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Construction of piglet lying area in farrowing pens of organic pig production

Altering the construction of piglet lying area in the nest towards more air closeness and insulation led to clearly higher temperatures inside of the nest. Several original curtains made of PVC-stripes were replaced in several steps by wooden boards that were additionally insulated. With some of these experimental designs it was possible to reach target temperature of 30 °C. The conventional piglet nest with PVC-curtains is not suitable for achieving appropriate temperatures in typically low temperature buildings of organic pig production.

Keywords
Piglet nest, farrowing pen, air temperature, organic pig production

Abstract
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The temperatures in piglet nests in organic farrowing stables are frequently too low. This was shown by own unpublished results of measurements in different farms within the framework of a research project to consolidate the competitiveness of the organic pig production in Bavaria [1]. Causation therefore is the high loss of temperature from the piglet lying area that are mainly due to insufficient construction of the coverage and the walls of the piglet nests. In addition the farrowing stables are mostly not heated and, in the lying area of the sow in the farrowing pen, there are often reached only about 10 °C air temperature in winter.

Because of these problems, the influence of different constructions of the nest on the potential temperatures inside of the nest was analyzed in the present experiment in a specially constructed experimental rig. Though, the intention was to reach an air temperature of 30 °C in the piglet nests at least, to provide optimal conditions to the new born animals [2; 3].

Material and methods

The measurements of the examinations took place in January 2010 in an empty, massive and not heated building. During the measuring the room temperature was constantly at 10 °C and complied exactly to the conditions of the surrounding of the piglet nests as given in the farms with organic pig production in winter.

Two nests were available for the examination. One of them stayed unchanged during the measure phases (control version) while the other has been changed constantly (test version). The elementary form of all versions of piglet nests consisted of a scaffolding of wooden slats (transversal section 3 × 5 cm) with the measures width 140 × depth 70 × height 60 cm. Rear panel and coverage consisted of 12 mm thick wooden multilayer boards. The middle of the coverage disposed of a cut out for an

infrared heater which has been tightly shut (**figure 1**). The piglet nests have been heated with electrical heating plates lying on the ground. Those came from the Company Rexlan and persisted of resin concrete and of a core of insulation material with the measures width 118 × depth 60 × height 5 cm. The heating plates of both nests were switched in a row and connected to a common temperature unit which recorded the air temperature of the experimental nests with a sensing device. The power of the plates added to 150 W respectively. They were flushed on the concrete floor of the building which also equates to the terms in a farrowing stable. It has been approved in a pilot test that both heating plates brought equivalent heating energy. Control and experimental nest have been positioned parallel with a distance of 50 cm.

In the control version both sides and the front of the piglet nest have been furnished with full-length PVC-stripes. Those overlapped itself to about 1 cm and have been below shortened so that they just hang free. The distance to the wooden slat on the floor was about 2-3 mm (**figure 2**).

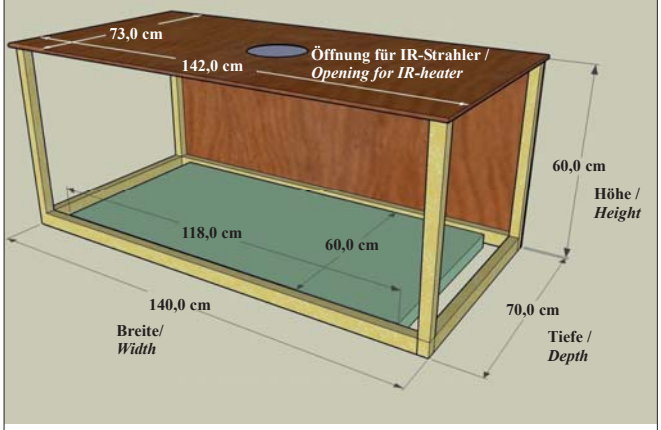
There were 6 experimental versions totally (**figure 2**):

- Version 1 with wooden multilayer boards on the side walls
- Version 2 with wooden multilayer boards also on the front side and a 30 × 30 cm sized loophole for piglets without PVC-stripes
- Version 3 equal to version 2 but with PVC-stripes on the piglet loophole
- Version 4 with additional insulation through 4 cm thick insulation board (insulation value 0.52 W/m² • K) and PVC-stripes at the piglets loophole
- Version 5 with insulation and a 30 cm high piglet loophole over the whole length with PVC-stripes
- Version 6 based on version 4 but with exclusive insulation of the coverage

Additionally, the effect of the air movement for version 1 and 4 has been proved, by placing a ventilator with 150 cm distance in front of the nests and a few PVC-stripes of the curtains, as a simulation of a defect curtain, were folded back (measurements 2 and 6). The nest version 6 has also been provided with an infrared lamp (IR)-lamp (150 W) (measurement 9). The heat input of a litter of about 10 piglets has been simulated herewith (3). However, the heater was not hung up in the centre of the nest but on the front right side placed in 10 cm height. To defend the sensing head from radiant heat, the IR-heater has been shielded through a 20 cm wide plank with about 5 cm ground clearance.

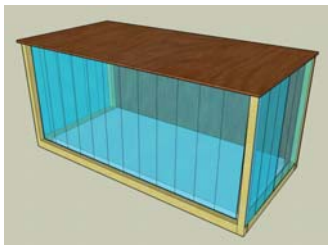
One experimental version, by which the IR-heater was placed in the nest as usual in the coverage, has been tested in the pilot experiment. However, it decided that the direct radiation of the sensing head falsified the measurement results. Therefore this version has not been considered in the main experiment.

Fig. 1

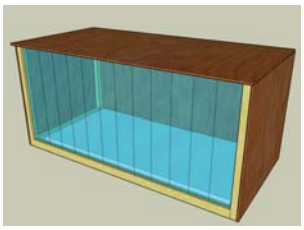


Basic form of control and experimental versions of the nest

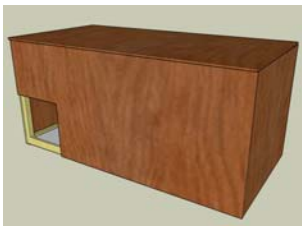
Fig. 2



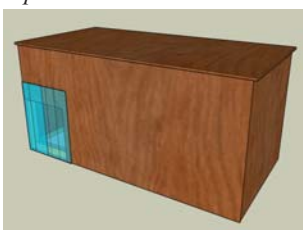
Kontrollnest /
Control version



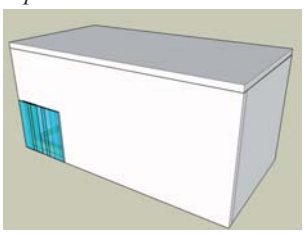
Versuchsnest, Variante 1 /
Experimental version 1



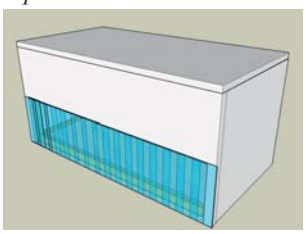
Versuchsnest, Variante 2 /
Experimental version 2



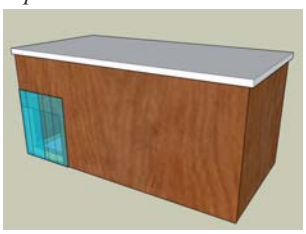
Versuchsnest, Variante 3 /
Experimental version 3



Versuchsnest, Variante 4 /
Experimental version 4



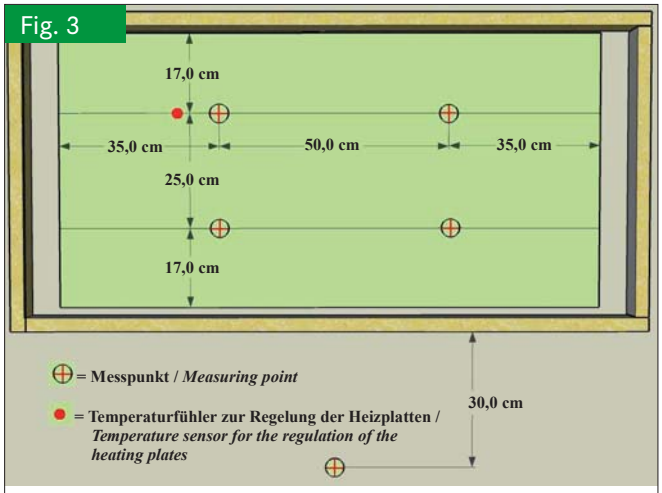
Versuchsnest, Variante 5 /
Experimental version 5



Versuchsnest, Variante 6 /
Experimental version 6

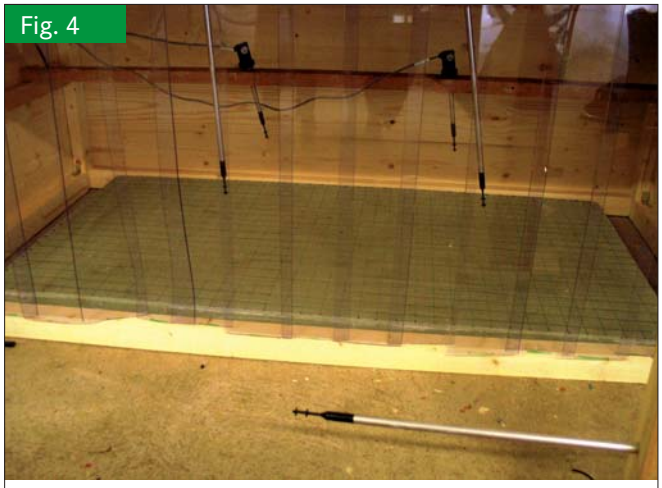
Control and experimental versions of the nest

Fig. 3



Positions for measuring temperature, air speeds and heat regulation (top view)

Fig. 4



Measuring sensors for temperature and air speeds inside and in front of the nest. Photos: Abriel

Measurements of air temperature and air speeds

Four sensors have been installed each in the control and experimental nest for measuring the air temperature and the air speeds. The sensors hung 20 cm over the heating plate and had a distance in longitudinal direction (right and left) of 35 cm from the plate border and 50 cm afar from each other. In cross direction (in front and behind) they were 17 cm afar from the plate border and 25 cm from each other (**figure 3**). The metering precision was 0.1 m/s for the air speeds and 2 K for temperature. The temperature sensor for controlling the heating plates was placed with a distance of 5 cm on the left beside the backmost left sensor of the experimental nest (**figure 3**). In front of the nests one sensor was placed 30 cm axial to the nest for measuring the air speeds (**figure 3 and 4**). The room temperature has been measured in about 2 m height behind the nests. Air temperature and air speeds have been recorded in minute cycle. The measurement duration per test preparation was 24 hours.

Attendant the surface temperature of the heating plates has been controlled with a laser gun.

In a pilot test the result was shown that the data which was determined with a laser gun, in fact laid about 2 K over the measured results with a contact thermometer.

Results and Discussion

The measuring results for the air temperature are shown in **table 1** as an average over the complete measurement duration of 24 hours each, because the temperature inside of these measurement periods were almost constant.

The room temperature of the building in which the experimental equipment has been established, was at slightly over 10 °C. Therewith the surrounding temperature of the experimental nests related to the temperatures in the farrowing pens, which were frequently observed under practical conditions. The results of the different measurement phases therefore could be transferred on the one hand to real stables in practice and on the other hand be compared among each other.

The temperatures in the control nest, which was conformed with its figuration to a usual construction in practice, remained with just under 20 °C far below the aimed target value of 30 °C. Under worst conditions, that is to say with a high air exchange, witch was generated in the experiment by a ventilator and incomplete PVC-curtains, the temperatures were even 1-5 K lower.

The air temperature in the experimental nest rose with increasingly closeness and better insulation from 22 to 30 °C.

In measurement 5 a target temperature of 30 °C has been reached by experimental nest 4 with complete insulation and a small loophole with PVC-stripes. With switching on the ventilator and incomplete PVC-curtains (measurement 6), the temperature in the nest reduced by 1.6 K.

Inserting the IR-heater with a capacity of 150 W, for simulating the heat-input of a litter with 10 piglets (measurement 9 based on experimental nest 6 with measurement 8), the temperature of the nest rose by 5,6 K. With this additional heat which is given under practical conditions through the presence of the piglets, a target temperature of 30 °C probably could have been reached also in measurement 4 and 6 with experimental nests 3 and 4 (with ventilator).

The surface temperature of the heating plates was predominantly in an acceptable range of 30 to 35 °C. With increasing closeness and insulation of the experimental nest the surface temperature rose in comparison to the control nest.

The air speeds in the experimental nest have always been in an favorable range below 0.1 m/s. In the experimental nest in measurement 6 (with ventilator) air speeds with more than 0.1 m/s were measured.

Because the adjusted temperature with 30 °C has not been reached, excepted measurements 5 and 9, it could be assumed that there was no temperature control and therefore the heating plates of both nests ran with full output. That means the plates did not switch-off in the meantime to reduce the temperature.

Table 1

Air temperature of control version and different experimental versions of the nest

Messung *Measurement*	**Versuchsnest** *Experimental version*	**Bemerkung** *Notice*	**Temperatur Kontrollnest [°C]** *Temperature control version [°C]*	**Temperatur Versuchsnest [°C]** *Temperature experimental version [°C]*	**Temperatur Raum [°C]** *Temperature room [°C]*
1	1		19.7	22.3	10.2
2	1	Ventilator, einige PVC-Streifen nach oben weggeklappt/ *Ventilator, several PVC-stripes folded back*	18.7	21.9	10.2
3	2		20.4	22.7	10.3
4	3		20.1	25.1	10.2
5	4		18.8	30.3	10.2
6	4	Ventilator, einige PVC-Streifen nach oben weggeklappt/ *Ventilator, several PVC-stripes folded back*	14.6	28.7	10.1
7	5		19.3	23.5	10.0
8	6		19.5	26.6	10.2
9	6	IR-Strahler (150 W)/ *IR-heater (150 W)*	20.5	32.2	10.2

Thereby the measurements of the control nest have not been affected by the temperature-regulation witch was based on the experimental nest.

Conclusions

The effected experiments showed, that the material of the enclosure and its insulation value, as well as the air exchange by cavities and increased air movement in the surrounding of the nest, have an influence on the temperatures inside of the piglets nests.

Modification of the enclosure showed clear effects on the temperatures of the nests in the experimental rig. Additionally it was shown that conventional enclosures of the nests, as they were found in practice (control version and experimental version 1), are insufficient with low temperatures in the stable. Because the temperatures inside the nests were well below the thermo-neutral zone with 34 °C of the newborn piglets [2], negative effects on the development of the piglets could not be excluded.

Advisable is a well operating heating plate with a reliable thermostat and an enclosure which is as tight as possible, also at the opening for the IR-heater. In addition for keeping the temperatures inside the nest, it is helpful to use insulating materials at least for the coverage.

It should be resolved in an experiment in practice, how the respective temperatures have an effect on the behavior and the development of the piglets. Observations of the behavior and registration of weight development and mortality rate would be insightful. For example it would be interesting, whether a small loophole or higher temperatures inside the nest had an influence on the acceptance of the nest and lying behavior. Also the influence on growth and mortality rate would be important criteria for a concluding evaluation of the construction of the piglet nest. As well it would have to be tested, how the activity (going in and out) and the body heat of the piglets have an influence on the temperatures inside the nest. In summary it could be retained, that keeping the temperature inside the nest is problematic with ambient temperatures of 10 °C as it is usual in practice and the temperatures inside the nests should be controlled frequently. On many farms with organic pig production there may be rectifications necessary.

Literature

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