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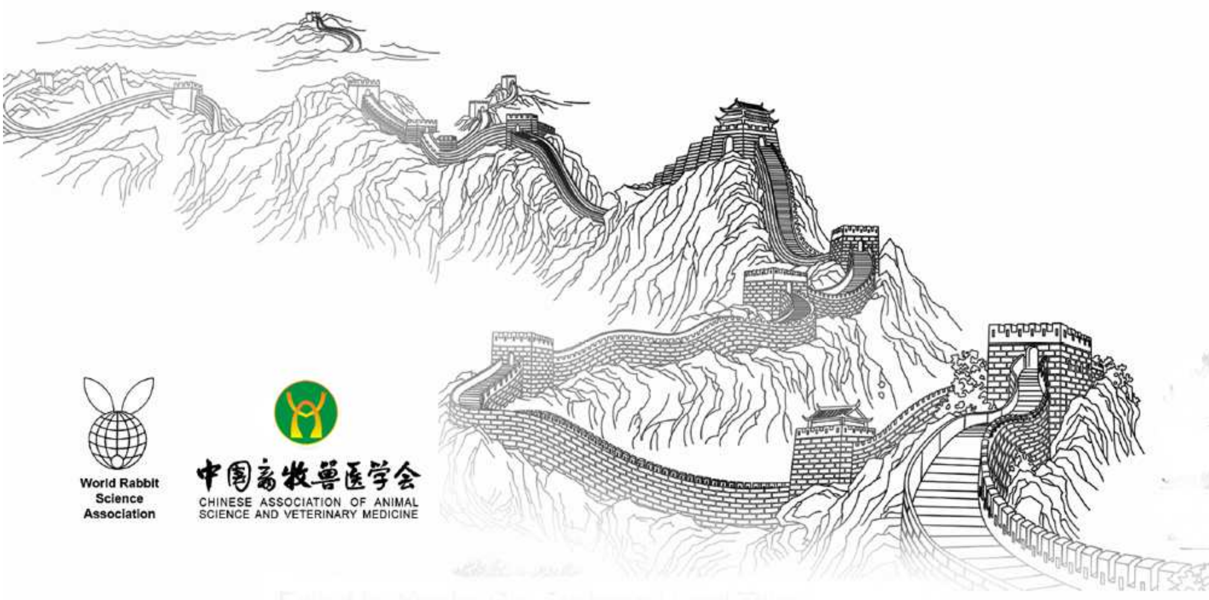

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EFFECT OF PHOTOSTIMULATION, LIGHT SOURCE AND SEASON ON REPRODUCTIVE PERFORMANCE OF RABBIT DOES

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ABSTRACT

The production of controlled nursing rabbits subjected to 9 h basal daily lighting with warm-white neon or cold-white LED lamps (light intensity 40-50 or 50 lux) was compared at two rabbit farms differing in photo-stimulation before AI (on day 11). At both farms on day 8 before AI the daily lighting was increased to 16 h and from day 3 after AI it was gradually reduced to 9 h. At Galgamácsa farm (June – October) the light intensity was also enhanced by using warm-white compact saving lamps to 55-80 lux in neon-lighted units or by setting the LEDs to 100 lux in the LED-lighted units. At Kartal farm (July – August) there was no supplemental lighting, i.e. the light intensity was not changed in the neon or LED-lighted units, only the duration of the daily lighting was increased. In summer at Galgamácsa, pregnancy (91%) and kindling rates (83%) were 5% higher ($P<0.05$) with LED than with the neon plus saving lamp photo-stimulations (85-87% and 78%). At Kartal, the 1-2% differences in favor of LED lighting were not significant for these traits. The number of kits born alive was higher in Galgamácsa (neon or LED: 10.3 or 10.6-11.0 kits) than in Kartal (neon or LED: 8.7 or 8.8-8.9 kits). Global productivity (number of live born kits per 100 AI) was the best in Galgamácsa, with LED lighting and stimulation in summer (782 rabbits). With the tested LED lighting and LED "dual" photo-stimulation (increased day length and light intensity around AI), the summer production of controlled nursing rabbits was improved. These results confirm the importance of light characteristics when stimulating rabbit does at AI by modified lighting.

Key words: Luminescent neon-tube, compact saving lamp, LED, Light intensity, Productivity

INTRODUCTION

The lighting program and its change before insemination (AI) influence the oestrus and it can be a useful biostimulation method (Theau-Clément, 2007; Szendrő et al., 2016). Light affects reproduction via the neuro-hormonal route. With artificial lighting, day length has the primary role but light intensity, colour and evenness of illumination can also be important (Tast et al., 2001; Kalaba and Abdel-Khalek, 2011).

The effect of photoperiod can vary depending on previous photoperiod used (Walton et al., 2011). Comparing 8, 10, 12, 14 or 16 h daily fluorescent lightning with 20 lux light intensity Mousa-Balabel (2011) found that 14 h lighting was optimal for doe performance. Supplemental lighting of 14 h per day with 30 lux light intensity with incandescent bulbs favored productivity when natural photoperiod was decreasing (Mattaraia et al., 2005). Quintela et al. (2001) and Theau-Clément (2007) also found better receptivity and fertility but they increased the day length from 8 to 16 h and used higher, 70 lux light intensity. Theau-Clément (2007) reported reduced weaning weight. Intermittent 12 h daily lighting with 40 lux light intensity reduced rabbit does' feed intake (Virág et al., 2000). Others assessed the impact of lighting schedule or light colour in rabbit does by the generally used, 30-70 lux light intensity (Gerencsér et al., 2008ab; Kalaba and Abdel-Khalek, 2011). Maertens and Luzi (1995) used higher, 120 lux light intensity with fluorescent bulbs and increased the day length from 10 to 16 h in preceding 5 days before AI. This lighting schedule resulted in reproduction similar to what they found with 16 h lighting. According to

Matics et al. (2015) with 16 h daily lighting, the rabbit does preferred cages with 10-20 lux to those with 150-200 lux light intensity but the number of kits born alive was lower. Besenfelder et al. (2004) studied the effect of 46-97 lux or 210-590 lux light intensity with 16 h daily neon lighting. They observed higher sperm concentration with higher light intensity. Sperm output can be influenced by the duration and source of lighting (El Hammady and Abdel-Kareem, 2015).

Because of energy saving, the incandescent bulbs or luminescent neon tubes are commonly replaced with compact energy saving lamps or dimmable LEDs. We experienced better evenness of illumination with LEDs than with neon tubes. This could positively influence doe performance.

Our aim was to assess the effect between neon and LED lighting and as novel biostimulation technique on reproductive performance of rabbit does subjected to local nursing practice.

MATERIALS AND METHODS

Animals and experimental design
The experiments were conducted at two central Hungarian near-by rabbit farms of S&K-Lap Ltd. with Hycole rabbits (Galgamácsa: n=9914, Kartal: n=2710) between June and October 2014. At Galgamácsa, the neon-tubes were replaced with LED lamps in building II in summer and in building I in autumn, while at Kartal in building I in summer (see Table 1).

Increase of daily lighting duration
There was no hormonal oestrus synchronization but on day 8 before AI, the 9 h L (8 a.m. to 5 p.m.) was increased by 7 hours to 16 h L (6 a.m. to 10 p.m.). The lighting was reduced by 2 hours on days 3 and 4 after AI (14L, 6 a.m. to 8 p.m. and 12L, 8 a.m. to 8 p.m.) and by 3 hours on day 5 after AI, returning to the 9 h (8 a.m. to 5 p.m.) daily lighting.

Increase of light intensity
At Galgamácsa farm, not only the duration of the daily lighting but also the light intensity was increased for photo-stimulation. In the neon-lighted buildings, 2x21W luminescent neon-tubes (150x20 cm) ensured the warm-white, 40-50 lux basic lighting. To increase light intensity, all 21W warm-white compact saving lamps in the middle light strip equipped 1.5-2 per m were turned on from day 8 before AI to day 3 after AI (55-80 lux light intensity). On day 4 after AI only every second lamp was on. Thereafter there was no supplemental lighting. In the LED-lighted buildings, the dimmable cold-white multichip four-die LED lamps (15x20 cm) provided the basic 50 lux illumination. To increase light intensity, the LEDs were set to 100 lux from day 8 before AI to day 3 after AI. On day 4 after AI the light intensity was reduced to 80-90 lux and then back to 50 lux. At Kartal farm, there was no increase of light intensity but the duration of the daily lighting was increased for light-stimulation purposes as described above (see Table 1).

At both farms, in air conditioned (20-23°C) buildings with windows, the rabbits were kept in wire-net breeding cages (80 x 53 x 90 cm) equipped with plastic mats and elevated platforms (40 x 53 cm) at 25 cm height. Controlled nursing was used by opening the metal-sheet nest door (9 a.m. to 10 a.m.) until lactation day 14 and free nursing thereafter. AI was done on postpartum day 11. Pregnancy was checked by abdominal palpation on day 14 after AI. Rabbit does were fed the same diet *ad libitum* (10.0 MJ/Kg DE, 17.5% CP, 3.80% EE, 14.9% CF, 7.7% ash).

The effect of lighting, season and building on pregnancy and kindling rates were evaluated by the chi-squared test while litter size was evaluated by ANOVA using the Statgraphics 6.0 (1992) statistical software. Productivity and global productivity were calculated as the number of live born kits or the number of 35-day-old weaned rabbits per 100 AI, respectively. Kit 35-day body weight was not calculated at Kartal.

RESULTS AND DISCUSSION

Based on the productivity and global productivity the best performance was found in Galgamácsa, with LED "double" photo-stimulation in summer (919 and 782 rabbits, Table 1). Pregnancy and kindling rates were 4-6% and 5% higher (91 and 83%, P<0.05) with LED lighting than with neon lighting and saving lamp stimulation (85-87% and 78%).

At Kartal, the light source had no effect as the pregnancy and kindling rates seemed to be only 1-2% better with LED lighting. However, only the day length was increased at photo-stimulation while the light intensity was not changed at this farm.

The number of live born kits per litter was 1.7-kit higher at Galgamácsa than at Kartal (10.5 vs 8.8). One explanation can be the different photo-stimulation but this has to be confirmed in further studies.

Table 1: Effect of photo-stimulation, light source, season and building on performance of rabbit does

Farm	Galgamácsa						Kartal			
Basic daily lighting										
light source	Neon	Neon	LED	LED	LED		Neon	LED	LED	
duration of lighting (h)	9	9	9	9	9		9	9	9	
light intensity (lux)	40-50	40-50	50	50	50		40-50	50	50	
Photo-stimulation										
increased day length	yes	yes	yes	yes	yes		yes	yes	yes	
increased light intensity	saving lamp	saving lamp	LED	LED	LED		no	no	no	
Season	summer	summer	summer	autumn	autumn		summer	summer	summer	
Building	I	II	II	I	II	Prob.	I	I	II	Prob.
Pregnancy rate, %	87.0^{b}	85.1^{a}	90.8^{cd}	92.3^{d}	90.1^{c}	<0.05	88.8	91.3	89.6	NS
Kindling rate, %	78.1^{a}	78.0^{a}	83.5^{b}	81.3^{b}	81.3^{b}	<0.05	82.8	84.7	85.0	NS
No. of live born kits	10.3	10.3	11.0	10.7	10.6	NS	8.71	8.96	8.82	NS
Productivity	802	801	919	868	863	-	722	759	750	-
Global Productivity	718	712	782	751	752	-	706	741	735	-
Kit 35 d body weight, g	1056	1016	1057	1061	1161	-	-	-	-	-

Values in the same row with unlike superscripts differ (P<0.05)
NS: P>0.05

The sexual receptivity at AI was not judged but the higher rates of pregnancy and kindling with LED lighting than with neon lighting suggest that the LED lighting had a positive effect on the oestrus and can be used as a photo-stimulation.

Our data confirm that other environmental factors, i.e. the season or farm conditions, can also influence the success of light-stimulation.

Quintela et al. (2001) studied different lighting programs to ours but they also applied a second stimulation, controlled nursing prior to AI. We presume that the nursing and lighting methods around AI interacted. That point needs further investigation.

The lighting program can affect kit mortality (Quintela et al., 2001) and body weight at weaning (Theau-Clément, 2007). Gerencsér et al. (2008a) reported larger weaning weight with blue vs white lighting. At Galgamácsa, the cold-white LED lighting had no adverse effect on kit 35-day weaning weight.

CONCLUSIONS

The LED lighting and photo-stimulation have positive effects on oestrus since pregnancy and kindling rates were increased compared to the values obtained by neon lighting.

With the tested LED lighting and LED "dual" photo-stimulation (increased day length and light intensity around AI), the summer production of controlled nursing rabbits can be improved.

Our results confirm the importance of light characteristics when stimulating rabbit does for better production by lighting. This needs to be studied more thoroughly in the future.

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