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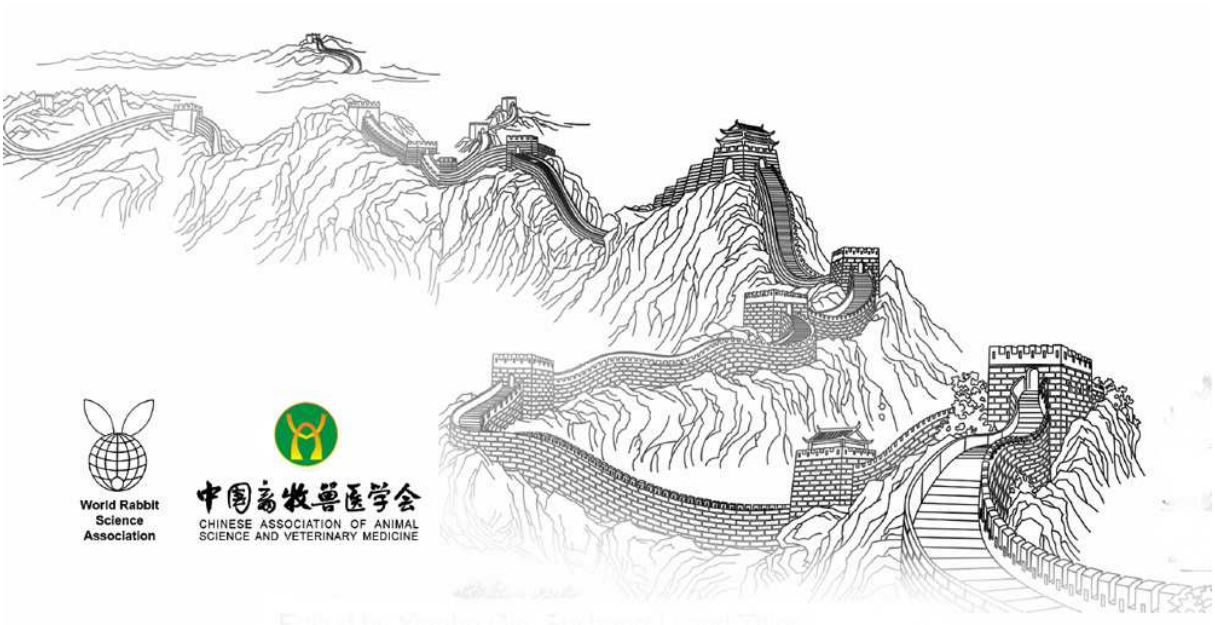

INFERTILITY OF FEMALE RABBITS ON COMMERCIAL UNITS

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ABSTRACT

In this study we determined the relation of female's rabbit infertility with several risk factors: the rabbit line (U.P.Valencia lines, Hy+, Hyla, Hycole, among others), body condition score /BCS (1 to 9), number of parity (1 to 37), and sanitary status (health and sick does, with 1 or more disorders). In the course of 161 visits to 81 doe farms in Spain, we examined and palpated 6147 lactating and rebred does sorted in 166 cohorts, over 74,892 "does at risk" (median: 368 does *vs* 825 median of "does per visited farm"). We visited the farms from November 28th, 2014, until January 12th, 2016. There were 2354 empty does and 3793 pregnant; however the median pregnancy rate of the 161 batches was 85 %. Fertility was mainly related with BCS ($p< 0.0001$), and also with health. Fertility of does with BCS = 4, decreased 10.4 % *vs* does with BCS= 5; on the other hand, fertility of does with BCS= 6 increased 11.7 %. Concerning the influence of sanitary status, fertility of does with coryza decreased 4 % in relation to healthy ones; sore hocks -9.4 %, or mastitis -35 %.

Key words: Female Rabbit, Infertility, Reproductive diseases, Risk factors, Rabbit Theriogenology

INTRODUCTION

On commercial farms housing the European rabbit (*Oryctolagus cuniculus*), occurrence of reproductive diseases is relevant. During 1997-2007 we visited 868 farms in Spain and Portugal (Rosell et al., 2009); during the 11-year study we performed 155 visits to 100 rabbitries, were the main emergency was related with Theriogenology. First disorder in does was infertility, followed by low fecundity, stillbirth and abortions; infertility included low pregnancy rate and kindling rate (IRRG, 2005), also the no acceptance of males in farms with natural mating. Reproductive diseases are the main causes of culling (Rosell and de la Fuente, 2009); but more information is needed (Arnau-Bonachera and Savietto, 2014). There might be several factors concerned: a) the semen and the supplier until the rabbitry, b) the person inseminating, c) the females, and their husbandry.

We will focus on the does and the rabbit producers. In relation with females, there can be infectious causes of infertility (Boucher et al., 2001), affecting the uterus (Galazzi et al., 1994), or the ovarian activity (Boiti et al., 1999). There might be intercurrent diseases, e.g., enteritis-diarrhoea or myxomatosis (Fioretti and Cerrone, 2003). There might be seasonal effects; e.g., temperature, lighting (Theau-Clément, 2007), feeding or water supply problems, toxicoses (Gu et al., 2005), and other factors, e.g., the age at 1st artificial insemination (AI), the remating interval (Nicodemus et al, 2002), affecting the whole farm or a cohort of females. Infertility can also be analyzed in relation with one doe, to seek a precise analysis of the interaction of reproduction with health or other risk factors (Castellini et al., 2010). Individual causes of infertility include the above cited and also metabolic disorders, trauma and tumours. Cardinalli et al. (2008) studied the interactions of body condition with reproduction, and Sánchez et al. (2012) evaluated reciprocal actions between health and body condition.

In this study, our aim was to estimate some individual risk factors of infertility: the rabbit line, the number of parity, body condition score and sanitary status of female rabbit, on-farm diagnosed empty or pregnant.

MATERIALS AND METHODS

Animals and experimental design

From November 2014 to January 2016 we made 161 visits to 81 doe farms in 17 provinces in Spain (17/ 50). On each visit we asked the producers about their inventories of does, number of batches, days of service (mount or AI), and day of abdominal palpations for pregnancy diagnosis. The first condition to include a cohort in our study was that negative and sick does should not be culled yet. We then explained the aim of our study to them. We compared negative and pregnant does from the same batch, previously palpated or not, but we palpated all does; we only checked does in lactation. Visits were made by a trained veterinarian (Rosell). The evaluation protocol included abdominal palpation, body condition scoring, explained elsewhere (Sánchez et al., 2012), and evaluation of sanitary status, with coryza, mastitis, sore hocks, manges (psoroptic, sarcoptic or both), and other clinical signs: gastroenteritis, dermatopathies compatible with *Pseudomonas aeruginosa* infection, abscesses or uterine morphologic anomalies (extrauterine pregnancies or mummified foetuses, among others). Scoring of these disorders was binary.

Statistical Analysis

Data were gathered on each visit and do not follow an optimally balanced design. Concerning does at risk, for instance, there might have been 1000 does in a farm, but divided in 2 batches: 1 inseminated 15 days previously (and then, able to be palpated) and another near to next parity, without kits; for this reason, we sorted "does per farm" and "does at risk". There might also have been several cohorts; in fact, we examined mainly 1 cohort per visit (lactating and rebred does). Statistical analysis was by SAS (Statistical Analysis System, rel. 9.1), utilizing CATMOD procedures. Statistical significance was indicated by a *p*-value < 0.05.

Factors of variation with a possible effect on the dependent variable (Fertility: + *vs* -), were estimated using the following model: $Y_{ijklm} = \mu + L_i + P_j + B_k + S_l + e_{ijklm}$
where L_i was explained by the effect of the i^{th} rabbit line (6 levels); P_j the effect of the j^{th} number of parity (9 levels); B_k , the fixed effect of the k^{th} body condition score, (6 levels: 2,3 4, 5, 6, 7); S_l, by the effect of the l^{th} sanitary status (8 levels), and e_{ijklm} the residual effect.

RESULTS AND DISCUSSION

Farm characteristics

We checked 6147 females in 81 doe farms on 161 visits from November 27th, 2014 to January 12th, 2016. The frequencies were as follows: 35 farms were checked once, 22 farms twice, 16 were checked during 3 visits, and 5 rabbitries were checked ≥4 times. The median size of the visited population was 825 does (minimum to maximum: 145 to 6000 does) and the median size of the cohorts of sampled does was 368 (minimum to maximum: 10 to 1750 does), with a median of 40 does per sampled cohort (minimum to maximum: 10 to 100 does). These farms correspond to the most specialized ones in Spain (MAGRAMA, 2015). Ninety-six per cent of them were closed-cycle, with maternity rooms and growing rabbits, with a duo-system (all in-all out) or without (does always in the same room). AI was used on 83.8 % of the farms. On 43.8 %, females were managed in one batch per farm and between 2 and 8 batches on the rest. On 70 % f the farms, does were serviced (by natural mating or AI) on day 11 postpartum, on 10 % on day 18, 15 % on day 25, or sometimes on days 32 to 45 postpartum.

Rabbit characteristics

The lines of the examined does were as follows: 4023 does from *Universidad Politécnica de Valencia* /UPV lines, 715 does from 3 or more crossings, 468 Hy+ does, 373 Hy + (male) UPV (female) crossed does, 272 Hyla does, 144 Hycole, 88 Hycat, 40 New Zealand white and 25 coloured (e.g., crossing from Fauve de Bourgogne), described elsewhere (de la Fuente and Rosell, 2012). The median of parity number was 4 (minimum to maximum: 1 to 37 parities), and mean: 5.7. In previous studies we found 6 kindlings during 2000-2005 (Rosell and de la Fuente, 2009) and 6.8 during 2007-2010 (Sánchez et al., 2012).

Pregnancy rates
During the 13-month study we examined 6147 does in a population of 74,892 females at risk, on the 161 visits. There were 2354 empty does and 3793 pregnant does, examined in 166 cohorts. The median of the observed day of pregnancy (also when we visited and diagnosed), was 17 days (minimum to maximum: 10 to 26 days), and lactation 30 (minimum to maximum: 21 to 65 days). The median of the pregnancy rate was 85 % (minimum to maximum: 61 to 95.9 %), per visited batch of does. Producers diagnosed pregnancy by abdominal palpation at 15 days median (minimum to maximum: 11 to 27 days). Pregnancy rates were similar to previous results in Spain (84 %), and 79 % of parity / service rate (Rosell and González, 2009).

Sanitary status
Of the 6147 examined does, 67 % were apparently healthy. Mean prevalences were 15.9 % for coryza (0 to 74 % of the sampled does in one farm were affected), 5 % for mastitis (0 to 30 %), 7.1 % for sore hocks (0 to 73.3 %) and 4.6 % for mange (0 to 94 %; in this case, prevalence corresponds to psoroptic mange) There were 1.2 % does with other disorders. Besides, 4.5 % of the does had ≥ 2 conditions. There were 4 does (in 4 farms), with 4 disorders: rhinitis-mastitis-sore hocks and mange; a relevant case of discomfort.

Body condition
The 6147 does had a median BCS = 4 (mean 4.51), with 41.1 % of does at 4/9, 34.3 % at 5/9, 11.8 % at 6/9, i.e., 87.2 % of them were in a normal BCS range (4-6 /9), 11.6 % at risk (3 or 7 /9) and 1.2 % had a welfare concern status (1, 2, 8 /9). Predominance of BCS 4 might be related to the age of sampled does: 30 days of lactation, which coincides with a decrease in BCS (Sánchez et al., 2012).

Risk factors for individual female infertility
We considered 4 independent factors: the rabbit line, number of parity, body condition score /BCS, and the sanitary status (**Table 1**).

Table 1: ANOVA-CATMOD of female rabbit infertility and some risk factors, with 6147 examined lactating does, pregnant or empty, in 81 doe farms, Spain, November 28th, 2014 to January 12th, 2016

Source of variance	DF	χ^2	*P>F*
Independent term	1	0.29	0.5911
Rabbit line	5	24.90	0.0001
Number of parity	8	30.56	0.0002
Body condition score	5	165.94	< 0.0001
Sanitary status	7	47.43	< 0.0001

The 4 analyzed factors were significant, and affected doe fertility. The main effect was due to BCS, with a χ^2 value of 165.94. According to a previous experience (Sánchez et al., 2012), this effect might include feeding and sanitary status of does, although the statistical model differentiates their effects. Fertility of does with BCS = 4, decreased 10.4 % *vs* does with BCS= 5; on the other hand, fertility of does with BCS= 6, increased 11.7 %. Concerning sanitary status, the fertility of does with coryza decreased 4 %, sore hocks -9.4 %, and mastitis -35 %.

CONCLUSIONS

In this preliminary study, the body condition score, determined on the day of diagnosis of pregnancy by palpation, was the main factor influencing female rabbit fertility, with a χ^2 = 165.94 ($P < 0.0001$).

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Infertility of female rabbits on commercial farms, Spain, 2014-2016.

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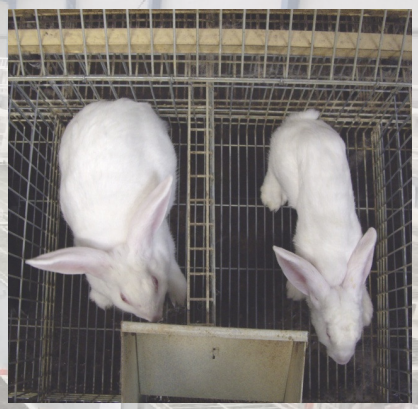

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Infertility of does on commercial farms

Conclusions: what could be recommended to the producers to improve welfare and results of their does?

What would be your suggestions to improve the future studies on female's infertility?

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Thank you very much for your attention

非常感谢您的关注

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