Effects of parity order and reproductive management on the efficiency of rabbit productive systems

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ABSTRACT

The aim of this work was to study the effect of parity order and reproductive management systems on rabbit production performance. A total of 73 rabbit does (I group) were submitted to a 35-day intensive rhythm [artificial insemination (AI) on day 4 *post-partum* (pp) and weaning at 25 days of lactation], and 108 rabbit does (SI group) were submitted to a 42-day semi-intensive rhythm (AI on day 11 pp and weaning at 35 days of lactation) during 9 months. Primiparous does had the lowest live body weight at parturition ($P<0.0001$) and at 21 days of lactation ($P<0.0001$). They also had lower milk production ($P<0.0001$) than does with later parities. I group animals needed a higher number of AI than SI group to become pregnant (1.70 ± 0.03 *vs.* 1.39 ± 0.03; $P<0.0001$: especially after the third). Prolificacy was not affected by the management system. Parturition interval (PI) was longer than expected in both groups [56.0 ± 1.4 and 50.9 ± 1.38 days in I and SI groups, respectively ($P<0.05$)]. Mean productivity, estimated as number of weaned rabbits per female and year, was 12 kits higher in rabbit does of the SI group ($P<0.05$). From the third parturition onward, an increase in live body weight of kits at different ages was observed. At 21 ($P<0.05$) and 25 days of age ($P<0.01$), kits from the I group rabbit does weighed more than those from the SI group; however, the latter showed a higher weight at 35 ($P<0.05$) and 60 days of age ($P<0.05$). Rabbit does with two or three parturitions had higher litter size at 21 and 25 days of age ($P<0.0001$ and $P<0.001$, respectively). Kit mortality between 21 and 25 days of age and between 35 and 60 days of age was not affected by treatments but was higher in the I group between 25 and 35 days (18.2 *vs.* 5.03% in the I and SI groups, respectively; $P<0.0001$) and as age of does increased ($P<0.05$). In light of these results, we could conclude that long term doe reproductive performance is negatively affected and litter viability decreased when using intensive compared to a semi-intensive reproductive management.

1. Introduction

Reproductive performance of rabbit does, as well as growth rate and mortality of their litters, are the factors that help define the productive potential of a rabbit farm. Wild rabbits in reproductive season mate immediately after parturition, and natural weaning takes place in around 25 days. In the *post-partum* (pp) period, domestic rabbit does are highly receptive on the first day after parturition (Ubilla and Rebollar, 1995). Intensive reproductive management by means of reproductive management such as artificial insemination (AI) near to parturition (day 4 pp) should have advantages compared to AI on day 11 pp in commercial farms, since theoretically two parturitions more per year should be obtained (Cervera et al., 1993). Nevertheless, it is well known that AI on day 4 pp is more effective with eCG treatment or biostimulation methods (Rebollar et al., 2006). Moreover, the females undergo a nutritional deficit when lactation and pregnancy overlap. This deficit increases when the period between weaning and next parturition is short, preventing does from complete recovery of the body energy lost during

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Table 1
Effects of parity order (PO) and reproductive management (RM) on doe performance and global productivity

	Parity order (PO)				Reproductive management (RM)		RSD	Prob>f		
	1	2	3	≥4	Intensive	Semi-intensive		PO	RM	PO×RM
Parturitions (n)	178	100	62	62	182	220				
Body weight (g)										
Parturition[1]	–	3867 c	3965 b	4035 a	3990	3922	205	***	n.s.	*
21 dpp	3982 b	4103 a	4177 a	4133 a	4158	4040	210	***	n.s.	n.s.
25 dpp	4065	4031	4121	4123	4086	4084	250	n.s.	n.s.	n.s.
35 dpp	3999	4083	4107	4131	4157	4003	208	n.s.	*	n.s.
Milk production (g)[2]	3423 c	4093 b	4545 a	4037 b	4017	4032	1095	***	n.s.	n.s.
No. AI	1.25 b	1.59 a	1.70 a	1.64 a	1.70	1.39	0.62	***	***	***
Prolificacy										
Dead born	1.28	1.00	1.41	0.82	1.20	1.05	2.45	n.s.	n.s.	n.s.
Born alive	8.04	9.02	8.61	8.59	8.23	8.90	3.70	n.s.	n.s.	n.s.
PI (days)[3]	51.8	55.2	52.4	54.5	56.0	50.1	16.4	n.s.	*	*
Productivity[4]	–	–	–	–	52.3	61.4	36.4	–	*	–

Means in rows with unlike letters differ (*$P<0.05$, **$P<0.01$; ***$P<0.0001$).
dpp: Days *post-partum*; No. AI: number of AI needed to achieve the corresponding parturition; PI: parturition interval; RSD: Root Square Deviation.
[1]Nulliparous doe LBW has not been considered in the analysis ($n=73$ and 105 in I and SI group, respectively).
[2]Milk production=0.75+1.75 LBW21; where LBW21 corresponds to live body weight of litter at 21 days of lactation.
[3]PI corresponding to parity orders 1, 2, 3 and 4 are the elapsed days between the first, second, third, fourth and average of fourth plus kindlings, respectively.
[4]Number of weaned rabbits/doe and year.

lactation (Xiccato, 1996) and decreasing prolificacy at the following parturition (Castellini et al., 2003). Early weaning at 21 days of age permits does to reduce body energy utilization for milk production but can impair fertility and prolificacy in multiparous does (Xiccato et al., 2005). Extensive rhythms provide a low number of parturitions per year, which may cause doe overfattening and subsequent impairment of their reproductive performance (Partridge et al., 1986; Parigi-Bini et al., 1996). This is why the current management systems used in Spanish commercial farms are usually based on AI of does at 11 days pp.

Even alternating rhythms (AI at 1 and 27 days pp) *vs.* fixed mating intervals (AI on day 11 pp) have shown better adaptation to does' physiology (Castellini et al., 2003). A few studies concerning long term effects on doe performance and kit viability have been made to compare intensive *vs.* semi-intensive rhythms.

In this experiment we compared two reproductive management (an intensive and a semi-intensive one), both applied simultaneously in an experimental farm with similar

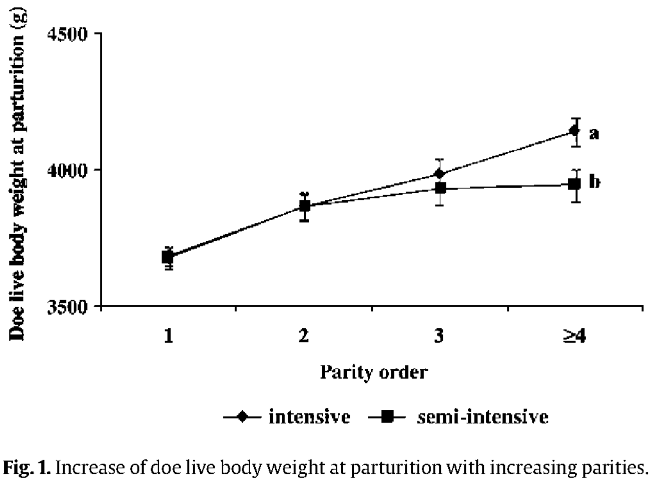

Fig. 1. Increase of doe live body weight at parturition with increasing parities. Means with unlike letters differ ($P<0.05$).

feeding and ambient condition, in order to evaluate their long term effects (including parity order) on productive parameters of females (live body weight, fertility, prolificacy and milk production) and on the litter growth and viability during the fattening period.

2. Materials and methods

A total of 181 rabbit does were housed on an experimental farm in the Animal Production Department of the UPM in individual flat-deck cages with a closeable nest box, under a constant photoperiod of 16 h light per day, a temperature of 18–22 °C, and a relative humidity of 60–75% maintained by a forced ventilation system. Nulliparous does were first inseminated at 19 weeks of age and, after their first kindling, does were randomly distributed in two experimental groups:

I group: 73 does for which complete records were available were inseminated on day 4 *post-partum* and weaned on day 25 of lactation.

SI group: 108 does were inseminated on day 11 *post-partum* and weaned on day 35 of lactation.

All lactating rabbit does had free nursing from parturition but were separated from their litters 24 h before AI and then inseminated using a pool of fresh heterospermic semen from bucks selected for growth performance. The semen was applied in a single dose with more than 20 million spermatozoa in 0.5 ml of a commercial diluent (Magapor, S.L., Spain). To induce ovulation, does were given an intramuscular injection of 1 µg buserelin acetate (Suprefact, Hoechst Marion Roussel, S.A., Spain). Twelve days after the first artificial insemination (AI), does were palpated to check for pregnancy. After kindling, the total number of live and dead kits (prolificacy) was recorded and litter size was adjusted to seven to nine kits per doe, by cross-fostering within parity order.

This reproductive management was followed for more than six inseminations. Non-pregnant does were inseminated

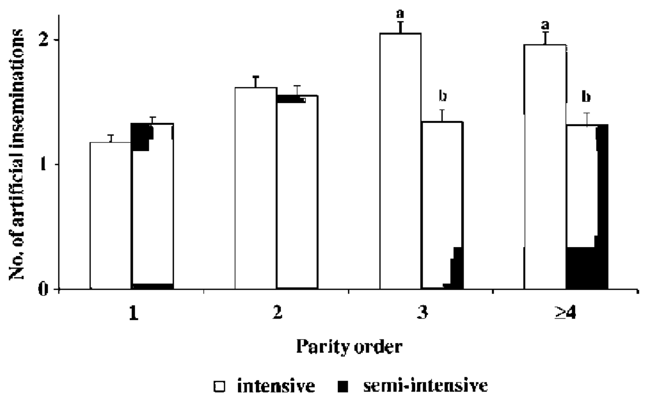

Fig. 2. Effects of parity order and reproductive management on the number of artificial inseminations needed to achieve parturition. Means with unlike letters differ ($P<0.05$).

35 days after the first AI in I group, and after 21 days in the SI group to avoid pseudopregnangy. After three infertile inseminations does were replaced. Weaned kits were moved to a fattening unit until they were 60 days old.

All females were fed *ad libitum* a commercial pelleted diet containing 18% crude protein (CP) and 12.7 g digestible protein (DP) per MJ digestible energy all throughout the experiment. Young rabbits of the I group (weaned at 25 days of age), were fed a pre-weaning diet until 35 days of age, formulated to reduce CP concentration to 16.5% CP and DP/DE ratio to 11.5 g/MJ by increasing alfalfa and decreasing sunflower meal. The productive parameters determined were: live body weight (LBW) of rabbit does immediately after parturition and on days 21, 25 and 35 *post-partum*, number of AI needed to achieve parturition, prolificacy (kits born alive and dead), parturition interval (PI) and productivity (number of weaned rabbits per doe and year), LBW of kits at birth (after equalization) and at 21, 25, 35, and 60 days, feed intake of kits between 25 and 35 days (in young rabbits of I group) and between 35 and 60 days and mortality (%) between 21–25, 25–35 and 35–60 days of age. Milk production was estimated by weighing the litters at 21 days of age and using the regression equation developed by De Blas et al. (1995), as follows: milk production (kg) = 0.75 + 1.75 LBW21 (kg); where LBW21 corresponds to live body weight of litter at 21 days of lactation.

All experimental procedures used in this research were approved by the Animal Ethics Committee of the Polytechnic University of Madrid and were in compliance with the Spanish guidelines for care and use of animals in research (BOE, 2005).

Statistical analysis was carried out using the SAS statistical package (Statistical Analysis System 8.2; 2001). A MIXED procedure was used according to an auto-regressive model to analyze repeated measures, including the effects of reproductive management (intensive or semi-intensive), parity order (first, second, third, and fourth plus) and their interaction with respect to productive parameters. Doe was considered a random effect nested in the treatment. For analysis of doe LBW and kit LBW at parturition, nulliparous data were omitted. Means were compared using a protected *t*-test and differences were considered significant when $P<0.05$.

3. Results

3.1. Rabbit doe parameters

Long term productive performance of does in both reproductive management is shown in Table 1. Parity order affected *LBW of females* at parturition ($P<0.0001$) and at 21 days of lactation ($P<0.0001$). Doe LBW at 35 days *post-partum* was 154 g higher in the I group ($P<0.05$), compared to the SI group. An interaction was observed between parity order and reproductive management ($P<0.05$) in relation to doe weight at parturition. As shown in Fig. 1, multiparous does from the I group with four or more parturitions had higher body weight than those of the SI group.

The lowest *milk production* was obtained in primiparous does ($P<0.0001$), and the highest in rabbit does with three previous parturitions ($P<0.0001$) (Table 1). The *number of AI* needed to obtain parturition was lower in nulliparous does than multiparous ones ($P<0.0001$). Reproductive management affected this parameter also, and rabbit does of the I group needed more AI to become pregnant than females of the SI group ($P<0.0001$). This was especially apparent from the third parturition onward (Fig. 2; $P<0.0001$).

Prolificacy (born alive and dead born) was not significantly influenced by management system.

Parity order did not affect the *parturition interval (PI)*. The mean was 53.5 ± 0.99 days. PI was higher than expected in both reproductive management systems, with an increase in the I group compared to the SI group ($P<0.05$), mainly between the 2nd and 3rd parturitions and between the 3rd and 4th parturitions (Fig. 3; $P<0.05$).

Productivity, estimated by number of kits weaned per doe and year, was higher in does inseminated on day 11 pp ($P<0.05$), with a mean of twelve weaned kits more than does inseminated on day 4 pp.

3.2. Kit parameters

Table 2 shows the productive performance of kits. Parity order affected *LBW of kits* at 21 days ($P<0.0001$), at 25 days ($P<0.0001$), at 35 days ($P<0.05$), and at 60 days of age ($P<0.0001$). Also, the reproductive management system had a significant effect on kit LBW at 21 days ($P<0.05$), at 25 days ($P<0.01$), at 35 days ($P<0.05$),

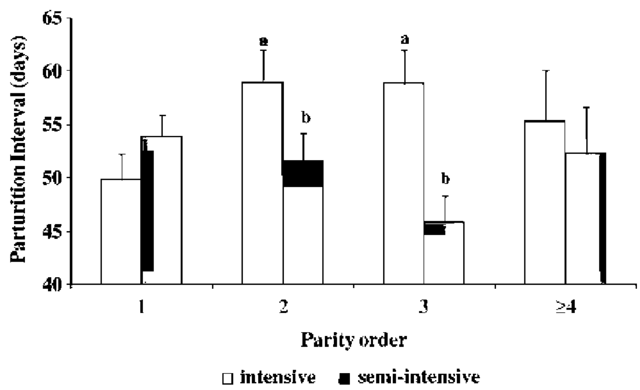

Fig. 3. Effects of parity order and reproductive management on parturition interval. Means with unlike letters differ ($P<0.05$).

Table 2
Effects of parity order (PO) and reproductive management (RM) on the performance of fattening rabbits

	Parity order (PO)				Reproductive management (RM)		RSD	Prob>*f*		
	1	2	3	≥4	Intensive	Semi-intensive		PO	RM	PO×RM
Parturition (*n*)	178	100	62	62	182	220				
Body weight kit (g)										
Parturition[1]	–	56.0	58.2	58.1	58.5	56.4	10.9	n.s.	n.s.	n.s.
21 dpp	273 b	263 b	318 a	337 a	307	289	77.7	***	*	n.s.
25 dpp	335 c	345 c	406 b	435 a	399	362	99.8	***	**	n.s.
35 dpp	691 b	687 b	674 b	755 a	671	732	163	*	*	**
60 dpp	1607 c	1622 c	1775 b	1892 a	1710	1788	243	***	*	*
Litter size										
Parturition[2]	8.0	9.0	8.6	8.6	8.2	8.9	3.7	–	–	–
21 dpp	7.29 b	8.88 a	8.59 a	7.40 b	7.83	8.25	2.28	***	n.s.	n.s.
25 dpp	7.21 b	8.55 a	8.29 a	7.15 b	7.61	7.99	2.45	**	n.s.	n.s.
35 dpp	6.97 a	7.83 a	7.12 a	6.04 b	6.54	7.73	2.40	***	**	*
60 dpp	6.74 a	7.01 a	5.93 b	5.44 b	5.96	6.61	2.25	**	n.s.	n.s.
Feed intake (g/day)										
25–35 days[3]	50.8	49.6	69.0	65.3	–	–	0.99	n.s.	–	–
35–60 days	109	128	113	86.8	113	105	116	n.s.	n.s.	n.s.
Mortality (%)										
21–25 days	3.27	5.71	3.78	3.75	3.22	5.03	9.43	n.s.	n.s.	n.s.
25–35 days	3.25 b	12.7 a	14.8 a	15.6 a	18.2	5.03	19.0	*	***	*
35–60 days	9.73	12.2	18.4	14.8	11.8	15.8	18.5	n.s.	n.s.	n.s.

Means in rows with unlike letters differ (*$P<0.05$, **$P<0.01$; ***$P<0.0001$).
dpp: Days *post-partum*; RSD: Root Square Deviation.
[1]Kit LBW of nulliparous does has not been considered in the analysis ($n=73$ and 105 in I and SI groups, respectively).
[2]Litter size at parturition was adjusted around seven to nine kits per doe, by cross-fostering within parity order.
[3]Feed intake from 25 to 35 days was measured only in I group.

and at 60 days of age ($P<0.05$). There was a significant interaction between the two main effects with respect to LBW at 35 and 60 days of age as shown in Fig. 4. Kits from multiparous does in the SI group with 3 or more than 4 parturitions were heavier than kits from does of the I group with the same parity order at 35 days of age (761.3±33.9 and 817.3±26.8 g *vs.* 585.8±32.8 and 692.3±29.4 g, respectively; $P<0.05$) and with 2 or 3 parturitions at 60 days of age (1726.2±37.3 and 1855.2±51.9 *vs.* 1518.1±44.8 and 1694.6±49.2 g, respectively; $P<0.05$).

Litter size at 21 and 25 days of age increased in multiparous does with 2 or 3 parturitions ($P<0.0001$ and $P<0.01$, respectively), but decreased at 35 days ($P<0.0001$) and 60 days ($P<0.01$) of age from the fourth and third parturitions onward, respectively. Rabbit does of the SI group had a higher ($P<0.05$) litter size at 35 days than those of the I group. There were no treatment differences in primiparous does but kit LBW increased ($P<0.05$) after 35 days in multiparous does of the I group, but remained low in does of the SI group.

Feed intake of kits weaned at 25 days was similar between 25 and 35 days as parity order increased, with an average of 58.7 g per kit. From 35 to 60 days of age, no significant changes were observed with respect to parity order or reproductive management. Kits consumed around 109 g/day of feed.

Main effects did not affect *mortality of kits* between 21 and 25 days of age. Nevertheless, a significant mortality increase between 25 and 35 days of age was observed in multiparous doe kits compared to those from primiparous does ($P<0.05$), and to weaned kits from the I group rabbit does ($P<0.0001$). In the I group, mortality increased 3.6-fold compared to the SI group. As shown in Fig. 5, there was a significant interaction between parity order and reproductive management on kit mortality from 25 to 35 days of age. During that period, kit mortality of multiparous does was higher in the intensive group ($P<0.05$). Between 35 and 60 days of age, kit mortality was similar throughout the whole experimental period.

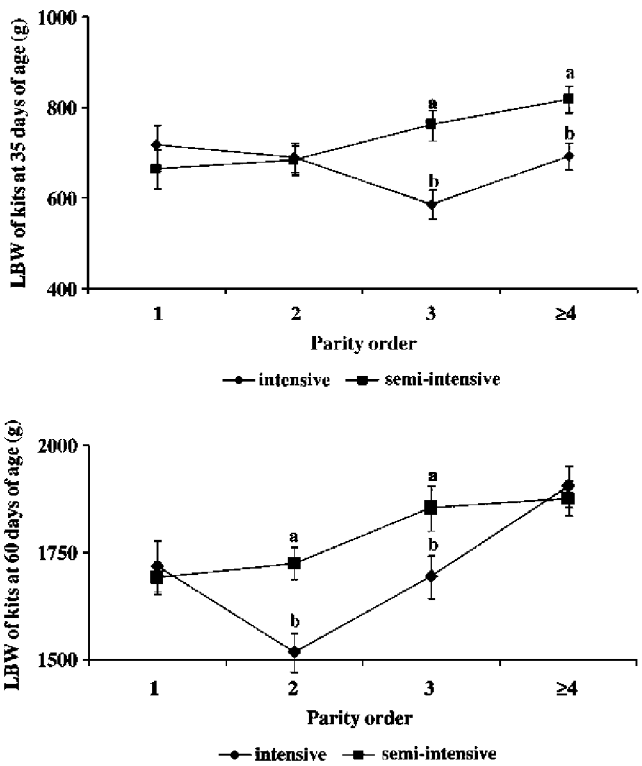

Fig. 4. Live body weight (LBW) of kits at 35 days of age ($P<0.01$) and at 60 days of age ($P<0.05$) in relation to the parity order of the doe. Means with unlike letters differ.

4. Discussion

4.1. Rabbit doe performance

In our study, LBW of does at parturition was similar to that observed in primiparous does by Fortun-Lamothe and Prunier (1999) and Xiccato et al. (2004), increasing over 180 g between the first and second parturitions, and afterwards around 90 g per parity. When rabbit does start their productive life, they usually have not yet achieved their total body development and for this reason their weight is lower.

It is known that primiparous does must finish their body growth with a relatively low ingestion capacity compared to their productive level (Xiccato, 1996; Parigi-Bini and Xiccato, 1998). Consequently, a clear negative energy deficit is found in these animals during first lactation. Using ultrasound, Pascual et al. (2002) observed a decrease of around 0.2 mm in peri-renal fat thickness during the three first weeks of lactation increasing to a loss of 0.9 mm in the last week. Similar results were obtained by Fortun-Lamothe et al. (2002), who determined by means of Total Body Electrical Conductivity (TOBEC) that there was a decrease of 5 MJ in the total energy content of primiparous does during lactation. Our results are in accordance with these studies, since primiparous does had the lowest LBW on day 21 *post-partum* at the time of the lactation peak. These does produced about 600 g less than multiparous females. Several authors indicate that energy output in milk during lactation is exceptionally high in rabbits compared to other species due to the intense milk production (200–300 g/day) and the high dry matter, protein, and fat concentration of this milk (Lebas, 1971; Fraga et al., 1989). Rabbit does with three previous parturitions had the highest milk production on day 21 *post-partum* because at this age multiparous does are able to bear a high energy cost because their feed intake capacity and their live weight have increased (Pascual et al., 1999, Xiccato et al., 2004).

On day 35 *post-partum*, the doe LBW of the semi-intensive group was lower than in the intensive one. This could be because the SI does were still lactating whereas the I group had been weaned 10 days before, prolonging their dry period and increasing the energy recovery time (Partridge et al., 1984, Cervera et al., 1993). Total rabbit milk production can be around 4 to 6 kg of milk. Based on the LBW of these animals, this is a very high production compared to other livestock species. This high expense affects the LBW of rabbit does and, if weaning is delayed (SI group), females are unable to recover their LBW.

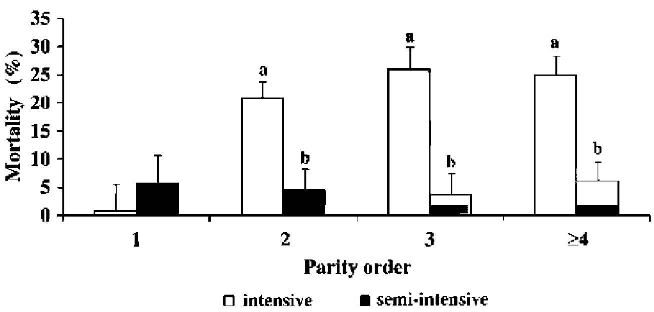

Fig. 5. Mortality (%) of kits from 25 to 35 days of age with both reproductive management systems. Means with unlike letters differ (P<0.05).

The ten-day rest period between weaning and next birth in the intensive group could be one of the reasons for the significant interaction obtained between parity order and reproductive management when studying LBW at parturition. This means that the longer dry period could allow for a lower cost in the I group, thus leading to a higher LBW at parturition.

Knowing the number of artificial inseminations needed to achieve parturition is an alternative way to measure fertility rates. In relation to this parameter, nulliparous does were the group that needed a lower number of AI because their receptivity and fertility are usually over 90 and 80% respectively when they are artificially inseminated (Rebollar et al., 1992, 2006). In the case of multiparous does, even though lactation does not completely inhibit *post-partum* ovarian activity, it is one of the main factors that may explain their lower fertility and the need of a higher number of AI to become pregnant. Rodríguez and Ubilla (1988) demonstrated that 98.5% of non-lactating multiparous does ovulate after a GnRH injection, whereas only 50.7 and 78.5% of lactating does ovulate on days 4 and 11 *post-partum* in response to GnRH injection, respectively. Fertility on day 4 *post-partum* is usually low (Díaz et al., 1988; Theau-Clément et al., 1990; Ubilla and Rebollar, 1995), and hormonal treatments such as eCG (equine Chorionic Gonadotrophin) or biostimulation methods (doe–litter separation) are necessary to improve receptivity and fertility in those cases (Rebollar et al., 2006). Xiccato et al. (2005) observed low fertility on day 2 *post-partum* due to a deficit in energy balance of females. This means that increasing the parturition–insemination interval could improve receptivity and fertility. In fact, long term results show that does of the I group needed more AI than rabbits of the SI group to become pregnant, so the number of pregnant females in the I group was lower than in the SI group. Also, when a 35-rhythm is applied in a farm situation, non-pregnant rabbits cannot be re-inseminated until other pregnant females are at day 4 pp. This results in an unproductive period in the I group. Together with this finding, we observed that PI was longer than theoretical or expected in both reproductive management systems. Differences were around 21 days longer in the intensive groups and 8 days higher in the semi-intensive group. This is why doe LBW at parturition of the I group was higher from fourth parturition onward compared to the SI. Nevertheless, parity order did not affect PI, due to the increased fertility and the lower number of AI that were necessary for multiparous does with more than two parturitions to become pregnant.

In the context of animal production, successful reproduction must be considered in terms of populations rather than on an individual basis. From this perspective, all the results obtained lead to a higher estimated productivity (number of kits weaned per year per doe) in the rabbit does of the SI group. Our results match those of Maertens et al. (2005), who considered inseminating does on days 5 to 12 pp as an intensive rhythm, obtaining 45–50 rabbits/doe/year.

4.2. Kit parameters

The highest LBW of kits (at all ages except at parturition) was observed after third or fourth parturitions. In the pre-weaning period (from birth to 25 days), kit LBW mainly depends on a relatively variable individual milk intake (around 360 to 450 g of milk) (Fortun-Lamothe and Gidenne, 2006). As time goes by, a higher feed intake of does and, subsequently, their increased milk production, could explain the higher pre-weaning LBW of kits in relation to parity order.

LBW of kits in the I group until 25 days was higher than in the SI group. On the other hand, at 35 and 60 days of age, LBW of kits from the SI group was higher. It is known that milk production increases between the first and the third week *post-partum*, but then it dramatically decreases, especially if the rabbit doe is at the end of its pregnancy. In this experiment, rabbit does of the I group tended to have a higher LBW at 21 days of lactation and needed more AI to become pregnant (Table 1), thus showing low fertility. Although milk production at 25 days was not determined, a high proportion of does in the I group were not pregnant and, maybe, had a higher milk production when their litters were weaned, which would explain the high LBW of 25-day-old kits in the I group.

On the other hand, kits from the SI group which were weaned later (at 35 days) reached a higher LBW at weaning and at 60 days old in does with 3 and more than 4 parturitions and in does with 2 or 3 parturitions respectively, as shown in Fig. 4. Under classical breeding conditions, in the period from 16 to 25 days old, kits access the feeder of the doe and have a total dry feed intake around 25–30 g/day per animal (Gidenne and Fortun-Lamothe, 2002). According to these authors, food intake increases 25-fold from 25 to 35 days of age. In our study, this transient period may have been less traumatic in the SI group kits, since they remained in contact with their mothers, which received a similar diet. Interactions of the main effects on LBW of kits were only visible at 35 and 60 days of age, since the multiparous does of the SI group were heavier than does of the I group. Litter size at 21, 25 and 35 days of age was higher in multiparous rabbit does with 2 and 3 parturitions; these mothers were in a period of higher milk production. However, after the fourth parturition, litter size was lower at 60 days of age. Researchers have demonstrated a marked maternal effect on litter size only up to 6 weeks of age, with a negligible effect afterwards (Blasco et al., 1983). This is why these results do not depend on a high or low milk production of rabbit does, but on the weaning conditions (weight, feed intake) and the kit's ability to be viable and survive during the *post-weaning* period.

With respect to reproductive management, litter size at 35 days was higher in the SI group. When weaning was performed at 25 days (I group), feed intake changes in the period from 25 to 35 days of age must be taken into account. Kits go from a single milk meal per day to a large number of alternating solid and liquid (water) meals irregularly distributed throughout the day without milk intake. Feed intake between days 25 and 35 of kits weaned at 25 days old was higher than that described by Fortun-Lamothe and Gidenne (2006) (around 35 g) in suckling rabbits, but our results agree with Xiccato et al. (2003), who reported that early weaning (at 18 to 25 days of age) increases solid feed intake compared to suckling animals. Even though feed intake of rabbits weaned at 25 days was more than enough, their LBW at 35 days old was lower and their mortality higher compared to rabbits still nursing at 35 days of age. As Fig. 4 shows, days 25 to 35 are critical for kit viability when early weaning is performed. Early weaned I group kits were fed a different diet with a lower DP/DE ratio to improve their gut health and survival rate. This diet reduced the amount of undigested protein reaching the caecum to reduce the proliferation of Clostridia and *E. coli* in the hindgut (Haffar et al., 1988; Gutiérrez et al., 2003). The hypothetical reduction of mortality in young rabbits could not be demonstrated in our study. In addition, the reduction in protein intake might affect their growth performance (De Blas et al., 1981). Different clinical signs and degrees of diarrhea were observed in dead rabbits. It is well known that digestive disorders are responsible for mortality and significant morbidity, characterized by reduced growth and poor feed conversion. Our results warrant a more intense study on weaning diets and nutritional preparation of the young before weaning.

5. Conclusion

In light of these results, we can conclude that the theoretical two parturitions more per year that could be obtained using intensive reproductive management compared to a semi-intensive system is difficult to achieve. In this long term study we have observed lower fertility and productivity, a higher parturition interval and reduced litter viability in the intensive group demonstrating that doe reproductive performance is adversely affected with respect to semi-intensive management.

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