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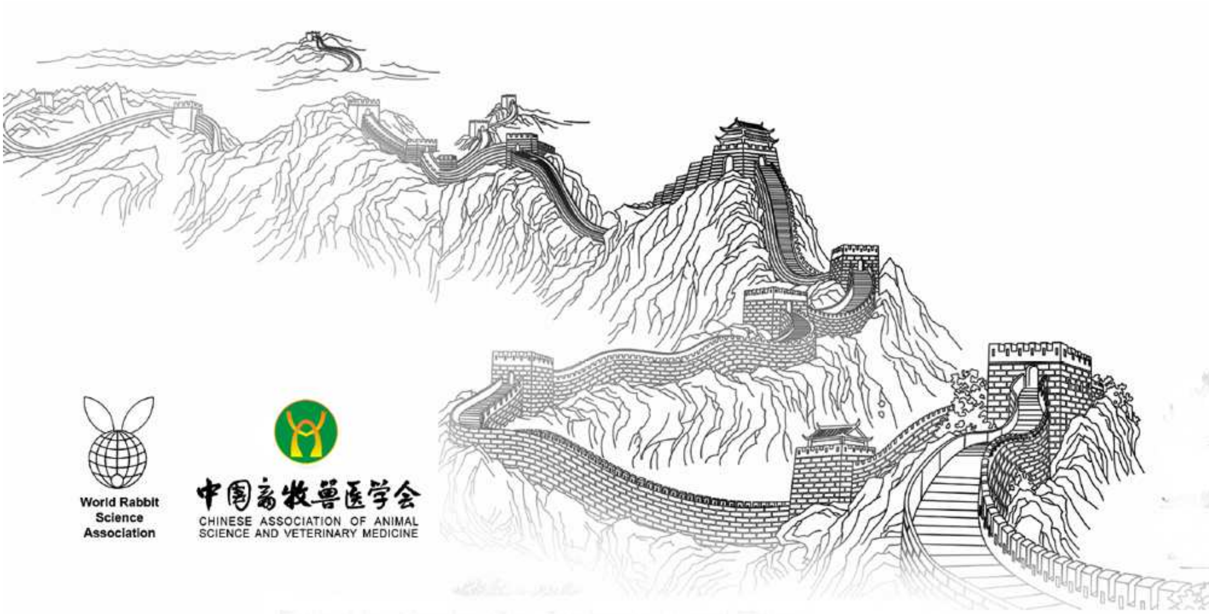

# COMPARISON OF THE GENETIC PARAMETERS AND EVOLUTION OF TWO RAISED POPULATIONS SEPARATELY BUT WITH THE SAME ORIGIN AND RENEWED FROM THE SAME NUCLEUS

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## ABSTRACT

The goal of this study is to check the efficiency of the genetic selection for a new selection nucleus of great grand-parental (GGP) of HYLA C female line. Indeed, in the case of the implementation of a rabbit breeding farm in China, a GGP nucleus was created (from French GGP animals) for the direct production of grand parental (GP) males and females. Two traits, which are used as selection criteria were compared between the GGP nucleus of France (primary nucleus) to the one in China (secondary nucleus): the quantity of kits born alive by litter and the individual weight at birth day. For the first criterion, the genetic evolution is positive in both cases: +0.35 born alive/year vs +0.31 born alive/year on average in GGP nucleus of France and China, with a heritability ($h^2$) of 0.093 and 0.068 respectively. For the criterion individual weight at birth day, the genetic evolution is also favorable: +0.40 g/year vs +0.32 g/year on average, respectively, in nucleus of France and China, with a similar heritability (0.098 vs 0.097, respectively).

**Key words**: Rabbit, Genetic parameters, Selection

## INTRODUCTION

In a context of creation of a rabbit breeding farm, it is essential to anticipate how the renewal of the parental females and males will be insured. There is two solutions: the first one is to provide at each batch young parental females and the second is to create a GP nucleus who give birth to the future parental females. However, when the size of the new farm is important coupled with the fact that the farm is abroad, creation of a GGP nucleus is justified. This is the third solution and it is much easier to manage. When Kangda group in China wished to create a big rabbit breeding farm, the question to insure the best possible management of the renewal was immediate. And the solution was to create a GGP nucleus in China (GGP daughter population) strongly connected with the French GGP nucleus (GGP mother population) with an organized renewal every year. The management of GGP nucleus is necessarily serious and rigorous. Indeed, GGP rabbits are raised in pure lineage and it requires a strict respect of the selection plan (active choice of future GGP males and females), and a rigorous follow-up of the consanguinity (controlled by realization of mating plans and selection by family). To validate the genetic progress of the Chinese GGP population, the genetics parameters and genetics values have been studied below. It concerns the HYLA C line precisely one of the female line in the HYLA scheme selection.

## MATERIALS AND METHODS

### Animals

In this genetic study the concerned animals are exclusively GGP from the HYLA line C. They are distributed in two populations: a mother population (closed nucleus since 2000) raised in Gosné (France) since 2007 in a selection center of high sanitary status; and a population raised in the breeding farm of the Kangda group in Qingdao (China). The GGP C Chinese population comes from the French GGP C nucleus, created with breeding rabbits arrived in 2008. This population is partially renewed once a year by the introduction of GGP females and GGP males from France. This partial renewal allows to change 60 % of females and all the males in Chinese nucleus.

**Data**

For both populations, all data of genealogies were registered since the implementation of the indexation model BLUP animal: in 2002 for the French population and in 2008 year of creation of the Chinese population. Today the genealogy includes 68912 rabbits from the French population, and 29333 rabbits born in China (4847 litters). Reproduction performances data for each population is also registered.

Furthermore, for the French population, the individual body weight at birth day are registered since 2007. There is today 48858 individual birth weights (4934 litters). In Chinese nucleus, individual weights at birth are not collected, but only individual weights at weaning and at the end of fattening in order to allow an adequate phenotypic selection.

**Selection methods of breeding rabbits**

For the French population, breeding animals from the C line are selected with a selection work based on three criteria: the number of kits born alive in every litter, the individual weight of young rabbits at birth as well as the weighty homogeneity intra litter at birth. So, the French population is selected from a global index Ig which combines the genetic value of the number of alive born young rabbits at birth (NV), the genetic value of the individual weight at birth (PDS) and the genetic value of the homogeneity intra-litter measured with the amount of individual body weights at birth per litter (ZV). This method of selection via a global index showed its efficiency and its relevance in rabbit selection (Garreau et al., 2005). This global index used for the selection of the future breeders of French GGPC nucleus uses only the data registered from this population.

For the GGP C Chinese population, future breeding rabbits are selected only with the trait: number of alive born young rabbit per litter. Performances data and pedigree come from Chinese and French populations.

For each trait, the values and genetic parameters are estimated by the method of the maximum of restricted likelyhood (REML) applied to an animal model with direct effect by using the ASReml software (Gilmour *and al.,* 2002). This model includes random effects and fixed effects, handled in classes. The model for NV included the fixed effects of batch and the parity order combined with the physiological situation of the female (lactating or not at the insemination day). The random effects are the permanent effect of the male, the permanent environmental effect of the female and the direct genetic effect of the female.

The models for individual body weight of young rabbits (PDS) and homogeneity intra litter at birth (ZV), included the fixed effects of batch, litter size at birth, parity order of the mother, length of the gestation and the age at the weighing. These last two effects are expressed in days since the insemination. Random effects are the common environment applied to the young rabbits of the same litter, the maternal environment and the direct genetic effect (Loussouarn *et al.,* 2013).

## RESULTS AND DISCUSSION

**Genetic evolution and parameters of criterion number of young rabbits born alive per litter**

In the table 1, we can see the genetic parameters of this criterion. The heritability is more important in the French population than in the Chinese population (0.093 vs 0.068). The permanent environmental effect of the female ($p^2$) are more important in Chinese population compared to the French population (0.103 vs 0.086) (Table1). The French population is raised since 2007 in a selection center with high sanitary status where the environment settings are controlled to limit environmental variations and allow a better comparison between groups of animals. For the Chinese population, environmental variations could be more important, and it causes a skew in the estimation of the genetic parameters and possibly increase the residual variance, by the way causes a diminution of genetic variance.

**Table 1. :** Genetic parameters of number of young rabbits born alive per litter (NV), single trait analysis: h² = heritability (± standard error); p ² = permanent environmental effect (± standard error)

| NV | France | China |
|---|---|---|
| h² | 0.093 (±0.019) | 0.068 (±0.013) |
| p² | 0.086 (±0.016) | 0.103 (±0.013) |

However, considering the curve of the genetic evolution of the number of alive born per litter (Figure 1), the genetic selection is very effective in both populations. The genetic progress is on average +0.35 alive born young rabbit living per year in the French population and on +0.31 in the Chinese population. We observe a parallel and increasing genetic evolution (curve of regression). The gap between curves is understandable by the gap generation which exists between GGP nucleuses. It illustrates perfectly the importance of the genetic interaction that there should be between both populations.

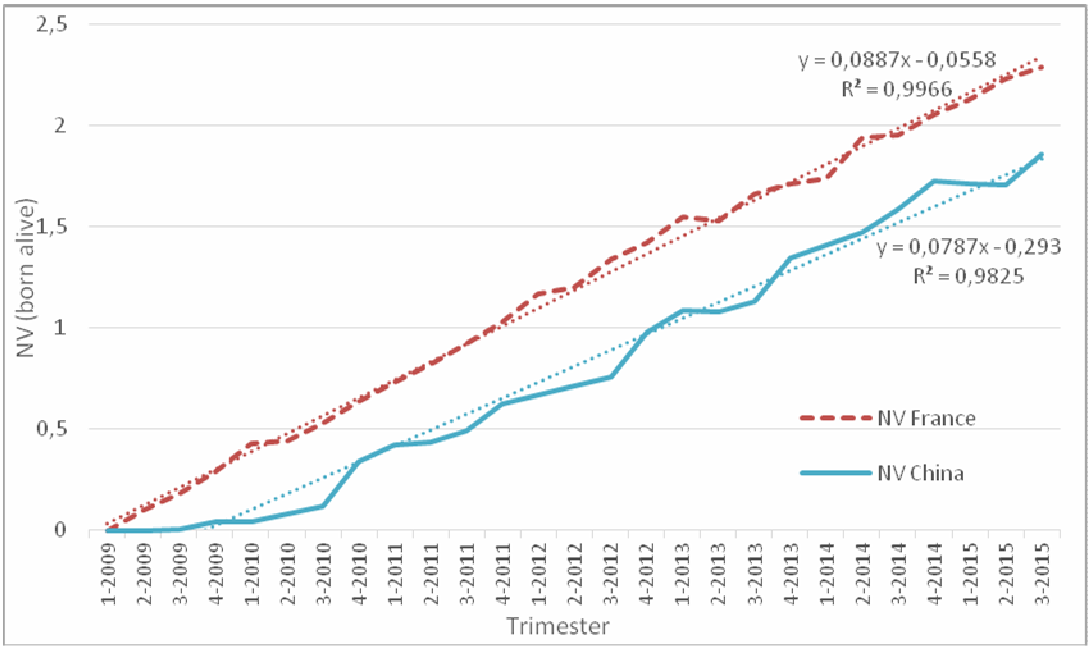


**Figure 1. :** Genetic evolution of trait number of born alive kits per litter (NV) depending on birth trimester for both populations (French and Chinese).

**Genetic evolution and parameters of individual weight at birth trait**

This trait is only measured and selected via the global index in the French population. However as both populations are connected by a regular renewal (French breeding males and females introduced once a year in China), the genetic progress including for this trait is measurable. In the table 2, we can notice that genetic parameters of this trait are similar between both populations.

**Table 2. :** Genetic parameters of the weight at birth, single trait analysis: h² = heritability (± standard error); c ² = common effect of litter environment (± standard error)

| PDS | France | China |
|---|---|---|
| h² | 0.098 (±0.016) | 0.097 (±0.017) |
| c² | 0.067 (±0.012) | 0.071 (±0.012) |

As for genetic evolution of the number of born alive per litter, in the figure 2, the genetic evolution of the body weight at birth is in constant progress in both populations. While knowing that Chinese nucleus was set up at the end of 2008 and that the selection on one day old weight began in the French nucleus only in the second quarter of 2009. Today the annual genetic progress is of +0.40g additional of weight of young rabbit for French nucleus and of +0.32g for the Chinese nucleus. And same as shown in Figure 1, the report is clear of a parallel genetic evolution between both GGP populations.

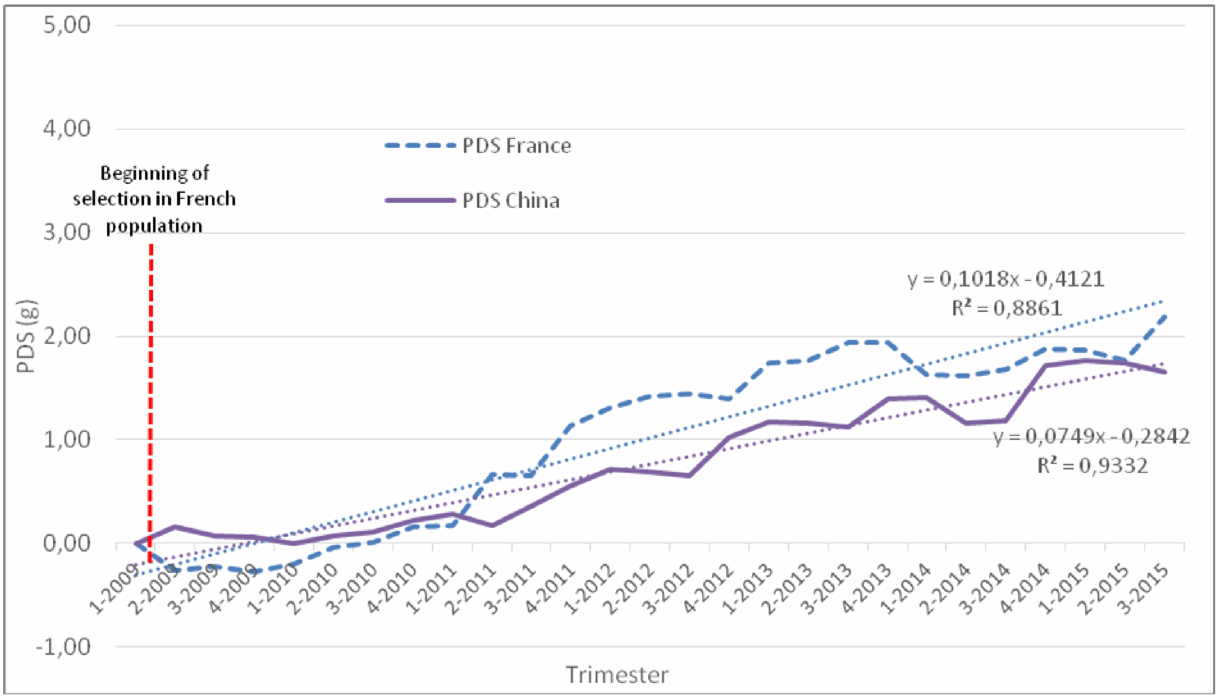


**Figure 2. :** Genetic evolution of trait individual weight at birth day (PDS) depending on birth trimester for both populations (French and Chinese).

## CONCLUSION

Creation and management of a new GGP nucleus is possible with a reliable and serious recording of pedigree data, reproduction results and sometimes additional measures (i.e. weight at a given age). And even if the secondary GGP nucleus is not selected on all criteria as the primary GGP nucleus, the genetic progress remains valid for the whole model of selection from the moment where connection is regular between primary and secondary GGP nucleuses.

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# Comparison of the genetic parameters and evolution of two populations raised separately but with the same origin and renewed from the same nucleus


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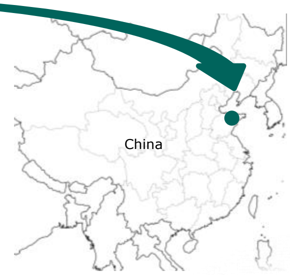
**Introduction:** **Kangda created a big rabbit selection farm in partnership with Eurolap with the objective to insure the best possible management of the renewal. For this a GGP nucleus (daughter population) strongly connected with the French GGP nucleus (mother population) has been create. To validate the genetic progress of the Chinese GGP population, the genetics parameters and genetics values have been studied. It concerns the HYLA C line, that is, one of the female line in the HYLA scheme selection.**

## Material and Methods:

- Animals and Data:

Hyla GGP C mother population


- Creation in 2008
- Partially renewal once per year (♂&♀)
- Common Data:
  - Genealogies
  - Reproduction performances




Hyla GGP C daughter population

- Genetic parameters: estimation by the method of restricted maximum likelihood (REML) applied to an animal model
- Selection methods for French and Chinese GGP nucleus: Number of rabbits born alive per litter (NV)

## Results and Discussion:

**Figure 1:** Genetic evolution of trait number of born alive kits per litter (NV) depending on birth trimester for French and Chinese populations

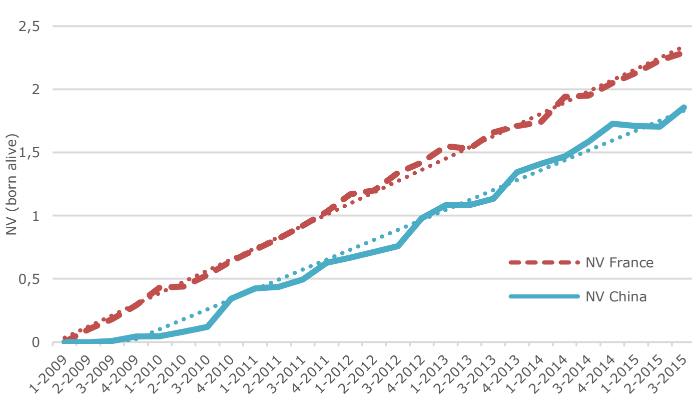



**Table 1:** Genetic parameters of trait number of rabbits born alive per litter (NV), single trait analysis: h²=heritability (±standard error); p²=permanent environmental effect (±standard error)

| NV | France | China |
|---|---|---|
| h² | 0.093 (±0.019) | 0.068 (±0.013) |
| p² | 0.086 (±0.016) | 0.103 (±0.013) |

**Genetics is very effective in both populations** (Fig. 1). The genetic progress is on average +0.35 born alive rabbits living per year in the French population and +0.31 in the Chinese one.

The gap between curves is understandable because of the generation gap which exists between GGP nucleuses.

Heritability is more important in the French population than in the Chinese one; and p² are more important in the Chinese population compared to the French one (Table1).

For French nucleus, **environment settings are more controlled** to limit environmental variations compare to the Chinese nucleus conditions. It causes a skew in the estimation of the genetic parameters and possibly can increase the residual variance, thus causes a diminution of genetic variance.

**Conclusion:** **Creation and management of a new GGP nucleus is possible and efficient if there is a reliable and serious recording of all data. With a important genetic connection between both populations, the genetic progress remains valid for the whole model.**