Proceedings 3rd World Rabbit Congress, 4-8 April 1984, Rome – Italy, Vol. 2, 437-445

MATING BEHAVIOUR AND INDUCTION OF OVULATION IN MEAT RABBIT

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INTRODUCTION

One of the most determinant factors of the annual production of young rabbits by the doe is the time interval between consecutive parturitions. This depends, when the reproduction rithm is fixed, on the times that the doe rejects mating and on those that having accepted it ovulation does not take place.

Unlike most of the domestic species the existence of a definite oestrus has not been detected in does (TORRES, 1977); in spite of having been observed cycles of follicular growth (DESAIVE, 1948) and cyclic changes in the plasmatic concentration of 17β estradiol (BATRA and KALLSTRAND, 1979). Nevertheless an association between the colour of the vulva and the acceptance of mating has been noticed (DELAVEAU, 1978). Ovulation is only produced as a consequence of coitus.

There are several factors, both environmental and intrinsic of the doe, that limit or modulate the acceptance of mating and the induction of ovulation. This paper deals with the detection and quantification of the effects of some of such factors on the above mentioned traits as well as the establishment of the possible relationships among them.

MATERIAL AND METHODS

The does used in this work were of medium size and specialized in meat production. They were kept at a constant level of illumination of 16 hours/day and at temperatures over 13°C. First presentation to the buck was made at about four and a half months of age. Presentations were only made on Fridays; when a doe rejected mating she was presented again the next Friday, acting in this way for a maximum of six weeks. First presentation post-parturition was made on the week following parturition, approximately about 10 days after it. Young rabbits were weaned at 28 days of age.

Does with zero, one or two previous parturitions were presented to bucks in the different seasons of the year. The number of suckling rabbits and the colour of the vulva was recorded at

each presentation. Colour was classified into four classes according to increasing intensity: - pale, pink, red and violet. Only in the three first presentations after parturition no-nulliparous does could have suckling rabbits. Does were weighed at the moment of acceptance and were - slaughtered seven or twelve days later. The number of corpora lutea were recorded so as to ascertain whether there had been induction of ovulation or not and to determine the ovulation - rate. Data were taken from April 1980 to May 1981; their distribution is shown in Table 1.

Table 1: DISTRIBUTION OF EXPERIMENTAL DATA

	SPRING-SUMMER						AUTUM-WINTER					
	NULLIPAROUS			NO-NULLIPAROUS			NULLIPAROUS			NO-NULLIPAROUS		
PALE	* 5	+ 3	- 1	50	11	0	5	1	0	43	16	1
PINK	24	9	8	46	14	9	8	5	1	35	14	7
RED	10	4	4	19	10	8	20	15	11	17	16	11
VIOLET	4	2	2	8	1	1	7	5	5	3	2	1

* number of presentations to male
\+ number of females accepting the male
\- number of ovulating females

Two different models (named 1 and 2) were used to analyze the acceptance of mating.

Model 1 was:

$$Y_{ijkl} = m + s_i + c_j + p_k + sc_{ij} + sp_{ik} + cp_{jk} + b(l_{ijkl} - \bar{l}) + e_{ijkl}$$

where,

Y_{ijkl} = the result of the l presentation of doe (1 for acceptance and 0 for rejection) made at the i season (1 for spring-summer and 2 for august-winter), being j - the colour of the vulva and k the level of parturition (1 for nulliparous and 2 for no nulliparous)

m = mean value

s_i, c_j, p_k = effects due to season, colour of the vulva and level of parturition

$sc_{ij}, sp_{ik}, cp_{jk}$ = interactions between them

l_{ijkl} = number of suckling rabbits ($\bar{l}$ = mean number)

e_{ijkl} = error of the model

b = regression coefficient of number of suckling rabbits, considered as a covari-- able in this model.

Model 2 was similar but for the use of covariable of variable with two values (1 for suckling - does and 0 for no-suckling).

Model 3 analyzed the induction of ovulation:

$$y_{ijkl} = m + s_i + c_j + p_k + sc_{ij} + sp_{ik} + cp_{jk} + b(l_{ijk} - \bar{l}) + b_1(w_{ijkl} - \bar{w}) + e_{ijkl}$$

where

y_{ijkl} = induction of ovulation (1 for presence of ovulation and 0 for its absence)

w_{ijkl} = doe weight at the moment of acceptance ($\bar{w}$ = mean weight)

b_1 = regression coefficient of doe weight

the others having the same meaning that in Model 1.

The estimates of parameters and effects of these models has been made by least square - analysis for unequal class number (HARVEY, 1975) including a test about the significance of the triple interaction. The method has also been used to analyze variables 0, 1 because their mean values are for from 1 or 0. The three models have been reanalyzed eliminating covariables in - order to asses how the estimates of the effects and the variance of error were modified, what - allows to know more directly the degree of association between covariables and factors within - the models.

RESULTS

1. ACCEPTANCE OF MATING

The results appear in Table 2. The proportion of does accepting mating was 55%. The effect of lactation, considered as all or nothing, was favourable to the acceptance of buck by lactating does (21% more than no-lactating) with a level of significance of 1%.

On replacing, the covariable lactation, by the covariable number of suckling rabbits at the moment of mating the effect of the latter, was not significant.

In the model 2 a favourable effect of nulliparous opposite to no-nulliparous (+30%) with a level of significance of 1% was appreciated. The amount of this effect fell to 14% with a level of significance of 10% when using a model not considering covariables. This decrease in the global effect of the level of parturition must be attributed to the effect of lactation that - would be comprised (with opposite sign) into the specific effects of no-nulliparous.

The season with lower temperatures and shorter days (autumn-winter) had a favourable - effect on the acceptance of mating (+11%).

The colour of the vulva was significantly associated (5%) with the acceptance of mating in such a way that the more coloured was the vulva the greater were the possibilities for the - doe to accept the buck.

The effects of the last two factors were not affected when the covariable (lactation) - was not included in the model.

2. TOTAL FAILURES OF OVULATION

The results appear in Table 3. The percentage of ovulating does was 62%.

The number of suckling rabbits had a negative effect on ovulation. This effect was highly significant, being partially responsible of the negative effect of no-nulliparous (a probability of ovulate 11% lower) on the induction of the ovulation.

Live weight at the moment of the effective mating had no significant effect on the probability of ovulation.

Warm and more luminous months were the most favourable on the induction of ovulation - (+10%).

The colour of vulva had a favourable and significant effect on the induction of ovulation; the more intense the colour the greater the effect.

The effects due to season or colour of the vulva were not modified by the inclusion or - not of the covariables into the model.

Table 2. Analysis of Acceptance of Mating. Model 1: Covariable, number of suckling rabbits. Model 2: Covariable, lactation (1)- no lactation (0).

MEAN	MEAN VARIANCE	VARIANCE FOR ERROR			DEGREES OF FREEDOM FOR ERROR		
		Model 1	Model 2	NC	Model 1	Model 2	NC
0.55	0.001	0.22	0.21	0.22	290	290	291

Means of number of suckling rabbits	TOTAL	SEASON	VULVA COLOUR	PARTURITION
	3.67	3.67 Spring-summer 3.67 Autumn-winter	5.47 Pale 3.49 Pink 1.38 Red 3.05 Violet	0 Nulliparous 5.05 No-Nulliparous
Means of lactation state	0.56	0.53 Spring-summer 0.59 Autumn-winter	0.82 Pale 0.53 Pink 0.26 Red 0.36 Violet	0 Nulliparous 0.76 No-Nulliparous

						F +	SIGNIF.-
Effects of season		Spring-Summer		Autumn-Winter			
	Model 1	-0.12±0.04*		0.12±0.04		10.11	0.01
	Model 2	-0.11±0.04		0.11±0.04		9.67	0.01
	NC	-0.12±0.04		0.12±0.04		10.18	0.01
Effects of vulva colour		PALE	PINK	RED	VIOLET		
	Model 1	-0.11±0.07	-0.07±0.05	0.17±0.06	0.01±0.08	3.83	0.025
	Model 2	-0.12±0.07	-0.08±0.05	0.18±0.06	0.02±0.08	4.56	0.01
	NC	-0.10±0.07	-0.07±0.05	0.16±0.06	0.02±0.08	3.47	0.025
Effects of parturition		Nulliparous		No-Nulliparous			
	Model 1	0.10±0.05		-0.10±0.05		4.73	0.05
	Model 2	0.15±0.05		-0.15±0.05		9.58	0.01
	NC	0.07±0.04		-0.07±0.04		3.34	0.10
Model 1. Regression coefficient of number of suckling rabbits 0.0116±0.0098						1.38	N.S
Model 2. Regression coefficient of lactation (1) -no lactation (0) 0.21±0.08						7.31	0.01

Interactions between two and three factors are not significant
* NC = without covariables ± = ± standard error + = Snedecor F
- level of significance

Table 3. Analysis of Induction of Ovularion. Model 3: Covatiables, number of suckling rabbits - and live weight of the females.

MEAN	MEAN VARIANCE	VARIANCE FOR ERROR		DEGREES OF FREEDOM FOR ERROR	
		Model 3	NC	Model 3	NC
0.62	0.003	0.15	0.17	113	115

	TOTAL	SEASON	VULVA COLOUR	PARTURITION
Means of number of suckling rabbits	3.13	3.13 Spring Summer 3.14 Autumn Winter	5.55 Pale 3.31 Pink 1.56 Red 2 Violet	0 Nulliparous 4.77 No-Nullipa-rous
Means of live weight of females	3751	3634 Spring Summer 3525 Autumn Winter	3683 Pale 3639 Pink 3465 Red 3415 Violet	3235 Nulliparous 3747 No-Nullipa-rous

						F+	SIGNIF.
Effects season		SPRING-SUMMER		AUTUMN-WINTER			
	Model 3	0.10±0.05*		-0.10±0.05		5.12	0.05
	NC	0.11±0.05		-0.11±0.05		5.26	0.025
Effects of vulva colour		PALE	PINK	RED	VIOLET		
	Model 3	-0.35±0.09	-0.05±0.07	0.13±0.07	0.27±0.11	6.00	0.01
	NC	-0.38±0.10	-0.06±0.07	0.21±0.07	0.23±0.12	7.48	0.01
Effects of partu-rition		NULLIPAROUS		NO-NULLIPAROUS			
	Model 3	-0.07±0.07		0.07±0.07		1.12	NS
	NC	0.11±0.05		-0.11±0.05		4.2	0.05
Regression coefficient of number of suckling rabbits -0.06±0.02						15.05	0.01
Regression coefficient of live weight of females -0.00007±0.004						0.35	N.S

The interaction between season and parturition is significant (0.025)

* NC = without covariables x = ± standard error + = Snedecor F

- = level of significance

DISCUSSION

1. ACCEPTANCE OF MATING

According to the results an intrinsic effect (model 2) due to number of parturition was observed, nulliparous does accepted mating easier. Lactation had a favourable effect on the acceptance but the number of suckling rabbits at the moment of mating had no influence at all.- The effect of level of parturition on the acceptance was quantitatively decreased by the opposite effect of lactation but, all in all, nulliparous does presented higher rates of acceptance (NC).

A lower sexual activity (following the postpartum oestrus) in the does during the first weeks following parturition has been observed by several authors (YASCHINE et al., 1967). BEYER

and RIVAUD (1969) appreciated it not finding any significant relationship between the rate of acceptance and the number of young rabbits of the litter, what agreed with our results. HARNED and CASIDA (1969) detected the existence of a lower number of great follicles in the ovaries of lactating does, both primiparous and multiparous.

YASCHINE et al. (1961) had observed already a similar effect of lactation on the number of ovarian follicles, although not always accompanied by a lower level of acceptance of buck. In this paper that a no-nulliparous doe was not lactating means, in most of the cases, that she was presented to buck after the weaning of her litter, that is to say four weeks after parturition. The effect assigned to lactation really included a concomitant phenomenon like the interval parturition-mating; lactation goes with an interval less than four weeks and no-lactation with an interval of four or more weeks.

The seasonal effect observed by several authors (MAY, 1975) could be due to the influence of daily photoperiodicity variable throughout the year. WALTER et al. (1968) reported that the acceptance of sire was higher in does raised in a 16 than in a 12 daily hours illumination regime. The results of this work showed that seasons with mild temperature and short photoperiod had the most favourable effect on mating behaviour. As the does were kept at a constant regime of 16 daily hours of illumination the seasonal effect must be attributed to the difference of temperatures during summer.

The relationship between the colour of vulva and the mating behaviour of the doe observed by DELAVEAU (1978) was confirmed in this experiment. It could be due to a higher level of estrogens in plasma that acting on the brain would determine the mating behaviour (LEVASSEUR and THIBAULT, 1980) and possibly acting, at the same time, on the reproductive tract would cause hiperaemia of the vulvar lips and intensification of their colour.

2. TOTAL FAILURES OF OVULATION

The number of suckling rabbits had a negative effect on the induction of ovulation. All in all the negative effect of the no-nulliparous (NC) is, almost exclusively, due to their presence. The detrimental effect of lactation on the induction of ovulation had been studied already by several authors (HARNED and CASIDA, 1969; FOXCROFT and HASNAIN, 1973). It is possible that the differents results obtained were due to the differences in the number of parturitions among the rabbits used in the experiments, without setting aside the possible differential effects of line.

The effect of the colour of vulva on the induction of ovulation was similar to the observed on the acceptance of mating. The more intense the colour the higher the frecuency of ovulating does. The results were esentially coincident with those of LEFEVRE et al. (1976). They recorded that the percentage of ovulating does rose as the vulva was more coloured (40, 85 and 100% for dams with pale, pink and red vulva respectively).

Observations made by FARRELL et al. (1968) in sexually mature does along two years showed that the induction of ovulation by coitus was affected by the season. According to their results

it was higher in spring and lower in the period between August and October. DOBROWOLSKI (1967) in does kept in non-controlled environment observed that the ovarian activity was higher in spring and presented lower levels in autumn, winter and summer. When kept in controlled environment the ovulatory response was higher in all the seasons, although the higher values went on being observed in spring. SELME and PRUD'HON (1973) also reported that the larger number of failures of ovulation took place in autumn.

In this experiment the warmer and more luminous were the seasons that had a more favourable effect on the induction of ovulation.

CONCLUSSIONS

A favourable effect of lactation on the acceptance of mating that counterbalanced the effect of level of parturition, favourable to nulliparous does, and decreased the differences between nulliparous and no-nulliparous does was observed. No significant relationship between the acceptance of mating and the number of suckling rabbits at the moment of mating was recorded. Possibly the favourable effect of lactation was affected by a concomitant phenomenon like the interval parturition-mating. The number of suckling rabbits had a negative effect on the induction of ovulation; effect that determined to a great extent the negative influence of level of parturition on the induction of ovulation in no-nulliparous.

The differential effect of season on the acceptance of mating may be due, as does were raised in a controlled environment, to differences of temperature and mainly to a possible negative effect on high temperatures in summer. Warmer and more luminous seasons had a more favourable effect on the induction of ovulation.

The effect of the colour of vulva on the mating behaviour increased with the colour intensity. The effect of the colour of vulva on the induction of ovulation showed a similar trend to that on acceptance of mating.

SUMMARY

The factors determining the mating behaviour,and the induction of ovulation were studied in does of medium size specialized in meat production. The does, accepting the buck were slaughtered at seven or twelve days after the mating that would produce the first, second or third parturition and in different seasons.

Lactation had a favourable effect on the acceptance of mating, not associated to the number of suckling rabbits. The number of suckling rabbits at the moment of mating had a negative effect on the induction of ovulation.

A close relationship between the intensity of the colour of vulva and the rate of acceptance of mating was observed. The effect of the colour of vulva on the induction of ovulation followed the same trend. Most of the does with pale vulva presented no induction of ovulation.

RESUMEN

Se han estudiado, en conejas de tamaño medio especializadas en la producción de carne, - varios factores que influyen sobre la aceptación de la monta y la inducción de la ovulación. - Las conejas que aceptaban la monta se sacrificaban a los siete o doce días del apareamiento que hubiese producido, en diferentes estaciones, el primero, segundo o tercer parto.

La lactación tuvo un efecto favorable sobre la aceptación de la monta, no asociado al número de conejos lactantes.El número de gazapos lactantes en el momento del apareamiento tuvo un efecto negativo sobre la inducción de la ovulación. Se observó una estrecha relación entre la - intensidad del color de la vulva y la aceptación de la monta. La misma tendencia del efecto del color de la vulva se apreció sobre la inducción de la ovulación. La mayoría de las conejas de - vulva pálida no ovularon.

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