RABBIT GENETICS AND BREEDING
Genetica y Mejora del Conejo

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The discussion will center on the critical analysis of findings in quantitative genetics applied to rabbit breeding, for two groups of production traits of economic importance : litter size and growth rate of the young including their feed efficiency, slaughter and carcass characteristics. The determination of the genetic parameters of populations have two main objectives :

- the discovery of the genetic determinants of the traits : additivity, dominance, overdominance for the direct and maternal genetic effects.

- the study of the theoretical efficiency of selection methods which can be used .

Crossbreeding experiments attempt to determine additive genetic effects between lines, heterosis and complementarity such that optimum combinations among lines can be discovered (the optimisation of breed resources according to G. DICKERSON). These experiments may also enable the genetic effects (direct, maternal and grand-maternal) to be defined.

The rabbit has been used as an experimental animal by some well know geneticians since the early half of the 20th century . It has also been used by O. VENGE who since 1950 had been able to demonstrate maternal effects on birth weight linked to differences in adult body size and differences in litter size between breeds. The analysis of the variability between breeds for adult body size had thus been taken up in some very early studies.

With respect to reproduction, as early as 1890 HEAPE (cited by O. VENGE) succeeded in transplanting two fertilized eggs from an Angora female to a Geant des Flandres female and since 1932 GREGORY defined the biological components of litter size. However, it was not until the 1960's that W.C. ROLLINS and his colleagues obtained preliminary results on the genetic parameters of litter size (at birth, and at weaning) as well as weight of litter at weaning in a N.Z.W. population at the Fontana experiment Station in California.

ROBINSON (1958) reviewed the publications on the genetics and physiology of the rabbit during the 1st half of the century. A general review which included later publications was presented by ROUVIER during the IInd World Congress on Rabbit Production at BARCELONE, 1980 (This round table will take a more detailed look at some of the genetic parameters of production traits). However that review showed that most publications were limited to repeat bilities, heritabilities for direct genetic effects in relatively small populations and limited production conditions. Important new findings now confirm the benefits to be derived from the analysis of genetic variability among lines for the biological components of litter

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Differences between breeds and lines for adult body size modify both the maternal and direct effects on growth. Maternal effects on growth before weaning are linked to differences between litter size and milking ability of does. In my opinion prolificity increases, on the average between breeds, when one changes from the light breeds to the medium sized breeds. A similar situation exists for milking ability. It is interesting to note that the mean prolificity for the medium sized breeds is 7 to 8 young regardless of the conditions of production. Naturally it is logical to utilise medium sized does for meat production in an intensive system. In fact, G. MASOERO indicates that the efficiency of feed utilisation of the doe and the litter up to the time of weaning is an economic trait to be considered in a feeding system based on concentrates. The use of does of medium adult body size, prolific and of good mothering ability may be quite interesting.

About 2/3 of the feed consumed by the doe and her litter up to slaughter represents the consumption of the young between weaning and slaughter. Il would then be important to increase the post weaning growth rate and efficiency of feed utilisation of the young. In this regard, the biological potential of the species demonstrated experimentally has not yet been exploited. Certain large body sized males when used in crosses with medium sized does can result in a slight reduction of growth rate at the time of weaning (due to stress of weaning), a very precocious post weaning growth and an improvement in carcass composition without any deterioration in carcass quality (OUHAYOUN, quoted by G. MASOERO). Investigations on breeds of males for crossbreeding, in considering the influence of males on all traits of production and economic interest should be developped. Between breed selection should be complemented by within line selection on multiple traits which should include the efficiency of feed utilisation. As MASOERO points out the best measure of this trait should be defined. This is equally true for post weaning growth. The question is, should one consider absolute growth rate or relative growth rate ?

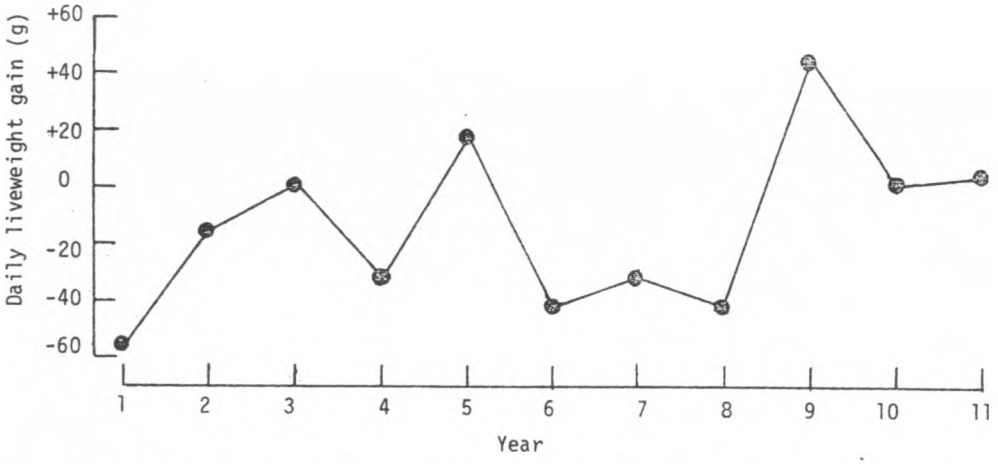

Figure 1. Daily live weight gain, annual deviations of Selection boars from Controls.

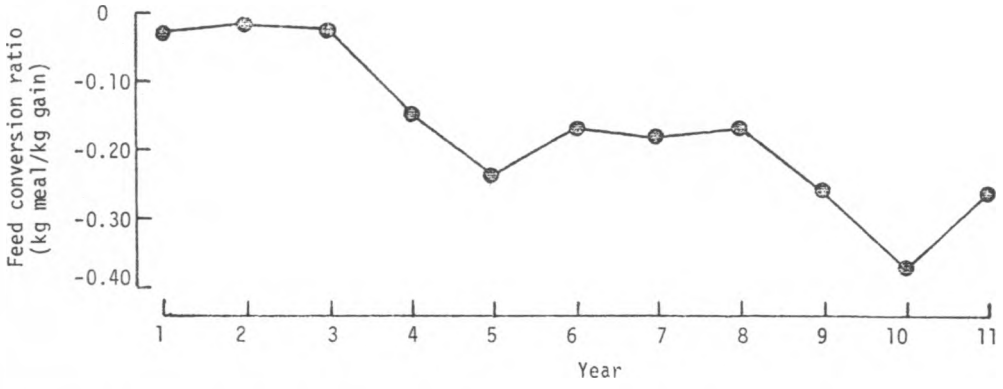

Figure 2 Feed conversion ratio, annual deviations of Selection boars from Controls.

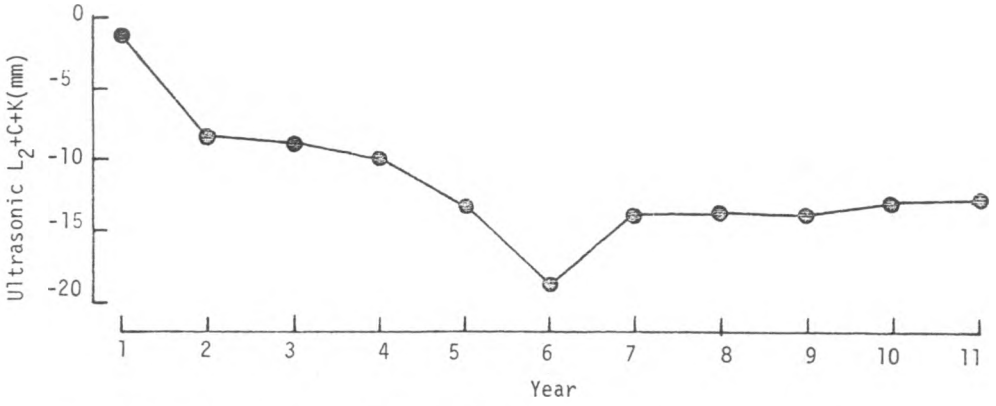

Figure 3 Ultrasonic backfat (L_2+C+K), annual deviations of Selection boars from Controls.

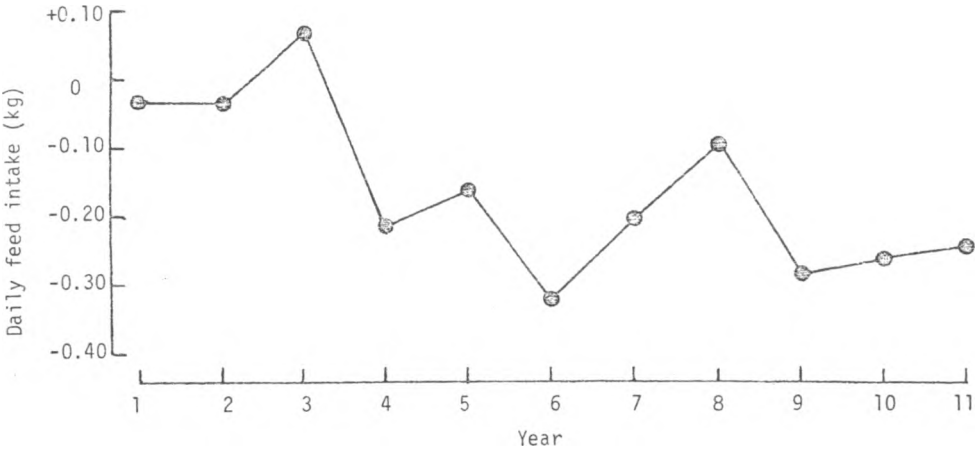

Figure 4 Daily feed intake, annual deviations of Selection boars from Controls.

These responses have been quantified in Table 1 where they are expressed as the regression of the performance of Selection line boars relative to Controls over time. The analysis has been split into two periods, years 1 to 6 and 7 to 11, to correspond with the change in the response of backfat thickness to selection. Growth rates showed little change over the early period of the study but increased significantly over the last 5 years (+8.7 g/day/year). During the first 6 years, feed conversion ratio declined on average by -0.03 units per year ($P<0.001$) and this rate of decline continued over the latter part of the work. The combined ultrasonic backfat measurement declined on average by -2.9mm per year ($P<0.001$) in the first period. Subsequently, no further progress has been recorded. Thus, at the end of the 11 year period of the investigation Selection line boars had some 20% lower ultrasonic backfat thickness (at the combined L_2 + C + K positions), converted their feed into liveweight around 10% more efficiently but grew at a similar rate to Controls.

These improvements in performance have been accompanied by some concomitant decrease in the voluntary food intake (VFI) of Selection line animals. Average daily feed intake on test decreased by -0.03 day/year in the Selection line relative to Controls over the first 6 years and this was followed by a non-significant reduction over the latter period of the work (Figure 4, Table 1). Thus, in year 11 Selection line boars consumed on average some 8% less feed per day than Controls over the test period (27 to 87 kg liveweight).

A series of feeding trials have been carried out to obtain detailed information on line differences in growth and carcass characteristics. Samples of boars from the two lines were individually fed from 27 kg live weight for 84 days, then slaughtered and their carcasses were physically dissected and chemically analysed. The first trial was set up to compare the two lines when they were allowed to express their feed intake potential and involved "to appetite" feeding for two one hour feeding periods per day (Ellis, Smith, Henderson, Whittemore and Laird, 1982). Details of growth performance are given in Table 2. Overall, Selection line boars consumed some 4.5% less feed per day, grew slightly faster (918 v 886 g/day) and has significantly better feed conversion ratios (-9%) than Controls. In terms of carcass characteristics, Selection line boars had lower killing-out percentages (77.2 v 78.6%), longer carcasses (853 v 821mm) and lower backfat depths at all points of measurement (Table 3). They had significantly higher lean (+9%) and bone (+6%) contents and less fat (-15%). Lean tissue growth rates were some 31 g/day higher in the selected line (+10%).

In a further trial appetite differences were removed by giving the two lines a generous fixed feeding scale for 84 days (Henderson, Whittemore, Ellis, Smith, Laird and Phillips, 1982). In comparison with the first study, line differences in daily liveweight gain and lean tissue growth rate were of a similar magnitude (Table 4). However, differences in feed conversion ratio were markedly reduced compared with "to appetite" feeding.

Thus, eleven years of index selection for economy of production and carcass lean content using ad libitum feeding regime has produced a line of pigs with reduced carcass fatness and improved feed efficiency. A major part of these changes has been achieved through the selection of animals with a reduced appetite although significant improvements have also been made in lean tissue growth rates.

REFERENCES

Ellis, M., Smith, W.C., Henderson, R., Whittemore, C.T. and Laird, R. 1982 Comparative performance and body composition of control and selection line Large White pigs. 2. Feeding to appetite for a fixed time (in press).

Henderson, R., Whittemore, C.T., Ellis, M., Smith, W.C., Laird R. and Phillips, P. 1982. Comparative performance and body composition of control and selection line Large White pigs. 1. On a generous fixed feeding scale for a fixed time (in press).