THESES OF DOCTORAL (PhD) DISSERTATION

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ANALYSIS OF FACTORS INFLUENCING THE RABBIT DOES' PRODUCTION

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1. ANTECENDENTS OF THE RESEARCH, OBJECTIVES

Length of lighting hours and changing of seasons affect the animals' production. The role of influence of the lighting is predominate through the different neural- and hormonal way, but it is more significant in the reproduction of animals. These effects are obvious even for nocturnal animals as the European wild rabbits (*Oryctolagus cuniculus*).

The daily rhythm is characteristic not only to a wild rabbit, but to domesticated rabbit too. Eating, drinking, defecation, urination, mating, kindling, etc. are more frequent in the dark, active period.

It is well known, changing of seasons also affects the reproduction of rabbit. Mating behaviour of the European wild rabbits start early spring with the increasing lighting hours while during autumn with the decreasing lighting hours the reproduction activity is substantially lower (LEBAS *et al.,* 1986). As for sires it can be seen in the change of genital organs: their knockers are retrograde and the production of sperm is ceasing. Reproduction seasonality of the domesticated rabbits can be observed if the cages are outdoor or the (natural) lighting of the building performed through the windows. Seasonality can be ceased or decreased with applying a lighting schedule of 16L/8D during the whole year.

It is known, that increasing the light period prior to mating or to insemination leads to higher receptivity and kindling rates (THEAU-CLÉMENT *et al.,* 1990).

According to researchs it can be have the same effect by the increase of the number of lighting hours as the PMSG treatment. The experiments that examine the effect of the light on the rabbit does' production have high importance.

Only a few experimental data have been published in connection with lighting and the light requirements of rabbits. Our knowledge is limited about the alteration effect of ideal light intensity or light period. According my best

understanding no author analyzed so far the effect of light colour on the rabbits' production.

Beside the illumination and the light colour the effect of other factors is also important.

The light period or more precisely its alteration have a biostimulation effect, similarly to the PMSG/eCG treatment, increases the proportion of the receptive and kindled does. Similar effect can be expected in case of the doe litter separation or of changing the nursing methods (THEAU-CLÉMENT, 2007). Since so far only few experiments have been conducted in connection with the latter method and sometimes their results were controversial, an experiment in this topic was also carried out.

At the intensive rabbit farms insemination generally occurs 11 days after kindling (42 day reproduction rhythm). The lactation and the next gestation are partly coincide which is an overload for the does. Particularly in nulliparous does can be observed a negative energy balance at the end of the pregnancy and near the lactation peak, it means that rabbits are not able to consume as large amount of feed as their demand. At the same time from the animal welfare viewpoint of the domesticated rabbits less intensive reproductive rhythms were suggested (CASTELLINI, 2007). Examining this topic, an experiment was conducted to compare the condition and production of does under semi-intensive and extensive reproductive rhythms (insemination on day 11 or 25 after parturition).

In the rabbit breeding practice a common question is, what is the recommended feed of the does and their kits between the 21st day of lactation and weaning. However, the nutrient demands of the does and kits are different (LEBAS, 2004). The energy and protein level in the diet of rabbit does are higher than that of the kits before and after weaning. If the rabbits are fed by lactation diet until weaning, this is not ideal for the kits, but giving fattening pellet the mother's

demand is not satisfied. The benefits and disadvantages of the two feeding programs, was also analyzed in the framework of an experiment.
The interaction between the factors may also have significance therefore in most cases two factorial experiments were carried out.

Aims

Throughout my experimental work I wanted to get answers for the following questions:

1. What are the effects of the periodic lighting on the production and nursing behaviour of rabbit does (8 hours light, 4 hours dark, 8 hours light, 4 hours dark)?
2. What are the effects of changing of the nursing method from free to controlled three days prior to the insemination on the rabbit does' production?
3. How influence the production and nursing behaviour of rabbit does if the daily lighting period is increased from 8 to 16 hours eight days prior to insemination?
4. What is the preferred light colour of the rabbits?
5. What are the effects of blue light on the production of rabbit does?
6. What are the effects of the reproductive rhythms (insemination on day 11 or 25) on the production and condition of rabbit does?
7. How will change the production of rabbit does if instead of the 16-hour lighting 8-hour lighting is applied with one hour extra light in the middle of the dark period for 8 days prior to insemination?
8. How it is influence the production of the rabbit does, if until weaning rabbits consume breeding pellet or their diet is changed for fattening pellet at 21 days of lactation?

2. MATERIALS AND METHODS

I present the common parts of the experiments in the same part of the dissertation. The special characteristics of the experiments are described in separate subsections.

2.1. Animals and housing

The experiment was conducted at the Kaposvár University with Pannon White rabbits. The rabbits were randomly housed in two identical rooms. The building was heated in winter and cooled in summer, in winter the temperature ranged between 15-18°C and it could reach 28°C in summer. Rabbits were fed *ad libitum* a commercial pellet. Water was available *ad libitum* from nipple drinkers. Fluorescent lamp was used in each room. The lighting intensity measured at the level of the rabbits ranged between 30 and 70 lux. We installed the lenght of light period by the help of automatic timer.

2.2. Reproductive rhythm

The rabbits were first inseminated at the age of 16.5 weeks then using a 42-day reproduction rhythm, AI occurred 11 days after kindling using diluted semen (of single buck). No hormonal treatment (PMSG/eCG) was applied any groups to stimulate the receptivity. The does were injected 1.5 µg/rabbit GnRH analogue (Ovurelin, Reanal) to their thigh muscle. In the Experiments 1, 2 and 3 does which failed to conceive were reinseminated 21 days after the unsuccessful insemination. In the Experiment 4 all does were inseminated in each 42 day, using one batch system.

2.3. Condition examination

Estimating the condition of does, total body electrical conductivity (TOBEC) method was applied. The measurements (E-value) were made using EM-SCAN device (Model SA-3203-type). The kindled does were locked out from the nest boxes (at the day before the measurement) and they were let nurse their kits immediately prior to the TOBEC measurements thus the milk within the mammary gland could not influence the results. TOBEC measurements of the non kindled does took place at the same day.

2.4. Effect of lighting program and nursing methods on the production and nursing behaviour of rabbit does (Experiment 1)

The 11 week old female rabbits were randomly housed in two rooms. The two rooms differed only in the lighting programs. In the first room the length of the light and dark periods were 16 and 8 hours, respectively (16L:8D = 16L). In the second room the light and dark periods changed using a rhythm of 8 hours light, 4 hours dark, 8 hours light, 4 hours dark (8L:4D:8L:4D = 8+8L).

In both rooms the rabbits were randomly divided into two sub-groups according to the nursing method. In the first sub-group the rabbit does could freely nurse their kits throughout the whole experiment (FS). In the second sub-group, with the aim of biostimulation, the free nursing was changed to controlled nursing 3 days prior to insemination (FS-CS). The nestboxes were closed in the afternoon of the 8th day after parturition and they were opened each morning on days 9, 10 and 11. Rabbit does were inseminated 15 minutes after nursing on day 11. After the insemination free nursing was applied. Since the rabbit is a noctural animal, so the nursing happens mainly in the dark period, using controlled nursing between day 8 and 11 the does did not have an opportunity to nurse their kits during the dark period. Only the production of those animals which became pregnant and kindled after the first insemination (n=119) was considered but the

results of the first kindling were not analysed because no biostimulation could be performed prior to the first AI. The experiment lasted for almost one year and altogether data from 469 inseminations was evaluated.

After kindling a continuous (24 h) video recording was performed for 17 days using infrared cameras (n=75 does). Time, frequency and duration of the does' nursing events (length of stay in the nest box) were recorded.

The effect of the lighting program on the nursing behaviour was evaluated independently from the nursing method (FS and FS-CS groups were jointly evaluated). The influence of the nursing method was however only analyzed in the 16L group.

Data was evaluated with the SPSS 10.0 software package. Production traits and nursing data were analysed by means of multi-factor analysis of variance. Lighting program and nursing method were considered as fixed effects while parity order were treated as random effect. Kindling rates, suckling mortality, distribution of nursing were analyzed by chi^2-test. Average number of daily nursing events was evaluated by means of one-factor analysis of variance.

2.5. The effect of a light stimulation prior to insemination on the rabbit does' production and nursing behaviour (Experiment 2)

Prior to the experiment, does were kept using a lighting program of 16L/8D and each doe already had 2-3 parturitions. The does were randomly housed in two identical rooms which differed only in the lighting program. In the first room a 16L/8D lighting schedule was used throughout the experiment (16-16L group). In the other room a lighting program of 8L:16D was used during the days after parturition and the photoperiod was increased to 16 hours per day for 8 days prior to insemination, after insemination the lighting period was modified to 8 hours per day (8-16L group). In the 16-16L and 8-16L groups, 153 and 154

inseminations (94 and 111 parturitions) of 55 and 54 rabbit does were evaluated, respectively.

Crossfostering was used equalizing the litters to 8-9 kits. The does could freely nurse their kits. The kits were weaned at 35 days of age.

Production was monitored at each parturition. In the first and the third kindlings the body weight of does and kits (individual and litter weight) were measured every 4 days (16-16L group: 33 does; 8-16L group: 48 does) together with feed consumption to calculate the weight gain of the litters and feed conversion ratio between days 2^{nd} and 16^{th} *postpartum*.

From kindling till 14 days *postpartum* 24-hour video recordings were taken with infrared cameras (16-16L group: 16 does, 8-16L group: 18 does). Time and daily frequency of nursing events and the length of stay in the nest-box were recorded for every doe.

Production- and nursing data were evaluated by means of multi-factor analysis of variance, and chi^2-test (pregnancy rate, mortality, frequency of nursing events) using SPSS 10.0 software package. Parity was included in the model as a random effect. Evaluating the nursing behaviour the days of the lactation were treated as a covariate.

2.6. Light colour preference of rabbits (Experiment 3a)

The experiment was conducted with Pannon White growing rabbits weaned at the age of 35 days (n=128) and placed to cage-blocks ($2m^2$) using a stocking density of 16 rabbits/m^2. The rabbits could freely move among the four cages ($0.5m^2$ each) through swing doors. The identical cages were only different in the colour of light (white, yellow, green or blue). All cages were equipped with feeder and drinkers. The lighting period was 16L and the lighting intensity was 80-90 Lux in every cage. The walls of cages were covered with white plates avoiding light percolation. The rabbits received a commercial pellet *ad libitum*.

The consumed feed per cage was measured weekly. After an adaptation week from the age of 6 weeks infrared video recording was performed once a week. The number of rabbits in each cage was counted every 15 minutes for a period of 5 weeks. The experiment was repeated for four times and the applied light colours were rotationally changed (altogether all cages were treated with all colours). Data were evaluated by means of one-factor analysis of variance applying SPSS 10 software package.

2.7. Effect of the colour of light and reproductive rhythm on the rabbit does' production (Experiment 3b)

During the experiment the two rooms differed only in the colour of light. In the first room the customary white colour of light was applied (W group, n=59 does, 288 inseminations), in the second room, blue colour of light was used (B group, n=63 does, 304 inseminations). A 16L lighting program was used in both rooms. The luminous intensity - independently because of the colour of the illumination - was between 30 and 70 lux.

Within both rooms two further sub-groups were randomly formed: in the first sub-group the does were inseminated 11 days postpartum (reproductive rhythm of 42 days: 42D group, n=61 does, 323 inseminations), in the second room the does were inseminated 25 days after parturition (reproductive rhythm of 56 days: 56D group, n=61 does, 269 inseminations). The 4^{th} and 8^{th} kindlings of the 42D does coincided with the 3^{rd} and 6^{th} kindlings of the 56D group at the 168^{th} and at the 336^{th} days of the experiment (*Figure 1*).

In the 42D group the does could generally nurse their kits freely but 3 days prior to inseminations controlled suckling was applied and the kits were weaned at the age of 35 days. In the 56D group, the kits were weaned 2 days prior to the insemination at day 25 (at the age of 23 days).

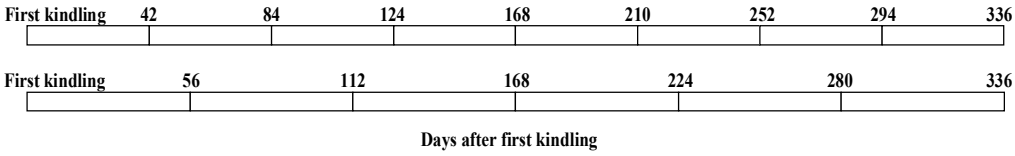

Figure 1: Theoretical kindling interval for the groups where the does were inseminated 11 days (upper line, 42D group) and 25 days (lower line, 56D group) after parturition

Only those rabbit does were used in the experiment that conceived after the first insemination. After equalization, at the first and latter kindlings every doe nursed maximum 8 and 10 kits, respectively. Does were culled due to conditional problems or if they did not conceive after two successive inseminations. The TOBEC measurements (E-value) were made using EM-SCAN device (Model SA-3203-type) at the first insemination of the does (at the age of 16.5 weeks, n=26 and 27) then at the age of 44-45 weeks (n = 22 and 17, respectively) in the 42D and 56D groups.

Production data was evaluated by means of multi-factor analysis of variance using SPSS 10.0 software package. The fix effects were the light colour (white or blue), the reproduction rhythm (42 or 56 days), the does' age (between days 1-168 and 168-336 of lactation).

2.8. The effects of the lighting schedule and feeding program on the rabbit does' production (Experiment 4)

The two rooms differed only in the lighting program. In the first room a continuous 16-hour long lighting period was applied (8:00-24:00; 16L:8D=16L; n=60 does, 239 parturitions). In the second room a 8-hour long lighting period was used (8:00-16:00) which was extended by an additional 1 hour light in the middle of the dark period (23:00-24:00) (8L:7D:1L:8D=8+1L; n=59 does, 223

parturitions) 8 days prior to each insemination (AI). After AI the lighting program was again 8L:16D (*Figure 2*).

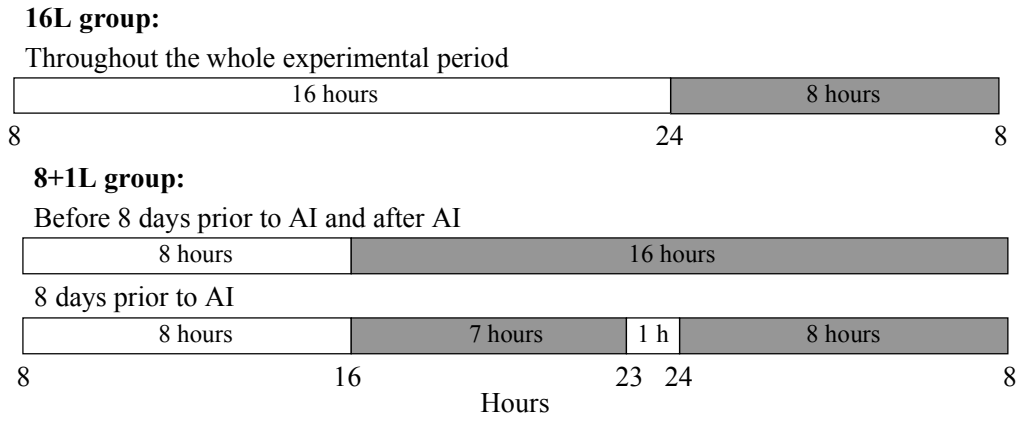

Figure 2: Lighting program

In both rooms two further sub-groups were formed. In the first the does and their kits received breeding pellet from parturition to weaning (BB group; n=60, 228 parturitions). In the second sub-group the breeding pellet was replaced by growing pellet from the 21st day of lactation until weaning (BG group; n=59, 234 parturitions).

During the experiment litter size (total born, born alive, at day 21 and at day 35), body weight of the does and litter weight at parturition, at 21st and 35th days of lactation were recorded. The conditions of randomly selected rabbit does (n=30) from every group were evaluated by TOBEC measurements (EM-SCAN Model SA-3203 type). The rabbits were weaned at the age of 35 days.

Feed consumption was measured during first gestation then between kindling and day 21 of lactation and between day 21 and day 35 of lactation. At the latter case the total feed consumption of the doe and her kits was recorded.

The 35 day old weaned random selected rabbits originated from the second and third parity (n = BB: 244, BG: 244) were placed into wire net cages (400x380 mm, 2 rabbits/cage). Body weight and feed consumption was measured every

two weeks. Using these recordings weight gains and feed conversion values were calculated. Mortality was recorded every day.

The data were evaluated by means of multi-factor analysis of variance (production of the does: lighting schedule, feeding program and parity order; production of the growing rabbits: feeding program and repetition), mortality was analyzed by chi^2-test using SPSS 10.0 software package. By evaluating the rabbits' condition (TOBEC, E-value) the body weight of the rabbits was also considered as covariate.

3. RESULTS

Effect of lighting program and nursing methods on the production and nursing behaviour of rabbit does (Experiment 1)

The objective of the experiment was to determine the effect of changing the 16-hour light and 8-hour dark photoperiod to 8-hour light, 4-hour dark, 8-hour light, 4- hour dark, and changing the free nursing method to controlled nursing 3 days before the insemination.

There was no significant effect of the lighting regime on the productive traits. 77% of the 16L does nursed their kits during the dark period. However, in the 8+8L group, 50% of the nursings occurred during the dark and 50% during the light periods. Thus the intermittent lighting disturbed the nursing behaviour of the does.

The nursing method significantly affected several traits. AI/parturition, body weight of the does at kindling, number of kits born alive, litter weight at day 21, average individual body weight of the kits at day 21 and suckling mortality were 1.38 and 1.24 ($P<0.05$), 4.51 and 4.37 kg ($P<0.01$), 7.95 and 8.46 ($P<0.05$), 3.06 and 2.92 kg ($P<0.05$), 395 and 382 g ($P<0.05$) and 5.3 and 7.3% ($P<0.05$) in the FS and FS-CS groups, respectively. Compared to the production per one insemination the advantage of the FS-CS group ($P<0.001$) was 16.2, 18.4, 9.3 and 6.3% for the traits of number of kits born alive, total number of kits born, litter size at day 21 and litter weight at day 21, respectively. Due to the change of nursing method the frequency of multiple nursing increased and several does nursed their kits between 8 and 12 h. The length of the nursing period in FS-CS group significantly exceeded that of FS does.

The effect of a light stimulation prior to insemination on the rabbit does' production and nursing behaviour (Experiment 2)

In this experiment it was examined, how influence the production and nursing behaviour of does if the 8-hour light was increased to 16 hours eight days prior to insemination.

The increased lighting period prior to insemination favourably affected pregnancy rate (16-16L: 61.4% vs. 8-16L: 72.0%, $P<0.05$). The number of kits born alive and litter size at 3 weeks of age were insignificantly higher in the 8-16L group, while the individual and litter weights at the age of 3 weeks were slightly higher in the 16-16L group. No differences were found for suckling mortality between the groups. Comparing the pooled results per one inseminations, the 8-16L does produced more kits alive at birth by 18.8% (6.20 vs. 5.22, $P<0.05$), which difference can be considered as substantial. The results suggest that light stimulation could be an alternative to PMSG treatments.

Changing the lighting affected the does' nursing behaviour: the daily frequency of nursing events increased and the lenght of nursing events was shorter in 8-16L group compared to 16-16L group.

Light colour preference of rabbits (Experiment 3a)

The objective of the experiment was to evaluate of the light colour preference test of growing rabbits.

Between the ages of 6-10 weeks the rabbits showed preference for the white colour light (28.0%). The observed (decreasing) preference order was the following: yellow (26.3%), blue (23.4%) and green (22.3%) ($P<0.001$). No significant differences were recorded for the feed consumption in the cages. Based on the results it can be concluded that the cage preference of the rabbits was slightly affected by the colour of light.

Effect of the colour of light and reproductive rhythm on the rabbit does' production (Experiment 3b)

The objective of this experiment was to analyze the effect of the colour of light (blue vs. white) and time of insemination after kindling (11 vs. 25 days) on the rabbits' production.

During the first gestation W rabbits had higher feed consumption (162 vs. 145 g/d, $P<0.05$) and larger body weight than B does. No significant differences were found for the number of inseminations per kindling and for litter size. Individual and litter weight measured at 23 days of age were higher in the B group (3498 g vs. 3611 g and 435 g vs. 451 g, respectively, $P<0.05$).

The number of inseminations per kindling was more favourable in the 56D group (1.22 vs. 1.12, $P<0.05$). The 56D does' body weight at kindling was larger than that of the 42D group (4188 vs. 4474 g, $P<0.001$). No significant differences were found for litter size. Slight differences were found for the individual and litter weight measured at 23 days of age ($P=0.055$ and $P=0.057$). Kindling intervals of the 42D and 56D groups were 46.6 and 59.5 days, respectively ($P<0.001$). The condition of the rabbit does (measured by the TOBEC method at 4-5th parturition) was better in the 56D group. Survival rate at the age of 336 days showed a difference of $P=0.07$ (13 and 26%) to the advantage of the 56D group.

The effects of the lighting schedule and feeding program on the rabbit does' production (Experiment 4)

The aim of the experiment was to compare two lighting regimes (continuous 16L:8D or 8L:7D:1L:8D) and two feeding regimes (breeding pellet till weaning or breeding pellet changed to growing pellet diet from the 21st day of lactation).

No significant differences were observed between the 16L and 8+1L groups for the number of inseminations per parturition, suckling mortality and the

condition of does at kindling measured by the TOBEC method. Significant differences were obtained for the body weight of the does (16L and 8+1L: at parturition = 4093 and 4184 g; at day 21 = 4689 and 4792 g; at day 35 = 4530 and 4611 g, P=0.005, P=0.002, P=0.018, respectively), litter size (16L and 8+1L: total born = 9.23 and 8.69, born alive = 8.83 and 8.24, at day 35 = 8.29 and 7.84, P=0.015, P=0.006, P <0.001, respectively), litter weight (16L and 8+1L: born alive = 556 and 532 g, at day 21 = 3280 and 3159 g, at day 35 = 8219 and 7741 g, P=0.048, P=0.006, P<0.001, respectively), individual weight of kits (16L and 8+1L: born alive = 63.7 and 66.1g, at day 21 = 390 and 400 g, P=0.008, P=0.034, respectively) and for feed consumption between days 21 and 35 of the lactation period (16L = 689, 8+1L = 660 g/day, P=0.001).

No significant differences were observed between the BB and BG groups for the number of inseminations per parturition, body weight of the does measured at parturition and at 21st day of lactation and for litter size. Change of the pellet type significantly affected the body weight of the does measured at the 35th day of lactation (BB: 4610 vs. BG: 4530 g, P=0.016), the litter and individual body weight of the kits at day 35 (BB: 8160 vs. BG: 7834 g, P=0.001; BB: 1006 vs. BG: 964 g, P<0.001, respectively) and the does' condition at kindling measured by the TOBEC method (E-value: BB: 1922 vs. BG: 1957, P=0.024). Body weight of the growing rabbits was significantly higher in the BB group (984 and 937 g, P<0.001, 1651 and 1621 g, P=0.008, respectively) at the ages of 5 and 7 weeks. After this period the body weights of the two groups were the same. The rabbits in the BG group showed significantly higher feed consumption (109 and 112 g/day, P=0.020) between the ages of 5 and 7 weeks. The feeding regime had no effect on the feed conversion ratio, morbidity and mortality of the two groups.

4. CONCLUSIONS AND RECOMMENDATIONS

The conclusions are shown in the same order as the results were presented in the Results and discussion section.

Experiment 1

The intermittent 8L:4D:8L:4D lighting regime is not advantageous from the aspect of production and it also disturbs the nursing behaviour of the does and suckling behaviour of kits which is disadvantageous for the well-being of the rabbits thus its application cannot be advocated. Our experiment showed that changing the nursing method (biostimulation) is capable of increasing the kindling rate and the production per AI. Contrary to the results of previous experiments the body weight of the suckling kits decreased. Changing the nursing methods from free to controlled 3 days before insemination can be recommended for the rabbit farmers as a biostimulation method.

Experiment 2

Based on our results, a light stimulation (from 8 hours to 16 hours light per day) 8 days before insemination (at 11 days after parturition) increased the pregnancy rate. Increasing of the daily lighting period is a good biostimulation method to increase the receptivity of does similarly to the hormonal (PMSG) treatment. According to our observation changing the lighting program affected the does' nursing behaviour: during lactation the frequency of multiple nursing increased, the average length of nursing events decreased in the 8-16L group. Additional, examinations covering the full behaviour repertoire are necessary.

Experiment 3a

The choice of cage depends on the colour of the illumination. Rabbits prefer staying in cages with white or yellow of light rather than in blue or green.

Experiment 3b

Although rabbits are nocturnal animals therefore they are not as sensitive to the colour of light as those animals that are active during the light period, for some traits significant differences were found between the groups illuminated by white or blue colour of light. Thus the effect of the colour of light is worth further analysis.

The 56 day reproductive rhythm was favourable from animal welfare viewpoint as the rabbit does had better condition and showed higher survival rate. On the contrary, the differences in yearly production were far too large (19-23%) which will prevent the breeders applying this system.

Experiment 4

According to our results the additional one hour long light period in the middle of the dark period (8+1L group) had no positive effect on the reproductive performance compared to the continuous 16-hour light. Despite of these results it may be worthy to make some additional examination. In case of other circumstances, e.g. lower pregnancy rate, the effect can be reached with this method is questionable. A longer period of extra light would be worth to test, maybe the 8-hour light plus 4-6-hour dark and the 2-4-hour extra light could sum up to a continuous 16-hour light.

Comparing the two feeding programs, feeding both the rabbit does and the suckling kits by breeding pellet until weaning is more advantageous then by growing pellet from 21 days to weaning.

5. NEW SCIENTIFIC RESULTS

Based on the experiments the following new results were obtained:

1. It was established that the periodic 8-hour light : 4-hour dark : 8-hour light : 4-hour dark photoperiod did not have any positive effect on the does' production but at the same time the periodic lighting program disturbed the nursing behaviour, which is against animal welfare.

2. It was established that the does housed in blue light had litters of significantly higher weight (litter and individual) at day 23 than that of does kept in white light.

3. It was established that rabbit does inseminated 25 days instead of 11 days *postpartum* had higher body weight, better condition and survival, which are favourable in terms of animal welfare. But because of the less frequent of kindlings, the number of rabbits per doe and year decreased by 23%, this is disadvantageous from economical aspects.

4. It was established that one hour extra light in the middle of the 16-hour dark period eight days before the insemination had no positive effect on the production of rabbit does.

5. It was established that feeding the does and their kits by breeding pellet till weaning was more beneficial than changing the breeding pellet to growing diet at 21st day of lactation.

6. PUBLICATIONS ON THE SUBJECT OF THE DISSERTATION

6.1. Papers published in foreign language peer-reviewed journals

Gerencsér Zs., Matics Zs., Nagy I., Szendrő Zs. (2009) Light colour preference of growing rabbits. Ital. J. Anim. Sci., Vol. 8; 205-207.

Gerencsér Zs., Matics Zs., Nagy I., Szendrő Zs. (2010) Effect of the colour of light and reproductive rhythm on the rabbit does' production. World Rabbit Sci., (submitted)

Gerencsér Zs., Matics Zs., Nagy I., Szendrő Zs. (2010) The effects of the lighting schedule and feeding program on the production of rabbit does and their kits. 1. Effect of lighting schedule. World Rabbit Sci., (submitted)

Gerencsér Zs., Matics Zs., Nagy I., Szendrő Zs. (2010) The effects of the lighting schedule and feeding program on the production of rabbit does and their kits. 2. Effect of the feeding program. World Rabbit Sci., (submitted)

Gerencsér Zs., Matics Zs., Nagy I., Radnai I., Szendrő É., Szendrő Zs. (2011) Effect of lighting program and nursing method on the production and nursing behaviour of rabbit does. 1. Effect of lighting program. World Rabbit Sci., (submitted)

Gerencsér Zs., Matics Zs., Nagy I., Radnai I., Szendrő É., Szendrő Zs. (2011) Effect of lighting program and nursing method on the production and nursing behaviour of rabbit does. 2. Effect of nursing method. World Rabbit Sci., (submitted)

6.2. Papers published in Hungarian language peer-reviewed journals

Szendrő Zs., **Gerencsér Zs.,** Princz Z. (2004) A fényperiódus hatása a nyulak termelésére (Irodalmi áttekintés). Állattenyésztés és Takarmányozás, 53. 3, 239-249.

Szendrő Zs., **Gerencsér Zs.,** Princz Z. (2004) A fény hatása az anyanyulak termelésére. Baromfiágazat, 1, 85-88.

Gerencsér Zs., Matics Zs., Nagy I., Biró-Németh E., Radnai I., Szendrő Zs. (2010) A termékenyítés előtt megnövelt megvilágítás hatása az anyanyulak termelésére. Magyar Állatorvosok Lapja, 132, 647-650.

6.3. Full conference papers in proceedings

6.3.1. In foreign language

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