An investigation of the use of blue light therapy to extend photoperiod in pregnant mares and its influence on gestation length on commercial breeding farms

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Application Pre-partum administration of artificially extended photoperiod through head-worn blue light masks may prevent prolonged gestation periods in mares and improve breeding efficiency on commercial farms.

Introduction Foals born earlier in the year have an advantage of maturity by the time they reach competition age (Langlois and Blouin, 1997) and mares can be bred again sooner, meaning economic profitability and sustainability of breeding is maximised (TenBroeck, 2016). However, multiple studies have shown that gestation lengths decrease as the natural foaling season progresses and the daily length of daylight gets longer (Hintz et al., 1979; Perez et al, 2003). Previously, it was shown that artificially extended photoperiod administered to pre-partum mares, from early December, significantly shortened gestation lengths (Hodge et al., 1982). The aim of this study was to investigate whether treatment with blue-light therapy, used to artificially extend photoperiod, correlates with a decrease in gestation periods on commercial farms in multiple geographical locations.

Material and Methods For this project, ethics approval was given by the Social Science Research Ethical Review Board at the Royal Veterinary College under reference number SR2019-0119. Data on gestation lengths were collected from three commercial breeding farms and 22 Thoroughbred mares, aged between 4 and 10 years old, for two consecutive years. In year 1, mares were exposed to natural photoperiod length throughout gestation. In year 2 mares were fitted with Equilume Light Masks from Dec 1st to extend photoperiod during the last trimester. Farms 1 and 2 were located in England, and Farm 3 in Japan. Sample sizes differed between farms, with 9, 5 and 8 mares on Farms 1, 2 and 3 respectively. No data on sires or foaling due dates was made available. During data collection periods, mares on Farm 1 were maintained at pasture and only stabled for 2h daily until Jan 15th, after which they were stabled each day, from 3pm, overnight. Mares on Farms 2 and 3 were turned out from 9am to 3pm daily and housed individually overnight. Barn lighting was switched off at 4pm. Mares on Farms 1 and 2 grazed ad libitum in their pasture, and on Farm 3, were supplied ad libitum forage whilst turned out, as grazing was limited. Concentrate feed was supplemented twice a day. Water and hay were provided ad libitum while stabled. In year 2, blue-light therapy masks (Equilume) that administered 50 lux short wavelength blue light (465 nm) to the right eye were fitted on Dec 1st until parturition. These masks were programmed to deliver blue-light into one of the mare's eyes from 4pm (dusk) until 11pm nightly. This provided an initial day length of approximately 14 hours, which increased with the progression of the seasons, to just over 16 hours by the end of the breeding season. Two-way repeated measures ANOVA followed by Sidak's multiple comparisons tests were performed using GraphPad Prism (Version 8.0). Data are presented as means +/- SEM and a P value of <0.05 was considered significant.

Results There was no farm x year interaction or main effect of farm on mare gestation lengths observed. There was a strong overall effect of year (P<0.0001) with a mean gestation reduction across the three farms of 13.5 days in year 2 (Figure 1). Similarly, multiple comparisons analyses revealed significant reductions in gestation lengths within each farm in Year 2 (15.3, 14.8 and 10.5 days respectively, Table 1)

Conclusion The results support the hypothesis, that administration of extended photoperiod via blue light masks to pre-partum mares during the final trimester reduces gestation length. Future studies should attempt to ascertain the minimum duration of treatment required to induce this effect as data on treatment length prior to parturition was not available in these studies. Further studies using larger sample sizes should account for other factors which influence gestation length, such as sire and parity, to further confirm the relationship.

References

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Hodge SL, Kreider JL, Potter GD, et al. 1892. Journal Veterinary Research. 43, pp5.

Table 1: Descriptive statistics for gestation length (mean +/- SEM) in days for mares from each of three farms and the compiled data in Year 1 (control) and Year 2 (Treatment with Equilume Light Masks)

	Farm 1		Farm 2		Farm 3		Compiled	
Year	1	2	1	2	1	2	1	2
Gestation length (days)	354.8+/-7.6	339.4+/-5.1	357+/7.3	342.2+/10.7	351.5+/4	341+/-5	354.4+/1.6	340.9+/0.8
Difference	15.3+/-2.3	14.8+/-3.1	10.5+/-2.5	13.5+/-1.5				
P value	<0.0001	0.0004	0.0013	<0.0001				

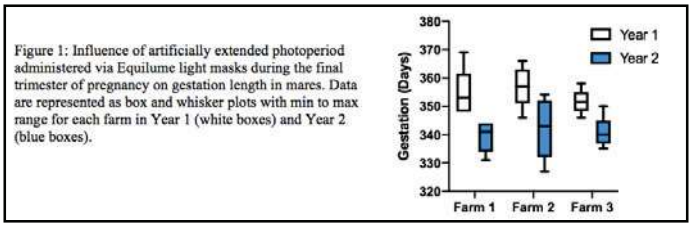

Figure 1: Influence of artificially extended photoperiod administered via Equilume light masks during the final trimester of pregnancy on gestation length in mares. Data are represented as box and whisker plots with min to max range for each farm in Year 1 (white boxes) and Year 2 (blue boxes).