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Short Communication

Field study analysis of the influences of deworming regimens and housing conditions on parasites and sperm output in 21 European boar studs

Martin Schulze [a,*], Christian Ammon [b], Gerd Nürnberg [c], Karin Rüdiger [a], Markus Jung [a], Janina Demeler [d]

[a] Institute for the Reproduction of Farm Animals Schönow, Bernau D-16321, Germany
[b] Department of Engineering for Livestock Management, Leibniz Institute for Agricultural Engineering Potsdam-Bornim, Potsdam D-14469, Germany
[c] Research Unit Genetics and Biometry, Leibniz Institute for Farm Animal Biology, Dummerstorf D-18196, Germany
[d] Institute for Parasitology and Tropical Veterinary Medicine, Freie Universität Berlin, Berlin D-14163, Germany

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A B S T R A C T

The current study reports the parasitological results of a quality control audit in 21 European boar studs. Field investigations were performed over a 2-year period (2012–2013) during the winter and spring. From each stud, an average of 30 (range, 25–33) individual faecal samples and ejaculates from 615 randomly selected Pietrain boars were analysed. Statistical analysis revealed a significant effect ($P < 0.0001$) of deworming regimen (DR) × age class of boar (A) and housing condition (H) × A on the presence of parasites. A second model indicated a significant effect ($P = 0.0262$) of DR × H × A on the presence of parasites. Sperm output was significantly affected ($P < 0.0001$) by the DR. Based on this study, recommendations for deworming AI boars are proposed.

Various exogenous factors affect the performance potential of a boar used for artificial insemination (AI) (Schulze et al., 2014a). Environmental variables to consider include maintenance and care of the AI boar, particularly exposure to parasites related to different management practices (Roepstorff et al., 1999). Surprisingly, studies on the epidemiology, prevalence or impact of parasite infection have only been focused on piglets, fatteners and sows (Pattison et al., 1979; Boes et al., 2010; Knecht et al., 2012), but not on boars. Therefore, the present study aims at: (1) investigating the effect of the presence of parasites on boar sperm output and (2) evaluating the effect of different deworming strategies on the presence of parasites.

During an external quality control programme in 2012 and 2013 performed in 21 boar studs in Germany (16), Austria (3), and Switzerland (2), an average of 30 (range, 25–33) individual faecal samples and sperm parameters (ejaculate volume, sperm concentration, and total sperm output/ejaculate) from 615 randomly selected Pietrain boars were analysed during the winter and spring. All boars received a commercial food supply (pellets) and were housed in individual pens equipped with nipple drinkers according to the European Commission Directive for Pigs Welfare[1]. Ejaculates were collected weekly by the gloved-hand method. Within 5 min after collection, sperm concentration (10^6/mL), determined using the NucleoCounter SP-100 technique (ChemoMetec A/S) according to the User's Guide, Revision 1.5 (2006)[2], and the volume of the ejaculate were recorded. Faecal samples were collected by the local veterinarian, stored in individual containers and sent to the Institute for Parasitology and Tropical Veterinary Medicine (FU Berlin, Germany) for coproscopical diagnosis. Four grams of each sample was used to determine the number of eggs/g faeces (epg) using a modified McMaster method with a sensitivity of 25 epg (Pereckienė et al., 2007).

All statistical analyses were performed using SAS 9.3 (SAS Institute). Boars were sorted into four age groups: ≤12 months ($n = 70$);

* Corresponding author. Tel.: +49 3338 709822.
E-mail address: m.schulze@ifn-schoenow.de (M. Schulze).

[1] http://ec.europa.eu/food/animals/welfare/efsa_opinions/index_en.htm
[2] http://chemometec.com/cell-counters/sperm-cell-counter-sp-100-nucleocounter/

http://dx.doi.org/10.1016/j.tvjl.2015.11.008
1090-0233/

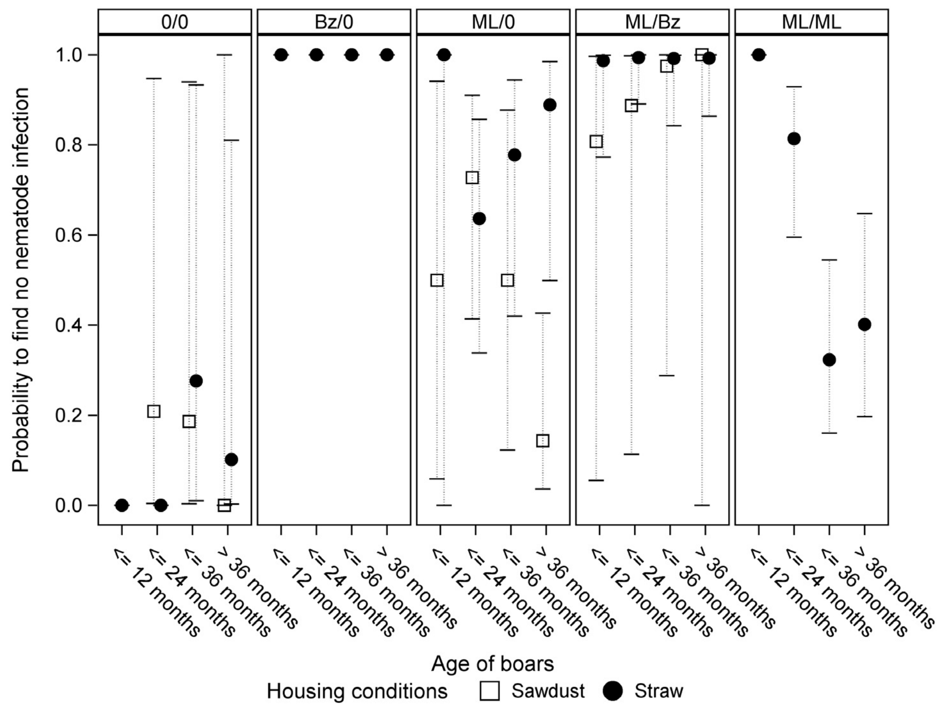

Fig. 1. Probabilities (mean and 95% confidence interval [CI] limits) to find a boar without nematode infection, displayed by deworming regimen (DR, quarantine/production), age class (A), and housing conditions (H) in 21 AI boar studs ($n = 615$); non-overlapping CI limits indicate differences between factor level combinations. ML, macrocyclic lactones; Bz, benzimidazoles; 0, no deworming.

≤24 months ($n = 246$); ≤36 months ($n = 150$); and >36 months ($n = 149$). Explanatory factors included age of the boars (A), housing conditions (H), deworming regimen (DR), and boar studs (BS, $n = 21$) within their organisation (ORG, $n = 10$). For the binary-coded nematode infection (NI; 0 = no, 1 = yes) a generalised linear mixed model (1) with binary distribution and a logit link function was used to estimate the probability P (NI = 0). The linear predictor included the fixed effects of DR, A, and H with all main effects and interactions, as well as the random effect of the BS within ORG with a banded main diagonal covariance structure allowing different variances. Severity of infection was investigated with the boar data that showed an epg >0. After a natural logarithm transformation, the epg was analysed with a linear mixed model (2) based on the linear predictor of (1). The generalised linear mixed model (3) for sperm output included NI in addition to the linear predictor of (1) and also used all main effects and interactions. A normal distribution and a log link function provided best fit while satisfying the homoscedasticity assumption.

Production data are summarised in Appendix: Supplementary Table S1. No ascarids and *Strongyloides* type eggs were found in the faecal samples. Trichostrongylid epg values ranged from 0 to 9225 (Appendix: Supplementary Table S2). No trichostrongylid eggs were found in eight studs. Five different DRs were used (quarantine/production): 1: 0/0; 2: benzimidazoles (Bz)/0; 3: macrocyclic lactones (ML)/0; 4: ML/Bz; and 5: ML/ML. Faecal examination revealed only 177/615 boars (28.8%) in 13 studs with an epg >0.

Model (1) showed a significant influence of the interactions DR × A and H × A ($P < 0.0001$ for both). DRs that include Bz either in quarantine or in production overall seemed to have better probabilities to keep the boars worm-free (Fig. 1). The influence of age class on nematode infection was inconsistent between DR and H, and no explicit trend could be found.

Model (2) displayed a significant influence ($P = 0.0262$) of the interaction DR × H × A (Fig. 2). The only significant difference among the estimable factor combinations was found between housing systems in age class 3 for DR3 ($P = 0.0356$). The epg of boars held on sawdust litter (720; 95% confidence interval [CI] limits: 184 and 2816) was higher than that of boars held on straw (25; 95% CI limits: 6 and 98).

In model (3) for sperm output, the only significant factor was DR ($P < 0.0001$). Mean sperm output for studs that ran DR1 was 140 (range, 132–149) × 10^9, which was higher than all other DRs. Studs that used DR2, DR3 and DR4 had an average sperm output of 69 (range, 61–78) × 10^9, 83 (range, 76–92) × 10^9, and 81 (range, 76–86) × 10^9, respectively. The average sperm output level of the three studs that used DR5 was 66 (range, 58–75) × 10^9, which was significantly lower than DR3 and DR4 (Fig. 3).

The present study aimed to investigate a possible interaction between infections with gastrointestinal nematodes and H and DR related parameters in AI boars. A direct influence of parasite presence (as determined by epg) on the boar's reproductive performance could not be found. Other factors, such as the overall management system, seem to be more important (Flowers, 2008). A negative correlation between reproduction parameters and parasite infection has been shown in fish (Kekalainen et al., 2014). In mammals, it has been reported that *Toxoplasma gondii* alters ejaculate volume in experimentally infected sheep (Lopes et al., 2009). The results of the descriptive statistics provide some evidence that the DRs ML/Bz and ML/ML might be superior. Concerning H, no preference with regard to transmission of parasites was