BREEDING OF YOUNG FEMALES DOES

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ABSTRACT

This paper describes strategies for rearing of young rabbit does with the objective to improve reproductive performance and prolong lifespan. Body development during rearing was considered the main factor to influence subsequent reproduction. Body development was manipulated by feeding level during rearing (*ad libitum* or restrictive) and age of first insemination (14.5 and 17.4 weeks) and was determined at the end of rearing by body weight and body composition. Does fed restrictively and inseminated at 14.5 weeks of age were too immature for reproduction. In these does, body weight was low (3.2 kg), protein development was not completed, and puberty characteristics were poor. An optimum body weight at first insemination was found (around 4 kg) to optimize litter size. At 14.5 weeks of age and *ad libitum* feeding during rearing, over 70% of the does did not reach optimum body weight of 4 kg. Litter size of these does was reduced by 1.4 kit. At 17.5 week of age and *ad libitum* feeding during rearing, more than 75% of the does weighed at least 4 kg. However, heavy does were fatter, had a lower feed intake in the first gestation period, and the number of does with stillborn kits was increased. In restrictive fed does inseminated at 17.5 week of age, 60 to 80% of the does weighed around 4 kg, and the number of kits born alive was increased compared to does fed *ad libitum* during rearing and inseminated at 14.5 or 17.5 weeks of age. Milk production was influenced by the feeding strategy during rearing. Restrictive fed does inseminated at 17.5 week of age produced more milk than *ad libitum* fed does inseminated at the same age. This could be explained by the fact that restrictive fed does had not formed excessive fat depots at 17.5 week of age and had a higher feed intake as *ad libitum* fed does at the same age. *Ad libitum* fed does inseminated at 14.5 week of age, gained weight in the first gestation and first lactation period. Competition for nutrients between body growth and production must have occurred, and resulted in smaller litters and lower milk production than restrictive fed does inseminated at 17.5 week of age. It was concluded that young does should have a body weight around 4 kg at first insemination to optimize litter size. Feed restriction during rearing increased uniformity in body weight among does and stimulated feed intake in the first gestation period. The best reproductive performance in the first parity was obtained in does restrictively fed and inseminated at 17.5 week of age. Rearing strategies only affected body weight development, feed intake in the first parity. Long-term effects over three parities were absent and culling rate of does was not affected.

Key words: rearing management, reproduction, body development.

INTRODUCTION

In modern rabbit production the limited reproductive lifespan of rabbit does is seen as a welfare (BLOKHUIS, 1995) as well as an economic problem. This is mainly attributed to a high culling rate of young does, caused by early death, diseases and reproductive problems (FORTUN-LAMOTHE and BOLET, 1995; XICATTO, 1996; own data collected at our Institute, not published).

During first lactation does loose substantial part of their initial fat (-40%) and energy reserves (-25% to -30%) (XICCATO, 1996). Moreover, concurrent pregnancy and lactation will display losses in nitrogen and mineral levels (XICCATO, 1996). Feed intake is reported to be the main limiting factor (XICATTO *et al.*, 1995, 1996). The nutritional deficit is considered to be responsible for the decreased reproductive efficiency of young does. Presumably, it deteriorates the animals' health and this could shorten the lifespan of young does.

Research has focussed on improving the energy balance and performances of young does by increasing the digestible energy concentration of the diet (Maertens and de GROOTTE, 1988; FORTUN and LEBAS, 1994; XICATTO *et al.*, 1992, 1995) or adopting a more appropriate reproductive rhythm (FRAGA *et al.*, 1989; CERVERA *et al.*, 1993; PARIGI-BINI *et al.*, 1996). Till now, this type of approach was only marginally successful in compensating the energy deficit during the first lactation.

Another approach to overcome the problems of a negative energy balance is to focus on the rearing conditions of young does. We hypothesized that those does, which are "well developed" and have an improved feed intake and/or efficient energy utilization at start of their reproductive career may be in favor to overcome the negative energy balance during first lactation. This should be expressed in either an improved reproductive performance or a decreased culling rate.

The objective of this paper is to overview effects of body weight and age at first insemination on body weight development, feed intake, productivity, and culling rate of young does in their reproductive period. The following sections will focus on conditions for rearing, relationships between different rearing strategies and body development in terms of organ and tissue growth. The consequences for productivity, feed intake, body weight development, and culling in subsequent reproduction will be discussed. Finally practical implications will be given.

CONDITIONS FOR REARING

In current rearing, does are often fed *ad libitum* from weaning to first insemination. Before weaning, milk intake varies and is influenced by the litter size, in which the doe is raised. First insemination is applied when 75% to 80% of mature body weight is reached (LEBAS *et al.*, 1986), usually around 14 to 16 weeks of age. At first insemination body weight is around 3.5 kg. At this time most of the bone and muscle tissue has been formed, and protein and ash content levels off at approximately 20% and 3%,

respectively (DE BLAS *et al.*, 1977). The reproductive organs show a rapidly increasing development around 10 weeks of age (OUHAYOUN, 1984) and they are supposed to be sufficiently developed at first insemination. Feed intake capacity is not fully developed at first insemination, but increases during subsequent lactations until it reaches a plateau level after the fourth lactation (CASTELLINI and BATTAGLINI, 1991).

We stated that does, which are "well developed", should be more capable to cope with the forenamed problems during first lactation. In this context, "well developed" refers to several factors, such as:

1. Enhanced skeleton growth (to create more volume for feed intake and/or fetes);
2. Higher degree of maturity (by delaying first insemination in order to obtain a heavier animal with more body reserves in terms of protein and fat).

However, postponing first insemination to older age will enable the animals to form excessive fat depots, which could cause problems. In ruminants, it is shown that excessive fat depots cause health problems due to fatty liver in lactation (RUKKWAMSUK *et al.*, 1999). In rabbits, an increased kit mortality at kindling has been reported in does with a higher body fat content at kindling (PARTRIDGE *et al.*, 1986). To prevent excessive fattening, a form of feed restriction during rearing could be applied. Feed restriction during rearing could also be a tool to improve feed intake during reproduction. When rabbits are fed less restrictive or fed to appetite after a period of feed restriction, compensatory feed intake will take place and feed efficiency is improved (LEDIN, 1984). These mechanisms could be useful to increase energy availability during first gestation and early lactation.

REARING STRATEGIES

Rearing strategies that focussed on body development during rearing by changing the level of feed intake during different phases of development, with or without postponing the age of first insemination were studied (ROMMERS *et al.*, 2001a, 2001b, 2004b). The rearing period was divided into two periods and the effect of feeding level was studied in each period. The following periods were distinguished:

1. Before weaning (4.5 wk of age). The period before weaning is characterized by a high growth rate of bone, heart and lung, intestines, and caecum. Milk is the major source of feed. The number of kits within a litter affects individual milk intake. We assumed that stimulating milk intake would stimulate skeleton growth and this would result in larger /heavier does. Therefore, an experiment was performed in which kits were raised in litters of 6, 9 or 12 kits and the effect on subsequent body development, feed intake and reproduction was studied (ROMMERS *et al.*, 2001a).
2. From weaning until first insemination. The period after weaning is characterized by a rapid development of the caecum until 5 to 6 weeks of age as a consequence of the transition from milk to solid food. Feed restriction should not be applied in this phase, because the caecum plays a major role in the digestion of the rabbit and feed restriction can even favor conditions for pathogenic agents (MAERTENS and PEETERS, 1988).

   Muscle (protein) tissue shows a high development rate until 10 to 12 weeks of age (CANTIER *et al.*, 1969; DELTORO and LOPEZ, 1985). By restricting feed intake from 5 to

6 weeks of age onwards, protein and fat deposition will be hindered. By gradually increasing feed in take after 10 weeks of age, sexual development will be stimulated that starts around 10 to 12 weeks of age. By increasing feed intake from 10 to 12 weeks of age onwards, does will be able to compensate for the loss in protein development. In this way, it can be prevented that young does will have developed excessive fat depots at first insemination, whereas sexual development in these does is stimulated. Restrictive feeding regime as described above was compared to *ad libitum* feeding and the effect on body development, feed intake capacity and subsequent reproductive performance was studied in young does that were inseminated at 14.5 or 17.5 wk of age (ROMMERS *et al.,* 2001b, 2004b).

The results of the different experiments (ROMMERS *et al.,* 2001a, 2001b, 2004b) showed that body weight and body composition at first insemination could be manipulated by rearing strategies. Body weight at first insemination depended on feeding level (both in the pre- and post-weaning period) and age at first insemination. Depending on the rearing strategy applied, body weight at first insemination varied between 3.2 kg and 4.2 kg (for restrictively fed does inseminated at 14.5 wk of age (R-14.5) and *ad libitum* fed does inseminated at 17.5 wk of age (AL-17.5), respectively).
In the experiments, in which body composition was determined at the end of rearing (ROMMERS, 2001a and 2001b), mainly body fat content was affected and varied between 14% and 24% of the empty body weight (for R-14.5 and AL-17.5 does, respectively). Body protein and ash content were hardly influenced and ranged around 20%, and 3% of the empty body weight, respectively, independent of rearing strategy. This is in agreement with the study of LEDIN (1984), who stated that in case of feed restriction priority is given to organ development. In our studies, protein and ash contents at first insemination were comparable to levels reported by DE BLAS *et al.* (1977) for five months old does. In the study of DE BLAS *et al.* (1977), it was stated that at five months of age growth rate had slowed down with the tendency to put on fat and that protein and ash development was completed.

We supposed that milk intake before weaning would enhance skeleton growth, but this was not supported by our results. Does raised in different litter sizes had similar ash content (ROMMERS *et al.*, 2001a). The reason for this is not clear, but there are several possible explanations. It could be that milk intake was not sufficiently reduced in does raised in litter of 12 kits to impose an effect. Skeleton growth might have a high priority at this age, so nutrients will first of all be used for this purpose, and/or does might have been able to catch up for the loss in ash content after weaning, because feed was given to appetite from weaning onwards.

CONSEQUENCES OF REARING STRATEGIES FOR PRODUCTION

The main objectives for application of rearing strategies are to improve reproductive performance of young does and to prolong their reproductive lifespan. Improved reproductive performance implicates improvement of several reproductive factors, such as: kindling rate, litter size, kit survival at kindling and during lactation, and milk

production. To prolong the lifespan of the does, a low culling rate during reproduction should be achieved.

Kindling rate

Based on the results of the experiments, kindling rate varied between experiments (range 62% - 85%), but was not affected by rearing strategies except for the strategy in which does were fed restrictively and inseminated at 14.5 week of age. A 5-day flushing period before insemination did not provoke receptivity in these does. These does had less developed uterine horns. According to the number of animals in which *corpera lutea* were observed on the ovaries, only 50% of the does had reached puberty, indicating that with this rearing strategy animals were too immature to start reproduction (ROMMERS *et al.*, 2001b).

Litter size

Rearing strategy seems to affect litter size. Heavier does, raised in litters of six or nine kits, produced more kits (+ 1.1 and + 2.2, respectively) in the first parity than small does raised in litters of 12 kits (ROMMERS *et al.*, 2001a). Based on the data of does fed *ad libitum* and inseminated at 14.5 weeks of age (ROMMERS *et al.*, 2002) a positive relation exists between body weight at 14.5 weeks of age and litter size in the first parity. Litter size improved from 6.4 to 8.9 kits for does weighing less than 3.5 kg to more than 4 kg at first insemination. Restrictive fed does inseminated at 17.5 weeks of age produced more alive born kits (+ 1.4) and weaned more kits (+ 0.6) in the first parity than does fed *ad libitum* and inseminated at 14.5 or 17.5 weeks of age (ROMMERS *et al.*, 2004b). Therefore, the relationship between body weight at first insemination and litter size in the first parity was studied in more detail. For this analyses, we used all available data sets (Rommers *et al.* 2001a, 2001b, 2002, 2004b) and studied the relationship for the following three rearing strategies: *ad libitum* feeding and first insemination at 14.5 weeks of age (AL-14.5), or 17.5 weeks of age (AL-17.5), and restrictive feeding and first insemination at 17.5 weeks of age (R-17.5).

The relationships between body weight at first insemination, and litter size in the first parity was studied by dividing body weight at first insemination into 6 body weight-classes: 1) < 3.5 kg, 2) 3.5 – 3.75 kg, 3) 3.75 – 4 kg, 4) 4 – 4.25 kg, 5) 4.25 – 4.5 kg, 6) > 4.5 kg. For body weight classes containing less than five does the average was not calculated. The percentage of does and the average litter size in each body weight class were calculated. The outcome is presented in Figure 1 for AL-14.5 does, in Figure 2 for AL-17.5 does, and in Figure 3 for R-17.5 does.

Figure 1 shows that litter size increases when does are heavier at 14.5 weeks of age. However, litter size seems to level off: between eight and nine kits at 4 to 4.25 kg body weight for data in ROMMERS *et al.* (2001a) and at 3.75 to 4 kg body weight in unpublished results. These results indicate that at 14.5 weeks of age, does need a certain body weight (in our study around 4 kg) at first insemination to improve litter size in the first parity. In ROMMERS *et al.* (2002) it was observed that heavy (> 4 kg) does at 14.5 weeks of age had similar feed efficiency during rearing than small (< 3.5 kg) does.

This implicates that heavy does could not have deposited additional fat tissue towards the end of rearing.

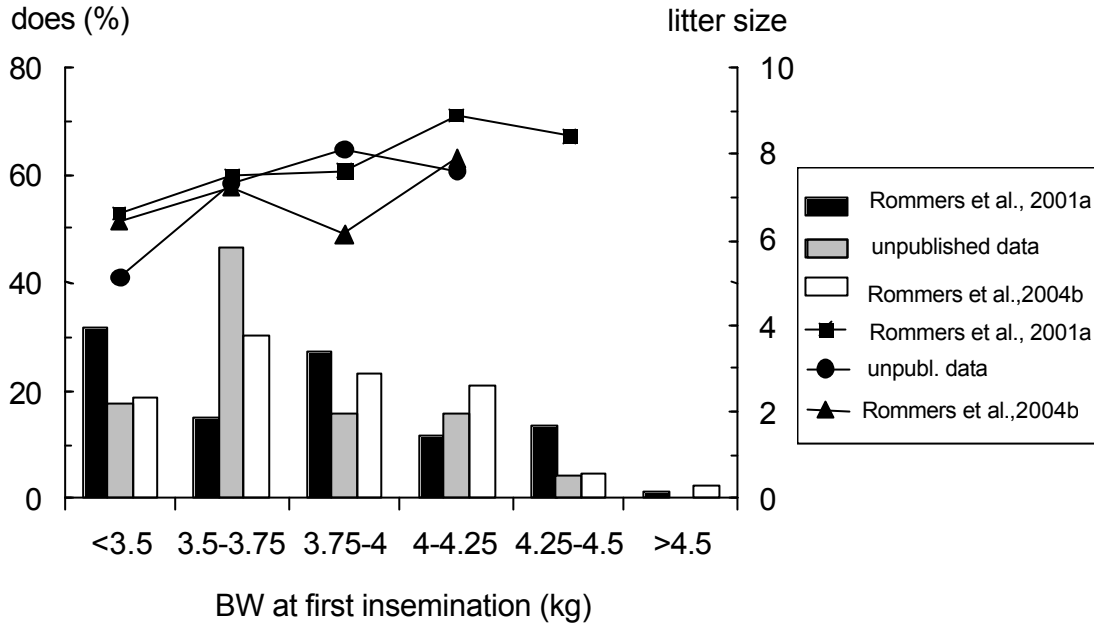

Figure 1. Relationship between body weight at first insemination at 14.5 weeks of age and litter size in the first parity for does fed *ad libitum* during rearing based on three experiments. The distribution of does in different body weight classes is presented in bars. Average litter size is represented by lines.

Heavy does must still have been deposited protein and fat tissue as small and medium does did. Therefore, heavy does contained more protein and fat, because they are heavier and this might indicate that they were more mature than medium and small does. This is supported by the fact that, does fed restrictively during rearing and inseminated at 14.5 weeks of age were small (3.2 kg) and showed poor fertility and embryo recovery (ROMMERS *et al.*, 2001b). It seems that body development of small does is not optimal at 14.5 weeks of age and results in a lower maturity and decreased litter size in the first parity. The fact that under *ad libitum* feeding conditions over 70% of the does did not reach body weight of 4 kg at 14.5 weeks of age (see Figure 1) can explain the decreased litter size. The improved litter size that was found in does raised in litters of six (LS6) and nine kits (LS9) in the pre-weaning period (ROMMERS *et al.*, 2001a) can be explained by the fact that more does (60, and 38.9% for LS6, and LS9, respectively) weighed around 4 kg at 14.5 weeks of age, whereas only 22.9% of does raised in litters of 12 kits did so. Body development of does raised in litters of 12 kits does not seem optimal at 14.5 weeks of age. In ROMMERS *et al.* (2002), small (< 3.5 kg), medium (3.5 to 4 kg) and heavy (> 4 kg) does were compared for subsequent performance. Litter size in small does was reduced compared to medium and heavy does (-1.3 and – 2.5 kits, respectively). Small does had a 25% lower growth rate during rearing. From these findings it can be stated that does need a certain body weight

(around 4 kg) to optimize litter size and under current rearing conditions first insemination should be delayed to older age.

To increase body weight at first insemination under *ad libitum* feeding conditions, the rearing period was prolonged until 17.5 weeks of age. The relationship between body weight at first insemination at 17.5 weeks of age and litter size is presented in Figure 2. Data presented in ROMMERS *et al.* (2001a) could not be used, because does inseminated at 17.5 weeks of age were also inseminated at 14.5 weeks of age, but had not become pregnant from the first insemination. Does were treated with a GnRH analogue (Receptal®; Intervet, Boxmeer, NL) to provoke ovulation. This treatment might affected litter size. In the body weight classes < 3.5 kg (ROMMERS *et al.*, 2004b) and < 3.75 (unpublished data), no average litter size was calculated, because of the small number of does.

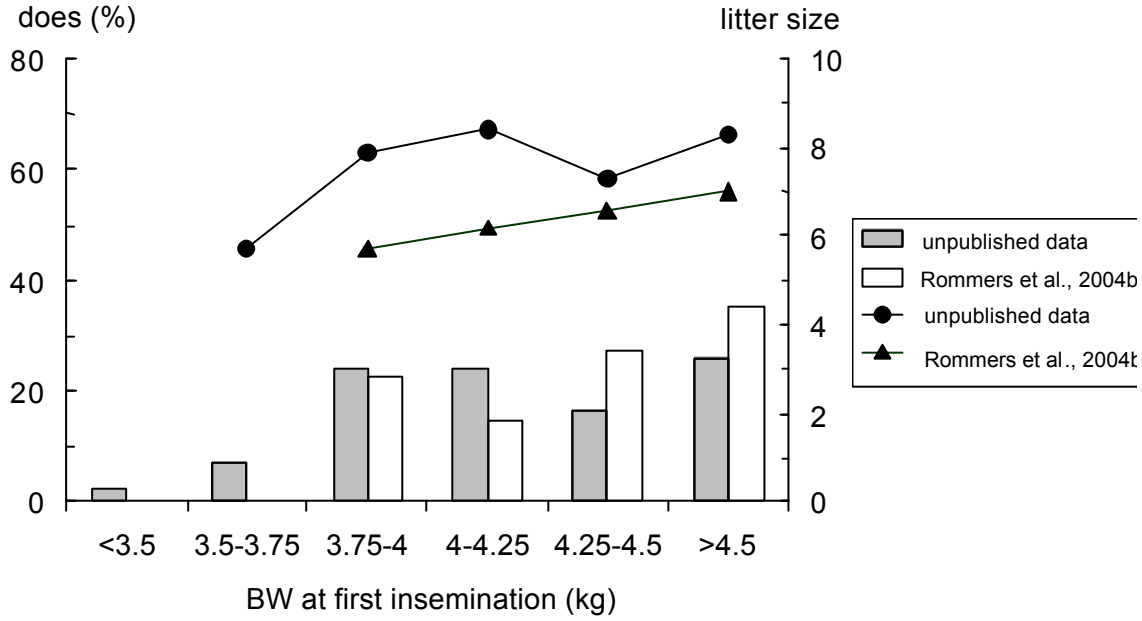

Figure 2. Relationship between body weight at first insemination at 17.5 weeks of age and litter size in the first parity for does fed *ad libitum* during rearing based on three experiments. The distribution of does in different body weight classes is presented in bars. Average litter size is represented by lines.

Figure 2 shows that litter size in the first parity is not strongly related with body weight at first insemination (at 17.5 weeks of age). No additional increase is achieved in litter size when does get heavier than approximately 4 – 4.25 kg for does in ROMMERS *et al.* (2004b), and around 4.25 – 4.5 kg for does in unpublished results. Litter size seems to level off at approximately 4 kg body weight, which is in accordance with does inseminated at 14.5 weeks of age. First insemination at older age (17.5 weeks) improved receptivity and embryo recovery (ROMMERS *et al.*, 2001b), but it did not result in increased litter size (ROMMERS *et al.*, 2004b) as compared to does inseminated at 14.5 weeks of age.

When postponing first insemination to 17.5 weeks of age under *ad libitum* feeding conditions more than 75% of the does reached body weight of at least 4 kg. However, heavy body weight at 17.5 weeks of age gives does with a high fat content. Under this rearing strategy, does were heavier at first insemination, but weight gain was mainly caused by deposition of fat tissue (ROMMERS *et al*, 2001b). Based on these results, it can be concluded that the number of does that reach a body weight of at least 4 kg is increased if first insemination is applied at 17.5 weeks of age. However, part of the does that reached over 4 kg body weight, will be fatter. A higher fat content can have negative effects during gestation and lactation as will be discussed later in this paper.

To prevent overfattening at first insemination, feed intake was restricted during rearing. Rearing period was prolonged with three weeks to enable does to restore protein and part of the fat development. At the end of rearing, R-17.5 does had similar body weight, ash, protein, and fat content as AL-14.5. Fat content was lower than AL-17.5 does (ROMMERS *et al.*, 2001b). Puberty characteristics of R-17.5 were similar to those of AL-14.5. Average litter size and percentage of does in the body weight classes were calculated. The outcome is presented in Figure 3.

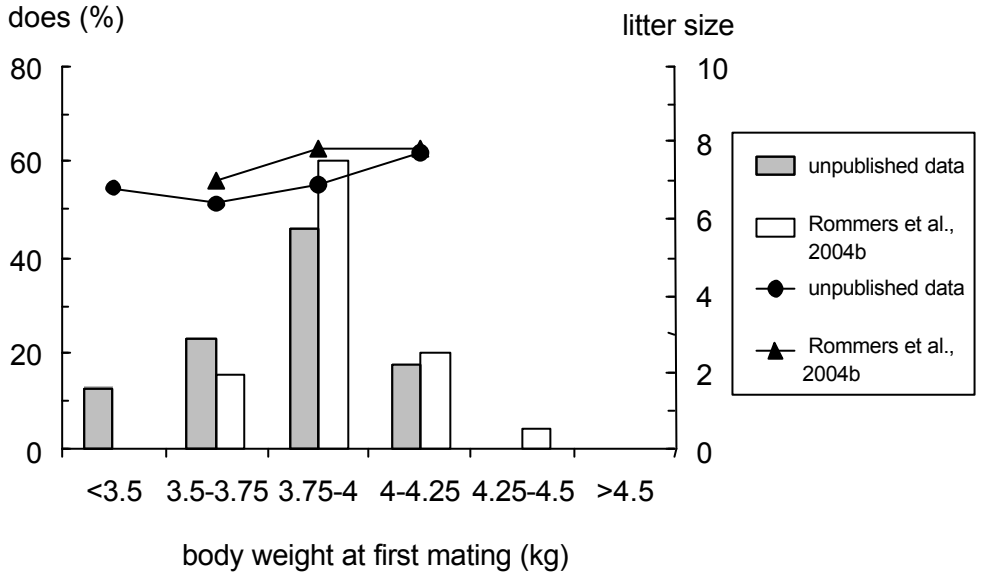

Figure 3. Relationship between body weight at first insemination at 17.5 weeks of age and litter size in the first parity for does fed restrictively during rearing based on three experiments. The distribution of does in different body weight classes is presented in bars. Average litter size is represented by lines.

Restrictive feeding during rearing increased uniformity in body weight at first insemination. The number of does weighed more than 4.25 kg was too low to calculate average litter size. The percentage of does that reached body weight around 4 kg at first insemination was 60 and 80% for unpublished data and data presented in ROMMERS *et al.* (2004b), respectively. There was no strong relationship between body weight at first

insemination and litter size. Litter size seems to plateau around approximately eight kits from 3.75 to 4 kg for does in unpublished results. Does in ROMMERS *et al.* (2004b) showed a small increase until 4 to 4.25 kg was reached. From 4.25 kg onwards, the number of does was too small and no more data were available.
It can be stated that restrictive feeding reduces variation in body weight at first insemination. This means a considerable decrease in the number of too small does at 14.5 weeks of age and number of too heavy does at 17.5 weeks of age, as was seen under ad libitum feeding conditions.

Stillbirth

In our experiments, there was no clear relationship between body weight at mating and stillbirth within one rearing strategy. The percentage of stillbirth varied greatly among does within treatments. Only a significant ($P < 0.05$) higher percentage of stillbirth was found for heavy does (body weight > 4 kg) inseminated at 14.5 weeks of age compared to small does (body weight < 3.5) (13.4% vs. 4.6%, respectively) (ROMMERS ET *al.*, 2002). No difference in stillbirth was found between AL-14.5 and AL-17.5 (ROMMERS *et al.*, 2004b).
The percentage of stillbirth seemed decreased for R-17.5 compared to AL-14.5 and AL-17.5 (2.3, 6.5, 13.5%, respectively; Rommers *et al.*, 2004b), but the difference was not significant. We also determined the number/percentage of litters, which had one or more stillborn kits. Fifty percent (20 litters with still born kits/40 litters) of the does in AL-14.5 had stillborn kits, 22.5% (9/40) in AL-17.5, and 9.1% (4/44) in R-17.5. Restrictive feeding seems to reduce the incidence of stillbirth. The percentage of does with stillbirth seems related to the voluntary feed intake of the does in the last week before kindling (ROMMERS *et al.*, 2004a). In does with a low feed intake an increased number of litters with stillbirth were found. Fetes growth in rabbits is characterized by a high growth rate during the last 10 days of gestation (XICCATO, 1996). PARIGI-BINI *et al.* (1992) showed that feeding level during gestation can affect mortality at birth. They reported a lower mortality rate at birth at higher feeding levels during gestation. The lower number of does with stillbirth of R-17.5 compared to AL-17.5 could be explained by the higher feed intake during the last week of gestation that was found in R-17.5 does (137 g/d vs. 172 g/d for AL-17.5 and R-17.5, respectively). The lower feed intake in AL-17.5 does could be explained by the higher fat content of these animals at first insemination compared to R-17.5 does (24 vs. 17%, respectively) and this is in agreement with the findings of PARTRIDGE *et al.* (1986), who found higher kit mortality at birth in animals, which have substantial quantities of fat.
In order to minimize stillbirth, restrictive feeding during rearing is preferred, because does will eat more throughout gestation resulting in decreased stillbirth at kindling.

Milk production

Litter weight at 16 days of lactation was used as an estimate for milk production in all experiments, because kits start to consume solid food from 17 days onwards (personal observation). The relationship between litter weight at 16 days and body weight at first insemination for the different rearing strategies is presented in Figure 4. In AL-14.5 does, milk production is independent of body weight at first insemination and varies

between 1.8 and 2 kg. At 17.5 weeks of age in does fed ad libitum, milk production slightly increases when does are heavier at first insemination, but the level of milk production is similar to AL-14.5 does. At 14.5 weeks of age, there were no does with body weight > 4.5 kg.

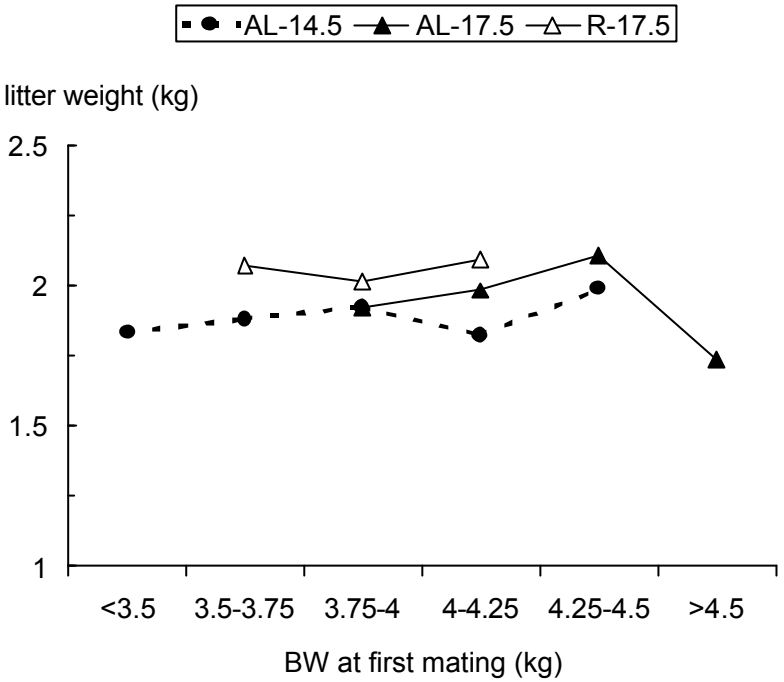

Figure 4. Relationship between body weight at first insemination and litter weight at 16 d in the first lactation for does fed *ad libitum* (AL) during rearing and inseminated at 14.5 or 17.5 weeks of age, and does fed restrictively during rearing (R) and inseminated at 17.5 weeks of age.

In AL-17.5 does heavier than 4.5 kg at first insemination milk production drops (to approximately 1.7 kg; $P < 0.01$). This could be related with the decreased feed intake during first lactation. Average feed intake during the first 16 d of lactation was decreased by 10% in does weighing more than 4.5 kg compared with does weighing 4.25 to 4.5 kg (data not published).

Does inseminated at 17.5 weeks of age and fed restrictively during rearing had an increased litter weight at 16 d of lactation compared to AL-14.5 and AL-17.5 (approximately +200 g), independent of body weight at insemination. Restrictively fed does inseminated at 17.5 weeks of age had an increased feed intake during first gestation (+20%) and first lactation (+10%) compared to AL-17.5 does. The extra available energy is most likely used for milk production.

In lactating does, R-17.5 does ate approximately 10% less food than AL-14.5 does during the first 16 d of lactation. However, AL-14.5 gained in weight, in the first gestation as well as in the first lactation period. This suggests that AL-14.5 does still have a “drive for growth”, because of their physiological immaturity at first insemination. Competition for nutrients between body growth and production must have occurred, and has resulted in smaller litters and lower milk production. This was not the case in R-17.5 does and

this explains the increased milk production found in R-17.5 compared to AL-14.5 does as shown in Figure 4.
A higher milk production will result in an increased kit growth and/or decreased kit mortality before weaning. The best productive performances were found in R-17.5 does (ROMMERS *et al.*, 2004b).

As we have seen, under *ad libitum* feeding conditions during rearing, milk production during first lactation increases slightly with body weight at first insemination until does are very heavy (> 4.5 kg). Milk production is not influenced by age of first insemination, but depends on the feeding strategy during rearing. In does fed restrictively during rearing the best performances were found probably because they eat well during lactation (as compared to AL-17.5 does) and give less priority to body growth (compared to AL-14.5 does).

Culling rate of does

We hypothesized that rearing strategies could prolong the reproductive lifespan of does, as result of an improved body development or an improved feed intake and/or efficient energy utilization. However, culling rate of does in the first three parities was not affected by rearing strategies. The overall culling rate for the different rearing strategies in our studies was 30.4%, 24.4%, and 26.7% for AL-14.5, AL-17.5, and R-17.5, respectively.
Data collected at our institute (not published) indicated that approximately 50% of the replacements occurred before the third litter is weaned. In our experiments, culling of does was recorded during the first two or three parities (depending on experiment), which covers most of the period of high incidence of replacement. Therefore effects could have been expected, if the rearing strategies would have had any influence on culling.
One explanation for the absence of an effect of rearing strategy on culling rate in this thesis might be that the number of does per treatment might have been too low. Because of practical limitations, larger numbers of animals per treatment were not possible in our experiments.
Another explanation for the fact that no effect of rearing strategy on culling rate was found might be that the applied rearing strategies had no long term effects on body weight development and feed intake in the first two or three parities. In all experiments, effects of rearing strategy were limited to the first parity. In the second and third parities no substantial effects of rearing strategies on body growth, feed intake, and reproductive performance were found.
Although rearing strategies affected body weight and body composition at first insemination, it gave no substantial profit in terms of body weight development, body composition and feed intake over two or three parities. Heavy does at first insemination (AL-17.5) lost substantial body weight during first gestation. *Ad libitum* fed does inseminated at 14.5 weeks of age showed substantial growth during first gestation that resulted in decreased reproductive performance in the first parity. Feed intake of R-17.5 does was improved in the first gestation and lactation period. However, the extra energy seems to have been used to improve reproductive performance in the first parity instead of improving energy balance, which has also been reported by XICCATO (1996). This

preference for reproduction makes it difficult to improve energy balance during first lactations and reproductive lifespan of rabbit does.

CONCLUSIONS

1. In order to optimize litter size, young does should have an optimum body weight. In our studies, optimum body weight was around 4 kg at first insemination.
2. Restrictive feeding during rearing and first insemination at 17.5 weeks of age improves uniformity in body weight at first insemination. Under *ad libitum* feeding conditions, more than 70% of the does will not have reached optimal body weight (around 4 kg) for litter size at 14.5 weeks of age. Litter size in these does is reduced by approximately 1.5 kits. At 17.5 weeks of age, the majority of the does (75%) is heavy (>4 kg). With restrictive feeding during rearing, between 60% to 80% of the does have a body weight of around 4 kg.
3. Extending first insemination with three weeks of age under *ad libitum* feeding conditions results in fatter animals. With restrictive feeding and first insemination at 17.5 weeks of age excessive fat deposition can be prevented, without reducing body protein and ash content.
4. Litter size and stillbirth were predominantly related to body weight at first insemination. Litter size increased with increased body weight at first insemination until 4 kg, when a plateau is reached. Small does (< 3.5 kg) are physiologically immature for reproduction. Stillbirth is increased in heavy does, due to a decreased feed intake during first gestation. Effects were restricted to the first parity.
5. Litter weight at 16 d of lactation (estimate for milk production) is influenced by the feeding strategy during rearing. Restrictive fed does mated at 17.5 weeks of age had the highest milk production, mainly caused by an improved feed intake compared to AL-17.5 does, and a lower weight gain during first gestation compared to AL-14.5 does.
6. Rearing strategies did only affect body weight development and feed intake in the first parity. Long term effects on subsequent parities were absent and culling rate of does was not influenced.

PRACTICAL IMPLICATIONS

Results discussed in this paper indicate that young does should have reached an optimum body weight (around 4 kg in our studies) to improve litter size. With the current rearing strategy, this body weight is often not reached. By establishing a threshold for body weight before does can be inseminated for the first time, litter size can be improved. In a cycled reproduction system, restrictive feeding can be used to increase the number of does with optimum body weight, which have to be inseminated at the same day. Restrictive feeding during rearing implicates postponing frst insemination with approximately three weeks. Besides an increase in uniformity of body weight and thereby improving litter size, restrictive feeding during rearing results in an improved milk production and increased weaning weight of the kits at the end of the first lactation.

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