ENTEROPATHY IN THE GROWING RABBIT.

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### ABSTRACT

This paper described the genetic variability for the resistance to 3 digestive stresses in the growing rabbit: after inoculation of coccidia (trial “coccidia”), with a low dietary fibre level (trial “fibre”), and after experimental reproduction of rabbit epizootic enterocolitis (trial “ERE”). Genetic variability was analysed from a sample of 48 sires, which produced the experimental young rabbits. These animals were weighed and examined on D0, D4, D11, D18, D25 and D32 after weaning (at 30d old). Three clinical patterns were checked: abdominal swelling, diarrhoea and mucus. For each trial, young rabbits without one clinical pattern were used as controls. The threshold daily gain was equal to the control rabbits average daily gain minus two standard deviations. One daily gain was considered to be abnormal when it was below the threshold. Mortality, clinical patterns and growth rate were used to assess individual response to one challenge. Three binary indexes were defined to describe young rabbit individual answer to one challenge. The first one (“Alive”) dealt with mortality. The second (“Resilient”) and the third (“Tolerant”) dealt with mortality and morbidity. Mortality and morbidity indexes were low for “coccidia” trial (61% of alive, 40% of resilient and 20% of tolerant), higher for “fibre” trial (75, 64 and 31%) and medium for “ERE” trial (66, 57 and 33%). Sire effect was significant for each index in the “coccidia” and the “fibre” trials. Sire effect was significant only for the “tolerant” index in the “ERE” trial. Correlations between sire rankings for the 3 indexes of one trial were always highly significant. Correlations between sire rankings were statistically significant between, on the one hand, “resilient” and “tolerant” indexes from “coccidia” and “fibre” trails. They were also statistically significant, on the other hand, between “alive” and “resilient” indexes from the “fibre” trial and “resilient” and “tolerant” indexes from the “ERE” trial. Our results demonstrated that there was a genetic variability for the resistance to 3 different enteropathies.

**Key words:** genetic resistance, epizootic rabbit enterocolitis, coccidiosis, fibre.

## INTRODUCTION

Genetic resistance to diseases is a very active research topic, as reviewed by BISHOP *et al.* (2002). Examples exist in all major domestic species, as Marek's disease and coccidiosis for chickens, mastitis and ticks for cattle, nematodiasis and scrapie for sheep. Wherever a disease is studied with sufficient detail, differences between animals in genetic resistance is usually found. There are likely to be many more examples of genetic differences between host animals in disease resistance. Disease resistance is often cited as the next great challenge facing animal geneticists. It is in fact a current major challenge, with large research efforts world-wide. The outbreak of rabbit epizootic enterocolitis (ERE) in 1997 induced research work related to digestive stresses. This paper analysed the genetic variability for resistance to three digestive stresses : a coccidia experimental infection, an ERE experimental inoculation and a nutritional deficiency in dietary fibre. These results are both preliminary and innovative.

## MATERIAL AND METHODS

### Animals

A total of 48 bucks were chosen from 4 lines. From each buck, 30 young rabbits were bred. A doe was mated with a different buck at each mating. Three different digestive stresses were applied in three trials, each using 1440 growing rabbits submitted, one day after weaning, either to : a "coccidia" oral inoculation , with 5 000 oocysts of *Eimeria magna* (ECKERT *et al.*, 1995) the day after weaning; a fibre deficiency in the diet given ad libitum from weaning in order to cause a non specific enteropathy (BENNEGADI *et al.*, 2001; GIDENNE, 2003); an experimental oral administration, the day after weaning, with a 500 µl of an "ERE" inoculum. The ERE inoculum (TEC2) was obtained from intestinal content of a diseased rabbit (LICOIS and COUDERT, 2001). All young rabbits were bred at the INRA "Le Magneraud" experimental farm. Young rabbits from "coccidia" and "fibre" trials were raised after weaning at the same experimental farm, while those from the "ERE " trial were inoculated and raised at Sourches in Glon company experimental farm.

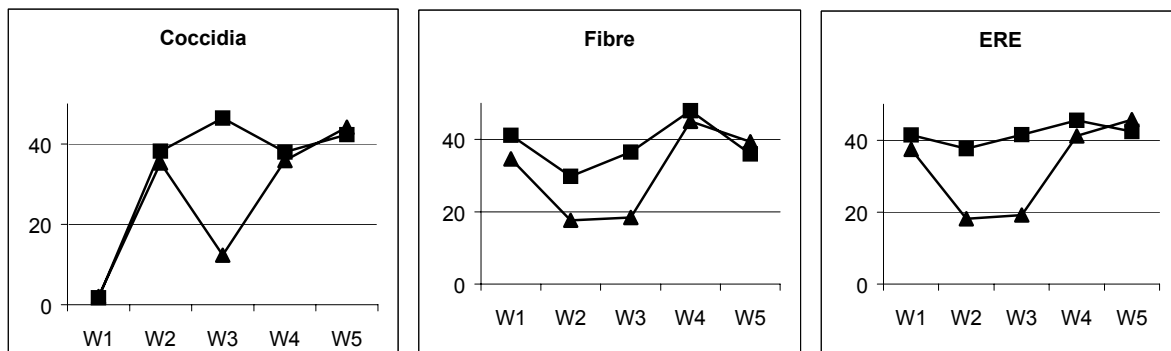
Animals were identified and weighed at birth. A doe suckled 9 or 10 young rabbits, which were bred by 9 or 10 different does, in order to avoid any maternal genetic effect. Animals were tattooed at 23 days and weaned at 30 days (D0). They were raised after weaning in 9 or 10 different cages. Animals were weighed and examined at D0, D4, D11, D18, D25 and D32. Three clinical patterns were checked: abdominal swelling, diarrhoea and mucus. Individual mortality and apparent cause were recorded daily. An autopsy was performed on dead rabbits. Mortality, clinical patterns and growth rate were used to assess individual response to one challenge at each moment (D4, D11, D18, D25 and D32). An average daily gain was worked out between each control (Weekly daily gain) and for the whole fattening period (Post-weaning daily gain). For each trial, young rabbits without one clinical pattern were used as controls for the average daily gain. The threshold was equal to the control rabbits average daily gain minus two

standard deviations. One average daily gain was considered to be abnormal when it was below the threshold, within a period.

Three binary indexes were defined to describe young rabbit individual answer to one challenge. The first one (“Alive”) dealt with mortality. It was equal to 0 if the young rabbit was alive at D32 and equal to 1 otherwise. The second (“Resilient”) and the third (“Tolerant”) dealt with mortality and morbidity. A “resilient” rabbit was an animal alive at D32, with a normal post-weaning daily gain. A “tolerant” rabbit is a “resilient” rabbit with no clinical pattern and no abnormal weekly daily gain. On the other hand, a “resilient” rabbit could get clinical patterns or abnormal weekly daily gains. Each breeding shed was divided in 3 sectors with the same number of cages. The first one was near the entrance door, the second one was in the middle and the third one was opposite.

## Methods

Alive, resilient and tolerant indexes were studied with the CATMOD procedure from the SAS (1999) software to test the sector and the sire effects. This procedure is a logistic regression in order to analyse binary traits. To be included in the analysis, a sire must have more than 19 offspring. Correlations between rankings for two indexes and/or two trials were estimated with a Spearman correlation coefficient (Procedure CORR from SAS).



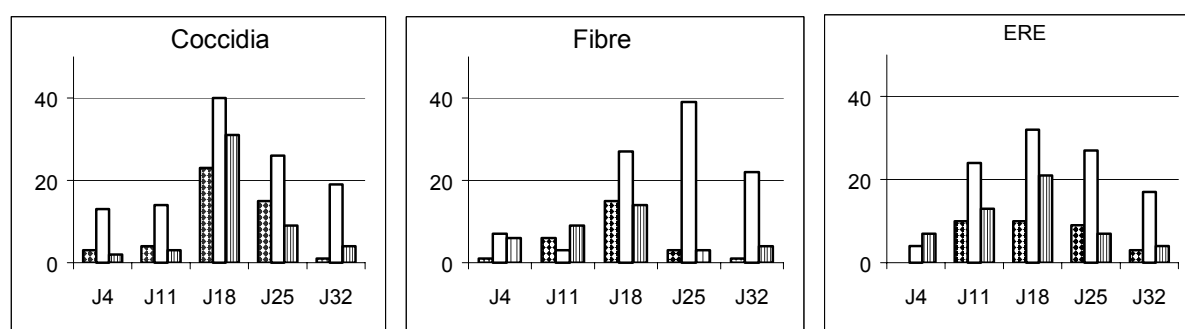
**Figure 1, 2 and 3 : Weekly daily gain for alive rabbits at D32 in the “coccidia”, “fibre” and “ERE” trials. The curve with squares represents rabbits without clinical patterns and the curve with triangles represents rabbits with clinical patterns**

## RESULTS AND DISCUSSION

### Trials description

Figure 1 to 3 present weekly daily gain of young rabbits with and without clinical pattern. Average daily gain was equal to 0 just after inoculation in the “coccidia” trial. There was no difference between the two groups except between D11 and D18. For “fibre” and “ERE” trials, control animals have a higher average daily gain between D4 and D18.

Figures 4 to 6 present variation in mortality, clinical patterns/ and in abnormal weekly daily gain. There were fewer deaths and abnormal weekly daily gains before D11 in the “coccidia” trial, whereas 20% of animals were found dead between D11 and D18. More than 30% of young rabbits had an abnormal weekly daily gain. More than 40% got at least one clinical pattern. These phenomena were less pronounced later. Similar observations were made for the “fibre” trial with lower percentages, with 40 % of the alive rabbits at D25 having at least one clinical pattern. Mortality rate reached 10% on D11, D18 and D24 for the “ERE” trial. Clinical patterns incidence fluctuated between 22 and 32%. There were less abnormal weekly daily gains (8-20%). Resilient and tolerant percentages were low the “coccidia” trial (Table 1), high for the “fibre” trail and intermediate for the “ERE” trial.



**Figure 4, 5 and 6 : Percentages of dead rabbits (Left bar chart with black diamonds), of rabbits with clinical pattern (Middle bar chart) and of rabbits with abnormal weekly daily gain (Right bar chart with vertical lines) for the “coccidia”, “fibre” and “ERE” trials.**

**Table 1. Number of alive, resilient and resistant in each trial**

Index	Trial «coccidia» : 1251 rabbits		«fibre » : 1468 rabbits		«ERE» : 1064 rabbits	
	Yes	No	Yes	No	Yes	No
Alive	758 (61%)	493 (39%)	1104 (75%)	364 (25%)	702 (66%)	362 (34%)
Resilient	495 (40%)	493+263=756 (60%)	946 (64%)	364+158=622 (36%)	603 (57%)	362+99=461 (43%)
Tolerant	244 (20%)	756+251=1007 (80%)	456 (31%)	622+490=1112 (69%)	350 (33%)	461+253=714 (67%)

### Sector and sire effects

Sector effect was often significant. Sire effect was significant for each index in the “coccidia” and the “fibre” trials. Sire effect was significant only for the “tolerant” index in the “ERE” trial.

Correlations between sire rankings for the 3 indexes of one trail were always highly significant. Correlations fluctuated between 0.50 and 0.85 and critical probabilities are always lower than 0.01. Table 2 presents correlations between rankings for the 20 sires, which had more than 19 offspring in each of the 3 trials. Correlations between sire rankings were statistically significant between, on the one hand, “resilient” and “tolerant” indexes from “coccidia” and “fibre” trails. They were also statistically significant, on the other hand, between “alive” and “resilient”

**Table 2 : Correlation between buck rankings for each trial and each index**

	alive2	resiliant2	tolerant2	alive2	resiliant3	tolerant3
alive1	0.10	0.32	0.31	0.01	0.06	0.05
resiliant1	0.19	0.52 *	0.48 *	0.15	0.09	0.11
tolerant1	0.40 \$	0.71 **	0.51 *	0.23	0.25	0.24
alive 2				0.35	0.49 *	0.62 **
resiliant2				0.40 \$	0.48 *	0.44 \$
tolerant2				0.14	-0.07	0.01

Above the diagonal for the 20 bucks with more than 19 offspring for the 3 trials. Under the diagonal : for all the bucks with more than 19 offspring in each trial. 1= «coccidia» trial; 2 = «fibre» trial, 3 = «ERE» trial. P< 0.01 : \*\*; P< 0.05: < 0.01; P< 0.10: < 0.01

## DISCUSSION

There were no real control group to estimate the threshold of an abnormal daily gain. Control individuals were young rabbits without any clinical pattern. However, they could be ill as shown by their weak weekly daily gain between D0 and D4 in the “coccidia” trial.

Fluctuations in mortality rate, in clinical patterns and in abnormal weekly daily gains for the “coccidia” were not expected (LICOIS *et al.* 1995). Mortality rate reached a peak at D18; a lot of abdominal swellings and abnormal weekly daily gain were observed at the same time. This syndrome of enteropathy seemed similar to an ERE episode, but was not really identified.

There was a sire effect on the 3 indexes for the “coccidia” and the “fibre” trials. Therefore, one could argue that there is a genetic variability for the resistance against enteropathies in rabbits. Sire effect was only statistically significant for the “tolerant” index in the “ERE” trial. A new experiment is underway to test if there is a genetic variability for the resistance against ERE. To our knowledge, such a resistance was not demonstrated often. BASELGA *et al.* (1988) proved a sire effect for the resistance against respiratory diseases. There was a link between sire rankings for “coccidia” and “fibre” trials on the one hand, and for “fibre” and “ERE” trials on the other hand. One could speculate about shared resistance mechanisms for the 3 stresses.

In conclusion, our study demonstrated a genetic variability for the resistance to 3 enteropathies in the growing rabbit.

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