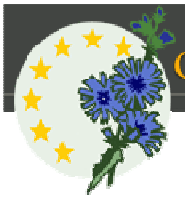

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QualityLowInputFood

Improving quality and safety and reduction of cost in the European organic and 'low input' supply food chains

Integrated Project (IP)

Food Quality and Safety

Deliverable 1 Reduction of Ascaris transmission to pigs by cleaning the dunging area

WP4.1.2.2 Effect of cleaning /disinfection strategies on helminth infections in finishing pigs

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Reduction of Ascaris transmission to pigs by cleaning the dunging area

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Abstract
Ascaris suum is the most prevalent helminth on organic pig farms (Carstensen et al., 2002) and is transmitted mainly via the faeces. The use of anthelmintics does not fit in the organic principles and preventive measures are promoted. This project focused on assessing the efficacy of a cleaning protocol for the dunging area of pens on *Ascaris s.* transmission to pigs. In 4 batches with 8 identical pens for 15 pigs each (n=480 pigs) 6 pigs per pen were orally infected with *Ascaris s*. The other pigs can be earliest infected at 10 weeks and half of the pens were thoroughly cleaned at that time. Affected livers and egg counts in the manure had to show if this cleaning protocol keeps the non infected animals free of *Ascaris s*. The results show no effect of the cleaning protocol on the non infected pigs. These pigs had 57% damaged livers in both treatment and 50% had positive egg counts in the manure. The conclusion is that pen hygiene does not contribute to a reduction of *Ascaris s.* infections.

INTRODUCTION

Ascaris suum is the most prevalent helminth on organic pig farms (Carstensen et al., 2002). It is transmitted mainly via the faeces of infected pigs. The parasitic eggs are infectious to other pigs after an incubation period in the dung of at least 4 weeks.
This study dealt with the contamination of finishing pigs on farms with outdoor access to concrete runs, and the transmission of parasitic eggs between pigs and pens. A key factor is the transmission that occurs through faeces. Regular (every three weeks) cleaning is a method to achieve an *Ascaris s.* free status without medication (Roepstorff and Nansen, 1994). However, this measure is time consuming and often unpractical. Cleaning once during a batch of pigs might be a way to break the lifecycle of *Ascaris s.*
A good moment to clean is 10 weeks after the start of the growing-finishing phase, because the prepatent period is about 6 weeks and the time for development of the infective larvae in the egg at least 4 weeks. This means that if not infected pigs are introduced in a pen contaminated with a few infective eggs of *Ascaris s.*, they will have a patent infection at earliest at 6 weeks. The earliest eggs produced by these pigs will at the earliest reach infectivity after 4 weeks. Reinfection of pigs will thus occur at least after 10 weeks. Thourough cleaning would remove most of the eggs before they are infective for the pigs. After 10 weeks, the pigs are still infected and they will start to excrete eggs. These eggs will be infective at least 4 weeks later. Pigs can pick up these eggs, but this infection will reach maturity at least 6 weeks later. This means that we are now at 20 weeks after the introduction of the pigs to the pen. It is likely that all the pigs have been brought to the slaughterhouse within this period of 20 weeks. When the pen is empty, thourough cleaning is again very necessary to remove all eggs. Pigs sampled at 16 weeks or later (till 20 weeks) should be negative if the cleaning was 100% effective.
Therefore, in this project the objective was to test the hypothesis whether the *Ascaris s.* burden for organic finishing pigs can be reduced by cleaning the outdoor run once, at a time just before the eggs have become infectious.

MATERIAL AND METHODS

At the ASG organic research farm in Raalte, Netherlands, an experiment with 4 batches of 8 groups (14 to 16 pigs per pen) was conducted. The two treatments were randomly assigned to the 8 pens of the finishing pig building. One row of 4 pens was on the West and one on the East side of the building. The pens consisted of an indoor area with a creep and 2 feeders (dry pelleted feed) and an outdoor area which was roofed for 75%. Water was available in a bowl on the side partition above the slatted floor. Each pen measured a width of 4.57 m and a depth of 4.65 m indoors and 3.20 m outdoors. This means 1.3 m² indoor and 1.0 m² outdoor for every pig. The indoor pens had a 16 cm raised slatted floor of 1.60 m deep near

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the side wall and a slatted floor of 1.60 m deep on the outer side of the outdoor run. All solid concrete floors have a slope of 1-2% towards the slatted floor. The pigs in each pen received a daily amount of approximately 0.5 kg of chopped straw on the solid floor every day. All pen partitions, except on the outer side of the pen, were solid to prevent pens effecting each other.
The upper 2 m of the side wall consists of a fabric with 50% openings and a manually controlled curtain. An open ridge served as the main air outlet. A creep of 1.75 deep and 3.00 m deep and transparent PVC flaps provided the required microclimate for the animals. No heating system was available in this finishing room. See figure 1 for further details.

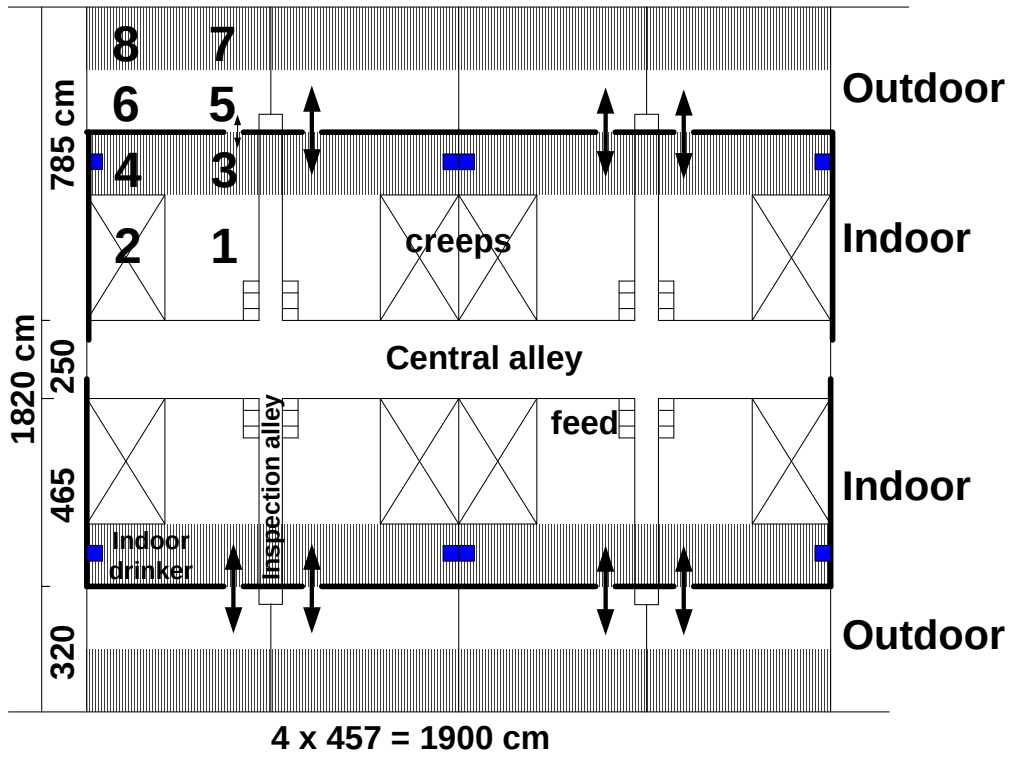

Figure 1. Layout of the room (8 pens indoor and outdoor, area codes in upper left pen)

Treatments
The treatments were:
Nocleaning: No cleaning of the outdoor run during a batch (16 weeks) of finishing pigs;
Cleaning : Thoroughly cleaning with water (high pressure) of outdoor run in week 10.
Day 70 was choosen as it takes 6 weeks for any eggs taken up by a pig to become adult, and another 4 weeks for eggs excreted by these adult *Ascaris s.* worms to become infectious. Thorough cleaning at day 70 following introduction of pigs breaks this cycle, as it will take another 4 weeks for newly excreted eggs to become infectious. At that time the animals have been sent for slaughter.
The batches of 8 groups were repeated 4 times from August 2006 until Januari 2008 (32 groups, 16 replicates per treatment. At the beginning of each finishing period 6 pigs of 25 kg were orally infected with 1,000 *Ascaris s.* eggs to provide a controlled and identical level of infection in each group. The 8-10 non infected pigs served as focal animals.

Observations
The presence of *Ascaris s.* eggs was checked by counting eggs in manure samples:
- at the day of infection a pooled sample per pen
- 3 weeks after infection another pooled sample per pen
- 6 weeks after infection individual samples
- 9 weeks after infection individual samples
- Just before slaughter (week 14-16) individual samples.

Slaughterhouse information on condemned and affected livers.
Pen fouling was recorded weekly in 8 rectangular areas per pen: 4 indoor and 4 outdoor.

Age and weight at start and slaughter age and weight were used to calculate the daily weight gain. Veterinary treatments and mortality was recorded on specific sheets.

Statistical analysis
In this experiments animals (egg counts, liver condemnations) and pens (pen fouling) were used as experimental units. The model to analyse the data was: Y = μ + cleaning treatment + batch + cleaning*batch + e. The datasets and the graphs were prepared in Microsoft Excel and the data analysed using "General Analysis of Variance" in Genstat (Payne et al., 2007).

RESULTS

We started the experiment with 472 pigs of 25 kg and 11 weeks of age. In batch 1 and 2 we had 14 pigs per pen, in batch 3 15 and in batch 4 16 pigs per pen. We ended the experiment with 463 animals, which means that in total 9 animal died during the experiment. At slaughter the animals had an average carcass weight of 94.2 kg and an average calculated live weight of 119.8 kg.
Figure 2 shows the percentage condemned and affected livers at slaughter. In batch 1 the experimental infection proved to be unsuccessful, because no liver damage and no *Ascaris s.* eggs were found at any occasion. In batch 2 the pooled samples of week 6 and the individual samples of week 9 showed a high percentage of pigs had a positive egg count. This indicates an infection of the not experimentally infected pigs from already present eggs in the pen at the start and not from the infected pigs.
In batch 3 the results of the faecal examinations showed that at the start of this study and after 3 weeks, all pooled samples from each pen were negative. After 6 weeks, most experimentally infected pigs were positive. However, in some pens (pen 1, 3 and 7) all not experimentally infected pigs had no *Ascaris s.* egg excretion, while in pen 2, all not experimentally infected pigs were positive. Therefore, like in batch 2 part of the not infected animals picked up their infection from the pen.
In batch 4 the results of the faecal examinations showed that at the start of the study and after 3 weeks all pooled samples from the pens were negative. The results of the faecal examinations at the end of the study (individual samples taken before slaughter) showed that some not infected pigs were excreting eggs, but the majority did not. Of the infected pigs 78% had an affected liver against 70% of the not infected pigs. Probably the not infected pigs have picked up their infection from the pens before the eggs shed by the experimentally infected pigs became infective, because it is unlikely that the development of eggs could happen in the autumn due to low temperatures.

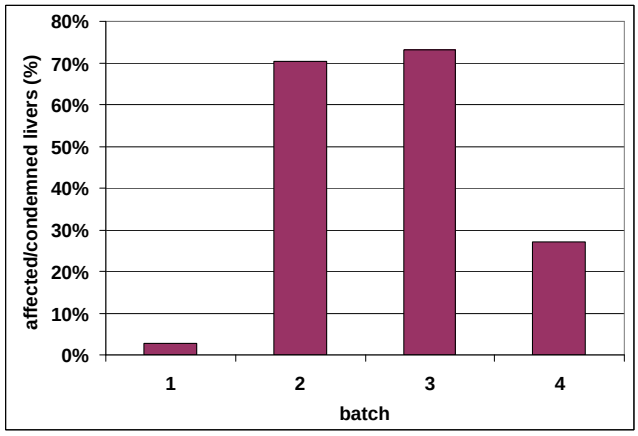

Figure 2. Percentage of affected and condemned livers at slaughter per batch.

The percentage of unaffected livers was 59.9% for "Nocleaning" and 51.8% for "Cleaning" (N.S.). Figure 3 shows the differences between treatments. None of the differences was statistically significant.

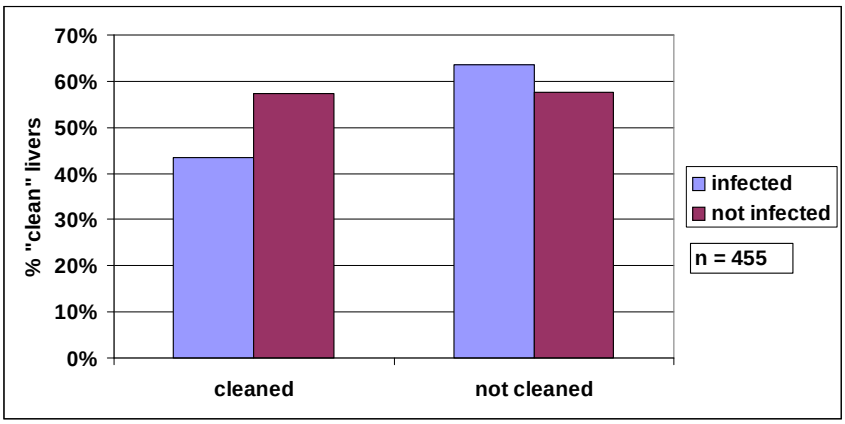

Figure 3. Proportion unaffected livers per treatment and infected/not infected pigs.

When *Ascaris s.* eggs were counted in one of the manure samples of a pig the pig was labelled as "positive". On average 50% of the pigs was "positive" and when batch 1 was excluded it was 60%. Table 1 shows the percentage of positive pigs per cleaning treatment and infected or not infected. None of the differences was significantly different.

Table 1 Percentage of animals with *Ascaris s.* eggs in the manure (all differences N.S.)

	treatment		
	no cleaning	cleaning	total
not infected	50.9%	49.1%	50.0%
infected	49.2%	50.8%	50.0%
total	50.2%	49.8%	100.0%

[a]Means with a different superscript indicate a significant difference (P<0.05)

The pen fouling scores showed a clear preference of the pigs for dunging on the outdoor run as shown in figure 4. The lying area under the creep was the cleanest part of the pen, followed by the feeding/activity area and the indoor slatted area. The outdoor run was the dirtiest area of the pen.
Figure 5 shows the development of pen fouling during the experiment. When the pigs grow older the pen becomes dirtier, but with no difference between cleaning and no cleaning. Within a few days after cleaning the outdoor run was as dirty as before.

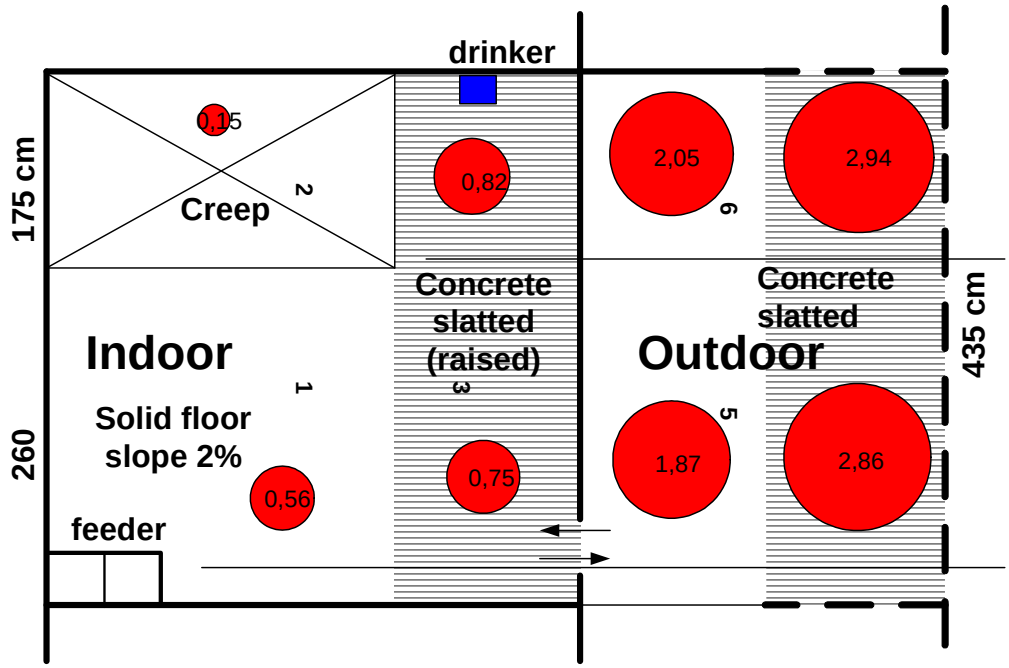

Figure 4. Layout of the pen with level of pen fouling in red circles, the largest circles on the slatted outdoor area reach 75% of the maximum score and the smallest in the creep is 4%.

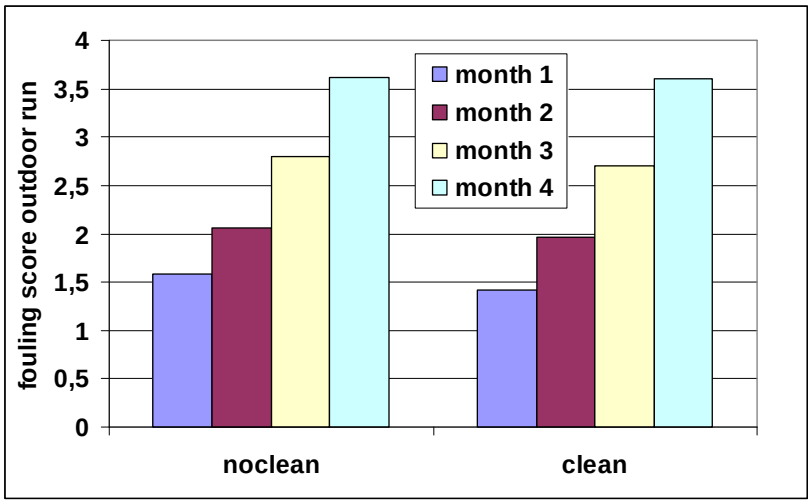

Figure 5. Development of outdoor pen fouling score during the growing-finishing phase

DISCUSSION

The applied method in this experiment to infect half of the pigs in a pen manually and keep the other pigs free of infectious *Ascaris s.* eggs functioned very well. This makes it very clear if the pigs were not infected or infected by the penmates or infected by remaining eggs from previous pigs in the pen. Unfortunately this also showed that our treatment, breaking the life cycle of *Ascaris s.* at 10 weeks by removing manure, did not work.

The results of the experiment showed that only a small number of *Ascaris s.* eggs is necessary for an infection. This is not surprising as Roepstorff and Nansen already concluded in 1994, but the reduced infection pressure by removing the majority of the *Ascaris s.* eggs did not lead to lower egg counts and less affected livers at the slaughterhouse. We even found *Ascaris s.* eggs in the manure of not infected animals before they could be infected by their infected pen mates. This led to the conclusion that despite thorough cleaning some infectious *Ascaris s.* eggs were still present in the pen at the start of a new batch. We did not find this effect in the first batch on an *Ascaris s.* free floor, because no pigs with *Ascaris s.* infections were housed there before.

Also reduction of contact with manure (Vermeer et al., 2006) did not reduce the number of pigs infected with *Ascaris s.*. This means that during a batch there is not much to gain by reducing manure contact and removing manure.

CONCLUSIONS

- Cleaning the outdoor dunging area of organic growing finishing pigs 10 weeks after the start at 25 kg does not prevent the pigs from being infected by *Ascaris s.*
- Conventional cleaning between batches does not remove all *Ascaris s.* eggs.

PRACTICAL IMPLICATIONS

On the other hand it seems to be very important to clean the pen between two batches. This means outdoor as well as indoor area and every surface, gap and slot. Before cleaning a chemical treatment can be applied to make the eggs less sticky and easier to remove. A treatment to eradicate *Ascaris s.* is not yet available.

The preliminary conclusion is that cleaning alone is not able to reduce *Ascaris s.* infections, but should be part of a package of measures against *Ascaris s*.

ACKNOWLEDGEMENT

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