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# Novel manure scraper systems for fattening pigs

Two novel manure scrapers (combiscraper and folding combiscraper) used in pig fattening were tested to measure their effects on animals' behavior. Data were recorded during two fattening periods. Both the type of the scraper and the age of the pigs had a significant influence on the occurrence of the behavior 'avoiding the scraper sideways' and 'crossing the scraper in the middle'. The majority of pigs crossed the folding combiscraper in the middle as compared to the combiscraper. Moreover, a larger number of pigs in the growing phase avoided to cross the scraper sideways in comparison to animals of the finishing phase. The results indicate that the aggregate dimension of a scraper (height and depth) is of major importance to the animals.

## Schlüsselwörter

Mastschweine, Schieber, Entmistungstechnik

## Keywords

Fattening pigs, manure scraper, manure system

## Abstract

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■ In pig husbandry, organic and other quality-label farms increasingly use solid-concrete floors in both housing and outdoor areas. Moreover, to ease the workload and save time, manure-scraper systems are being fitted in an increasing number of such systems. To date, no special scraper has been developed for the pig-production sector. Instead, scrapers from the cattle-production sector, or scrapers made to the farmers' specifications have been used. This gives rise to the problem that neither the different behaviour of both species (e.g. the distinctive exploratory behaviour of pigs) nor their different anatomical features (e.g. body size) are taken sufficiently into account in the design of the scrapers.

To date, no experimental studies have yet been conducted in the pig-production sector (i.e. with breeding and fattening pigs) on the design of manure-scraper systems from the point of view of animal welfare. This study should therefore answer the question of how scrapers must be designed for fattening pigs in order to take account of the behaviour and anatomical features of this species. To this end, in a first part of the project, the behaviour vis-à-vis existing scrapers not specifically developed for pig production was recorded [1]. It was discovered that the aggregate dimension (i.e. the sum of the height and depth

of the scraper) as well as the length of the side wings influence the behaviour of fattening pigs, with it being easier for them to climb over scrapers with a smaller aggregate dimension.

The project part presented here should give an indication of the behaviour of fattening pigs when dealing with manure-scraper systems developed specifically for them.

## Animals, Materials and Methods

### Folding Combiscraper

Unlike existing folding scrapers, the newly developed folding combiscraper also had side wings, making it even thinner at the sides (**Figure 1**). This was intended to make it easier for the fattening pigs to cross it. The aggregate dimension of the scraper body of the new folding combiscraper was 21 cm (height, 11 cm; depth, 10 cm), whilst that of the side wings was 15 cm (height, 11 cm; depth, 4 cm).



Abb. 1

Novel folding combiscraper with foldable extensions (Foto: A. Ettinger)



Abb. 2

Novel combiscraper with foldable extensions (Foto: A. Ettinger)

### Combiscraper

The cleaning shield of the newly designed combiscraper was incorporated in the scraper body (**Figure 2**). Hence, the aggregate dimension of the new scraper – unlike that of existing scrapers – remained unchanged on its return travel, since no shield was folded upwards and out during backward movement. The aggregate dimension of the scraper body of the new combiscraper was 30 cm (height, 11 cm; depth, 19 cm). The aggregate dimension of the traction-cable guide at the widest spot on the scraper body was 45 cm (height, 11 cm; depth, 34 cm). The side wings were both 85.5 cm long, with an aggregate dimension of 15.5–22 cm (height, 11 cm; depth, 4.5–11 cm). The long side wings provided the animals with a fairly large area that was thinner than the central block. It was expected that this would make it easier for them to cross this area. On the return travel the side wings were straightened up, providing room for an avoiding sideways manoeuvre.

### Experimental Design

Studies of the newly developed scrapers for fattening pigs took place in Agroscope Reckenholz-Tänikon ART's experimental housing in Tänikon, in two pre-fattening and finishing pens, each with 27 animals. The manure scrapers were fitted in an outdoor area with a partly slatted floor. The outdoor area was covered over a width of 2.5 m in the centre with solid flooring, with a 1-m-wide slatted floor on two sides.

The fattening pigs were transferred to the housing at an average initial weight of 25 kg. Occupancy of the pens was continuous, with the animals moving from the pre-fattening to the finishing pens after a period of about seven weeks.

The studies were conducted during two fattening cycles. Both scraper types (folding combiscraper and combiscraper) were tested in each fattening cycle. The exchange of one scraper for the other coincided with the transfer of the animals from the pre-fattening to the finishing pens. At the time of the first data collection, the pigs were 12 to 14 weeks old. The second investigation took place when the animals were between 20 and 22 weeks of age.

The 27 animals in a pen were subdivided into three groups of nine. Allocation into the three groups was random, taking place at the time of the animals' transfer to the pre-fattening pens. For data collection, a group of nine was separated out in both the pre-fattening and finishing pens and given access to the outdoor area. The remaining two groups remained in a fenced-off area of the pen in the housing. Each data-collection period consisted of a two-day habituation phase, followed by a two-day experimental phase. The next group of nine was then given access to the outdoor area. In this way, the behaviours of all 27 animals in a pen were recorded in three blocks.

The scrapers were operated at a speed of 4 m/min. Surfaces were cleaned once daily.

The following behaviours were recorded:

- Cross in the middle: The animal crossed the scraper in the middle (the area without the side wings).
- Avoiding sideways: The animal dodged the scraper to the side.

In the analysis, the frequency of the behaviours was related to the number of animals present in the outdoor area. Accordingly, the results show the proportion of animals near the scraper expressing a particular behaviour. A total of 3 564 behaviours of 218 fattening pigs were analysed.

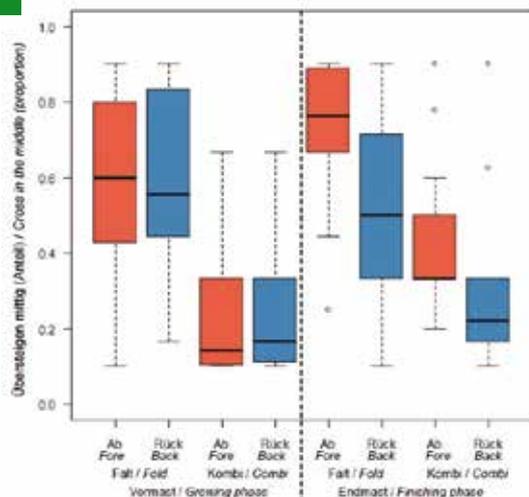
The statistical analysis was carried out using a mixed effect model. Fixed effects were both scraper types (folding combiscraper vs. combiscraper), age of the animals (pre-fattening vs. finishing) and direction of travel of the scraper (forward vs. reverse travel). Random effect was scraper type nested in age of the animals nested in direction of travel of scraper nested in group. "Cross in the middle", which showed normally distributed residuals, was transformed with the decadic logarithm, whilst "avoiding sideways" with binormally distributed residuals was dichotomised.

### Results and Discussion

The "cross in the middle" behaviour was exhibited by a higher proportion of fattening pigs when dealing with the folding combiscraper than with the combiscraper (**Figure 3**,  $p < 0.01$ ). Moreover, there was a significant interaction between the age of the animals exhibiting this behaviour and the direction of travel of the scraper ( $p < 0.01$ ). For both scraper types, the proportion of finishing pigs crossing the scraper in the middle during its forward travel was higher than during its return travel. By contrast, no effect of direction of travel was observed in the pre-fattening stage.

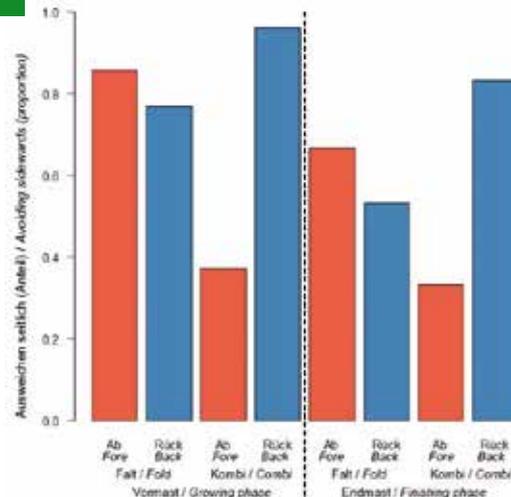
For the folding combiscraper, a higher proportion of fattening pigs exhibited "avoiding sideways" behaviour on the forward than on the return travel of the scraper. With the combiscraper, however, a larger proportion of the animals showed this behaviour on the return travel than on the forward travel (**Figure 4**; interaction between scraper type and direction of travel:  $p < 0.01$ ). A higher proportion of pigs tended to display avoiding sideways behaviour in the pre-fattening stage than in the finishing stage ( $p = 0.06$ ).

Fig. 3



Proportion of fattening pigs showing 'cross in the middle' behavior during the forward (fore) and backward run (back). Both types of the scrapers (folding combiscraper and combiscraper) were compared during the growing and the finishing phase

Fig. 4



Proportion of fattening pigs showing 'avoiding sideways' behavior during the forward (fore) and backward run (back). Both types of the scrapers (folding combiscraper and combiscraper) were compared during the growing and the finishing phase

The results confirm observations at scrapers not designed for use in the pig-production sector [1]. Once more, it became clear that the combination of aggregate dimension of the scraper body together with the folding lateral wings of the scraper influenced the behaviour of the animals. The newly developed folding combiscraper was crossed more often in the middle by both pre-fattening and finishing pigs than was the newly developed combiscraper with the higher aggregate dimension. With the pre-fattening pigs, there was no difference between the two scraper types in "cross in the middle" behaviour for the two directions of travel. Nevertheless, the proportion of pre-fattening pigs crossing the scraper in the middle was significantly lower for the combiscraper than for the folding combiscraper. Moreover, the same animals more frequently exhibited avoiding sideways behaviour of the combiscraper on its return journey. All these differences between the scraper types suggest that – owing to their smaller size – pigs in the pre-fattening stage still had difficulties in crossing scrapers with a high aggregate dimension, or were afraid to do so.

The length of the lateral wings of the scraper influenced the behaviour of the animals less than expected. The only striking observation was that the fattening pigs avoided the combiscraper less often on its forward than on its reverse travel when the lateral wings were folded, which made avoidance easier. This was not the case with the folding combiscraper, with its lower aggregate dimension in comparison to the combiscraper, and its significantly larger side clearance during its return journey.

## Conclusions

The differences in the behaviour of the fattening pigs when dealing with the folding combiscraper and the combiscraper both as a function of the direction of travel of the scraper and of the age of the animals suggest that the aggregate dimension

of a scraper is of great importance for the animals. Scrapers with a lower aggregate dimension can be crossed more easily. For this reason, there is further potential for optimisation in combiscrapers used in fattening-pig production, whose aggregate dimension should as far as possible be based on that of the folding scraper.

## References

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