SOLUTIONS FOR THE FARROWING OF OUTDOOR KEPT SOWS

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ABSTRACT

In Tuscany region a local race - Cinta Senese - is usually bred following old managerial systems, which often cause very low productive performances.

Simple building solutions were designed, suitable for an extensive breeding, with particular interest in farrowing phase. In 2 experimental outdoor pig farms (A, B), fences with farrowing huts were arranged: (a) pyramidal hut realized with sandwich panels and expanded polyurethane inside; (b) trapezoid section hut realized with sandwich panels and expanded polyurethane inside; (c) timber "A" shaped hut; (d) hut with an electro welded metallic frame covered with straw bales. In farm A 3 huts in a single fence were compared (a, b, d). In farm B 3 different fences were realized, each with a different kind of hut (a, c, d).

Behavioural and microclimatic parameters were collected in both farms. In the first farm the sows could choose among 3 different kinds of huts (a, b, d), enabling to examine any sow preferences for the farrowing period. In farm B behavioural data for each sow kept in each different pen were collected.

The sow's preference is clearly towards the hut made of straw bales. Even when 2 sows are inserted in an enclosure with an interval of some days between each other, both the sows choose the straw hut, also if other huts are available. In the first 3 days after farrowing the sow remains inside the hut for about 90% of daily time (89.2%) and devotes 29.3% of time to suckling. At the 20th day the sow spends 35% of time outside.

From the thermal point of view, the straw hut (d) is suitable for all the seasons. Especially in extreme seasons it shows properties of damping and shifting of thermal waves, consequently the temperature remains closer to thermal comfort conditions of the animals in comparison to other examined solutions. The thermal performances of the huts realized with sandwich panels and insulating material improve clearly when a protection with reed-matting is arranged on the outside.

The solution with straw bales can easily be built even by the breeder. Consequently the cost for its realisation is very low. This housing solution has aroused great interest among the breeders involved in the test.

KEY WORDS: Outdoor pig production, sustainable breeding, animal welfare, behaviour, local breeds.

INTRODUCTION

The outdoor pig breeding system, widely spread in centre-north Europe, is growing also in Italy where under certain circumstances it can constitute an alternative to traditional breeding systems.

Cinta Senese is a local pig race of Centre Italy regions. In last years the interest for its breeding is rapidly spreading. In particular in Tuscany region there is a great number of farms, 181 of the 197

present on the national territory, recorded in the Registry Office of the Pigs Breeders National Association (February 2003).

A study recently carried out to know the situation of Tuscany region (Barbari *et al*., 2003) remarks that the farms devoted to outdoor breeding generally are quite small (10 sows on average), family managed and with an average surface of 158.80 ha.

The wild extensive breeding is the most adopted system. It consists in the use of wide outdoor areas, generally in the wood, where the pigs are kept free. Additional feed is distributed to the animals and closed structures are used in the most delicate phases of the productive cycle, such as farrowing and weaning. The carried out survey has pointed out that most part of pig breeders use existing buildings, shelters or sometimes movable self-made or bought on the market huts. Basically, for the farrowing of the sows traditional pens in old farm buildings are used, but this solution seems to give a high loss of piglets for crushing (26% is the percentage of mortality declared by the farmers).

To meet farmers requirements and to rationalize the extensive breeding system reducing the losses and improving the productive performances, it is essential that the piglets mortality after farrowing is limited. This aim can be reached minimizing the number of crushed piglets and reducing attacks from predators such as foxes. It is important to remember that Cinta Senese race is little prolific, so the number of piglets produced per sow is low from birth (Campodoni *et al.*, 1998). Inside the hut it is important to create adequately comfortable thermal conditions in order to stimulate the sow stay, especially in the first days after farrowing, when the piglets are forced to remain indoors. If the microclimatic conditions are unsuitable the sows could search for more comfortable conditions in outdoor areas, thus reducing the suckling periods of the piglets.

In recent years some ethological studies were carried out to analyze the reproductive behaviour of Cinta Senese sows, the suckling method, the activity of sows and piglets kept in pens with full floor (Franci *et al.*, 2003; Sargentini *et al.*, 2003). However, references to the performances of Cinta Senese pigs bred outdoor in relation to structures or equipment are not available in the international literature.

Anyway, it is important to aim at the use of structures, such as movable huts, well-dimensioned, provided with systems suitable to reduce piglets losses for crushing, comfortable for the suckling sows. Such structures have to be easily available on the market at a low cost or directly built by the breeder himself. Actually the Cinta Senese breeding has developed in hilly-mountain marginal areas, so the restriction of investments costs is one of the essential elements for the economic success of the activity.

In our regions a very important factor to be considered is the weather, that is generally characterized by very hot summers. In summer season the hut, especially if directly exposed to sunshine without shading, can overheat giving unacceptable conditions for the thermal comfort of the sow (Barbari e Ferrari, 2001).

In experimental trials recently carried out by our Department (Barbari *et al.*, 2003), 5 different types of farrowing huts have been compared: (1) pyramidal hut realized with sandwich panels and expanded polyurethane inside (40 mm); (2) pyramidal hut realized with sandwich panels and expanded polyurethane inside (40 mm), but covered by reed-matting; (3) timber "A" shaped hut; (4) trapezoid section hut realized with sandwich panels and expanded polyurethane inside (50 mm); (5) hut with an electro welded metallic frame covered with straw bales. In the 5 huts, put on a ground exposed to the sun, different probes were applied to measure air temperature, radiant temperature, contact temperature, thermal flow, relative humidity.

The results of the experimental study have shown thermal performances quite different among the 5 examined solutions. The hut realized using straw bales was efficacious in the hottest periods of summer, thanks to high thermal capacity. Also the covering with reed-matting reduced the heat

input in the metallic structures. Both the arrangement of well proportioned openings for air ventilation to favour formation of convective movements and the disposition of the doors towards North or North-East were particularly important.

MATERIALS AND METHODS

The main aim of research was to identify kinds of huts which could be suitable for the use in extensive pig farms, devoted to Cinta Senese breeding, widely spread in the Tuscany region territories.

a

Pyramidal hut, covered with a reed mat

b

Trapezoidal hut

c

Timber hut

d

Straw hut

Fig. 1: Kinds of huts used during the experimental trials.

First of all, on the basis of different experimental tests formerly carried out and already mentioned in the introduction, 4 different kinds of huts for farrowing were fixed. The huts were realized using different materials, such as straw, timber, insulated galvanized sheet-iron. Two huts were bought on the market and two designed and made in the laboratory of the Department, suitable for farm self-building at very low costs.

The first hut (a) has an octagonal base and pyramid shape. It is realized by assembling sandwich galvanized-sheet panels with a high degree of insulation (expanded polyurethane, 40 mm). The hut has an excellent stack effect thanks to its shape and to the difference in height between inlet and outlet of the air (total height 2.10 m). It is 2.40 m width. The inlet door (1.00 x 0.70 m) is provided with transparent polyethylene strips to use during cold seasons. At the back a sash window is placed; anti-crushing tubes 0.25 m high are used inside the hut.

The pyramidal hut during the experimental activity was used also with a covering of reed mat, to evacuate the effect given by an outside further protection towards sunshine irradiation. The outer covering is important also from an aesthetical point of view, in fact it limits the visual impact of the galvanised sheet-metal in areas with a high landscape value.

The trapezoid hut (b) is one of most adopted solutions for the farrowing of outdoor kept sows in Centre-North Europe. Also this hut is realized by sandwich panels of double galvanized sheet-iron with expanded polyurethane inside (50 mm). The high insulation level of panels gives good conditions to protect the sows from sunshine irradiation.

The dimensions of the trapezoid hut are 2.30 m length, 1.90 m width, 1.10 m height. The inlet door (0.85 x 0.60 m) is placed in the middle of the frontal wall; on the opposite side a sash window is placed, adjustable for ventilation rate. Anti-crushing tubes are not provided inside the hut.

The timber hut (c) has a triangular section, that is "A" shape. It is realized with Douglas fir poles and boards. The hut has been studied with modular dimensions in width (1.80, 2.00, 2.20 m) to be easily enlarged and reorganized during the research activities taking into account the body dimensions of Cinta Senese sows, which are not known by the literature. The dimensions of the hut in length are steady (2.30 m). The hut is provided with anti-crushing poles placed at a height of 0.25 m from the ground, with a movable sheet-copper ridge and with a rear adjustable window. During the experimental activities also the timber hut has been covered with a reed mat to evaluate the effect of sunshine radiation.

The last hut (d) is made by an electro welded metallic frame (4.00 x 2.20 m) covered with straw bales. The squared-meshed metallic frame has an arched shape and is connected by a welding to a tubular base (35 mm x 35 mm x 2 mm). Over the metal framework the rectangular straw bales (30 about) are fixed, in such a way to realize a natural and optimum insulating layer. Outer the straw is covered by a plastic sheet to increase the life. The dimensions are 2.20 m in length, 2.70 m in width, 1.25 m in height. The frontal door is 0.90 x 0.70 m and on the opposite side a window is arranged.

The experimental activities were carried out in 2 farms both placed in the Province of Siena, which is an area with a old vocation for extensive pig breeding.

Farm A

Farm B

Fig. 2: View of experimental enclosures in the 2 farms.

Farm A occupies a surface of land of about 200 ha. The extensive pig breeding is carried out with a large use of wooden areas, particularly chestnut and holm oak woods. During the trials 26 Cinta Senese sows and 15 cross-breed sows were present. The farrowing phase was usually conducted outdoor without any structure or in makeshift buildings, in quite precarious conditions. In the farm high losses of piglets were registered because of a predation by foxes or other wild animals.

In the farm A just a single enclosure was realized, placed in such a way to have a small water basin in the middle. Inside the enclosure 3 huts were put, 4.50 m distant from each other, turned to face south: - pyramidal hut (a); - trapezoid hut (b); straw hut (d).

Farm B has 35 ha of wood. During the trials 35 Cinta Senese sows were present. Before the experimental activities the sows only farrowed in closed buildings, in traditional pens with full concrete floor. In farm B 3 outdoor enclosures were realized, about 500 m^2 each. Every enclosure lodges a different hut and is equipped with nipple drinkers for sow and piglets and with concrete troughs. Farm B was provided with : - pyramidal hut (a); - timber hut (c); straw hut (d).

Behavioural studies were carried out in the 2 pig farms to evacuate the utilization of the different constructive typologies and to remark possible problems connected to the employed structures or equipment. For the behavioural survey a closed-circuit television system with time-lapse videotape and monitor was installed. For the night-time recordings infrared lamps were placed.

In farm A preference tests were executed to verify the more appreciated solution by the sows. Therefore some sows near the farrowing date were introduced in an enclosure with 3 different kinds of huts (a, b, d). The utilization times of the huts by the sows, the suckling times inside and outside the huts, the activity and resting times of the sows inside the huts were calculated.

The trials in farm A were carried out from February to May 2003. The farrowing of 3 sows were studied (sow A1, sow A2, sow A3). For the preference tests the pre-farrowing period of the sows was considered. In order to calculate the activity and resting time inside the straw hut (d) and outside, the sows A1 and A2 were followed from 16^{th} day after farrowing to 27^{th} day; sow A3 from 5^{th} to 13^{th} day.

In farm B the behavioural tests were carried out mainly in summer season (May – September 2003). The farrowing of 3 sows was monitored (sow B1, sow B2, sow B3) inside timber hut (c). In this study the behavioural test refers to the day before farrowing, the day of farrowing, the 2 days after farrowing, the 20^{th} day from farrowing. Also in this study the activity, resting, suckling times of the sows were calculated, to evaluate the use of the hut during the lactating period.

In both farms microclimatic data were collected (air temperature and relative humidity) during different seasons of the year, by use of probes connected to a data logger and installed inside the huts.

Particular attention was paid to the effect of the covering made with reed mats in the huts a, b, c (galvanized sheet-metal, timber). For this purpose data on thermal performances were collected, before and after the employment of the covering.

RESULTS

In next figures and tables the main results obtained during experimental trials are reported.

The results concerning the preference tests by the sows A1, A2, A3 are summarized in figure 3. The tests with a single sow in an enclosure provided with 3 different huts show clearly the preference for the straw hut (d). This kind of hut has been used by the 3 sows put in the enclosures for the 55.16% of the time. In other words, when the sow is brought inside the fence with the 3 huts, it almost exclusively chooses the solution with electro welded metallic frame covered with straw bales.

On the contrary the graph of figure 4 shows the different behaviours of the sows A1, A2 and A3 in the straw hut, compared to the outdoor activities. It is important to remark that in the item "outdoor" the partial employment of the other 2 huts is also included (5.24% of time).

After the first 7-10 days of lactation, the piglets tend to get out of the hut and thus the suckling can take place outdoor. Therefore the suckling percentage shown in the graph (12.88%) is exclusively referred to the suckling inside the hut by the 3 sows between the 5th and the 27th day of lactation.

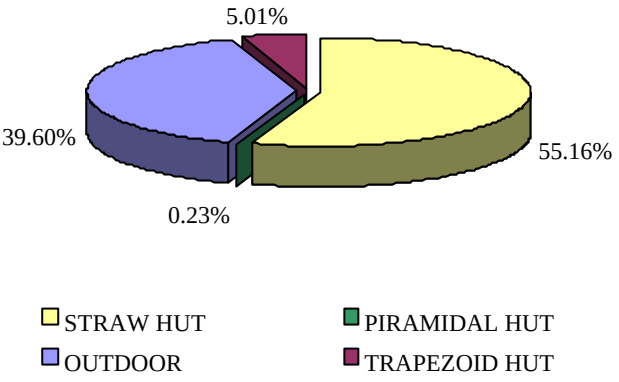

Fig. 3: Times of utilization of the 3 huts by the sows A1, A2, A3.

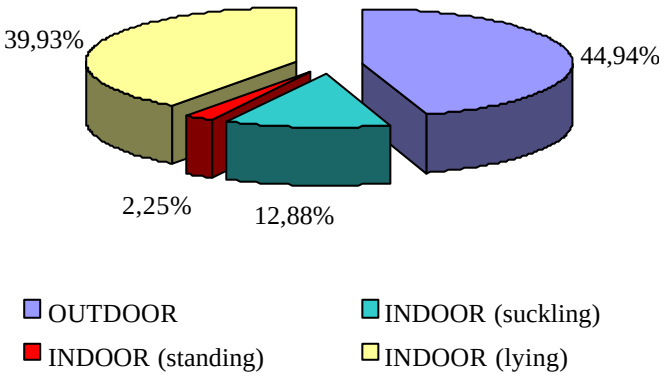

Fig. 4: Utilization of straw hut (d) by the 3 sows A1, A2, A3, in comparison to outdoor and other huts, with calculation of the main behavioural patterns (standing, suckling, lying).

To confirm the interest of the sows towards the solution with straw bales, it is also possible to cite a second test, carried out in farm A, based on the input of 2 sows in different times. In this case, after the first sow had adopted as housing solution the straw hut, the second sow, put in the enclosure some days later, preferred rather lodging in the same straw hut than using one of the other 2 free huts.

In farm B, the average behaviour of the 3 sows (B1, B2, B3) during the 24 hours before farrowing, the 72 hours after farrowing and the 20th day after farrowing is shown in graph of figure 5. This graph refers to the activity of the sows in the timber hut.

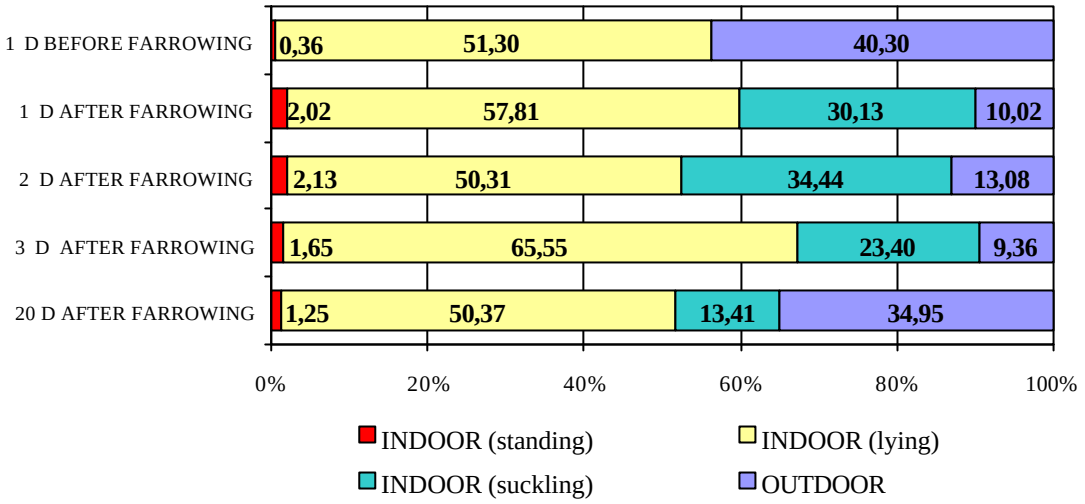

Fig. 5: Average times of utilization of timber hut by the 3 sows in farm B, during the summer season.

It should be noted that in the first 3 days after farrowing the sow exclusively suckled inside the hut, but even since the 3^{d} day it has greatly reduced the time devoted to suckling. On the 20th day the sow spent a good part of the middle hours of the day outdoor, then it used the hut for suckling of the piglets and for resting mainly in the evening and night hours.

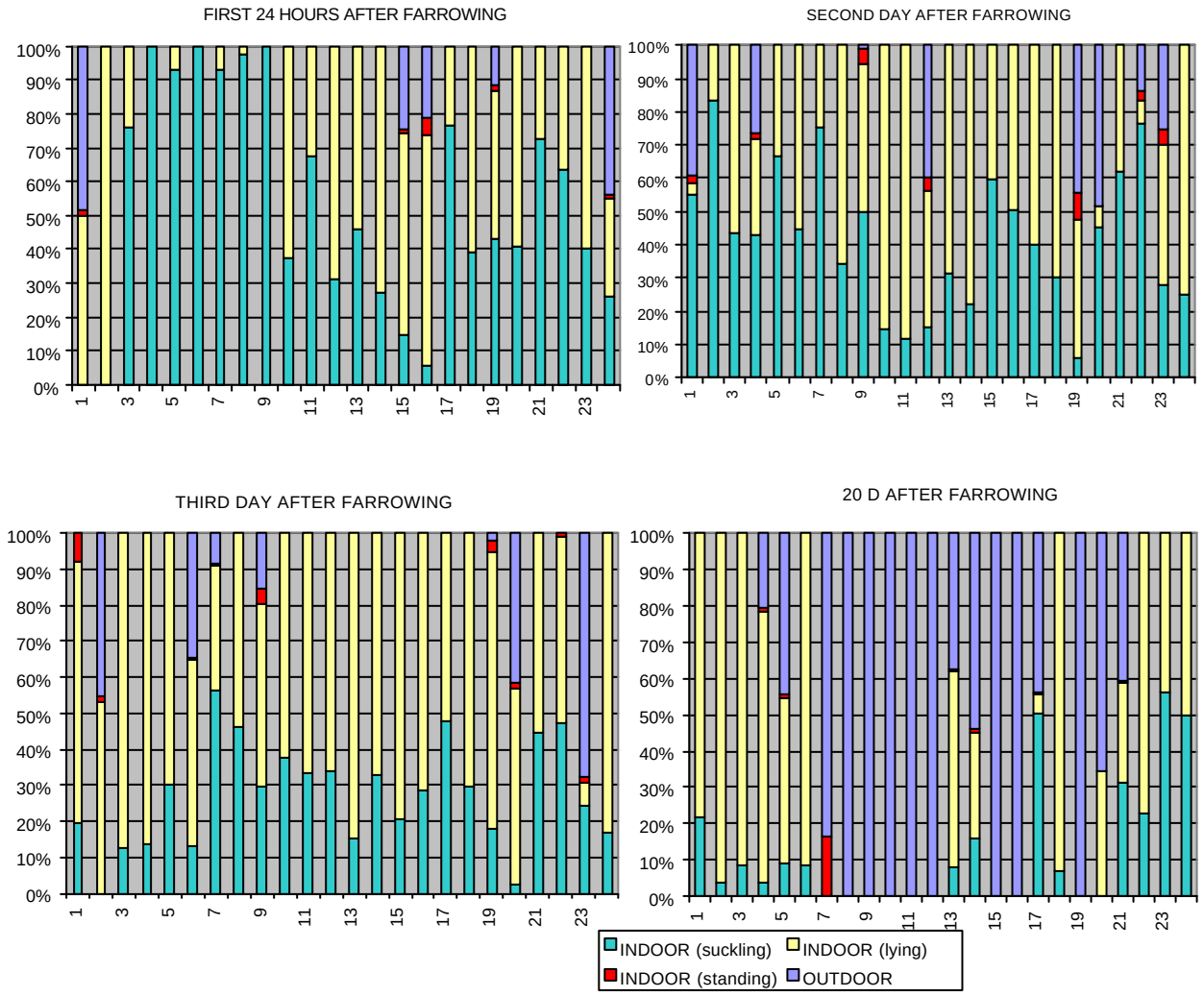

Fig.6: Main behavioural patterns of sow B1 in timber hut during the 1st , 2nd , 3rd and 20th day after farrowing.

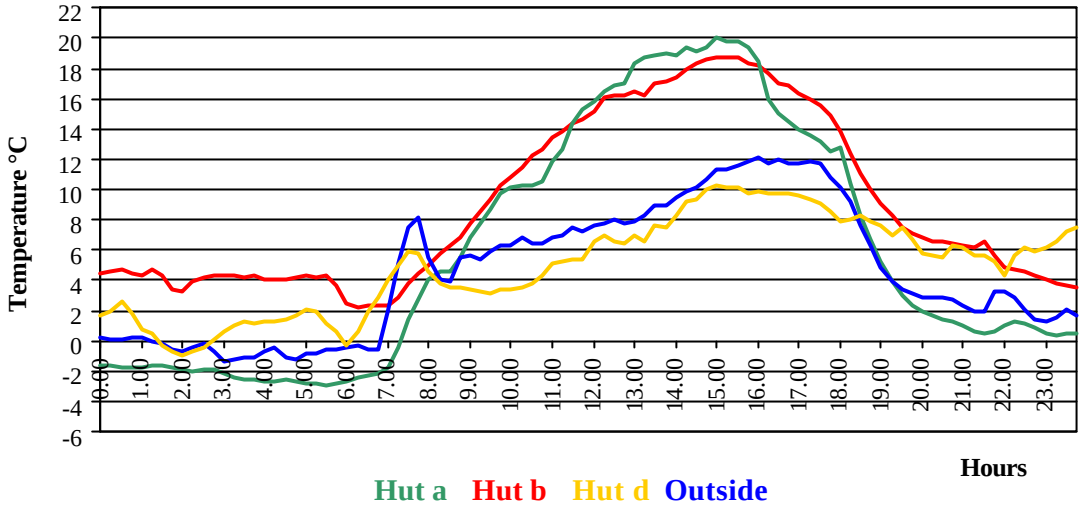

Fig. 7: Temperatures inside the huts a, b, d in farm A ("Typical day" of the cold period)

As regards to microclimatic parameters, the data collected in the 2 farms in different periods of the year have been elaborated. In this work only the data related to behavioural tests are reported. Therefore spring-winter data for farm A and summer data for farm B are presented.

Figure 7 shows the trend of the temperatures recorded in the huts a, b, d of farm A, during one of the coldest day.

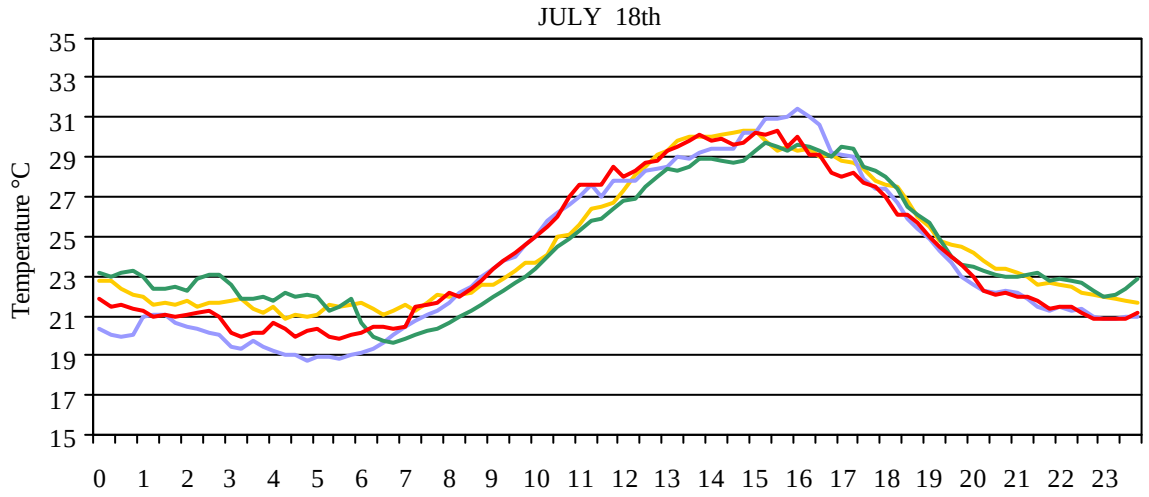

Fig. 8: Temperatures in different experimental huts (hut "a" and hut "c" are not arranged with reed-mat on the outside)

The graphs of figure 8 and figure 9 refer to the temperatures recorded in huts a, c, d of farm B during the summer season. It should be noted that the first of two mentioned graphs refers to the period during which the huts a and c were not protected with reed mat.

The second graph (fig. 9) reports the data collected after the application of the reed mats to the pyramidal hut (a) and to the timber hut (c).

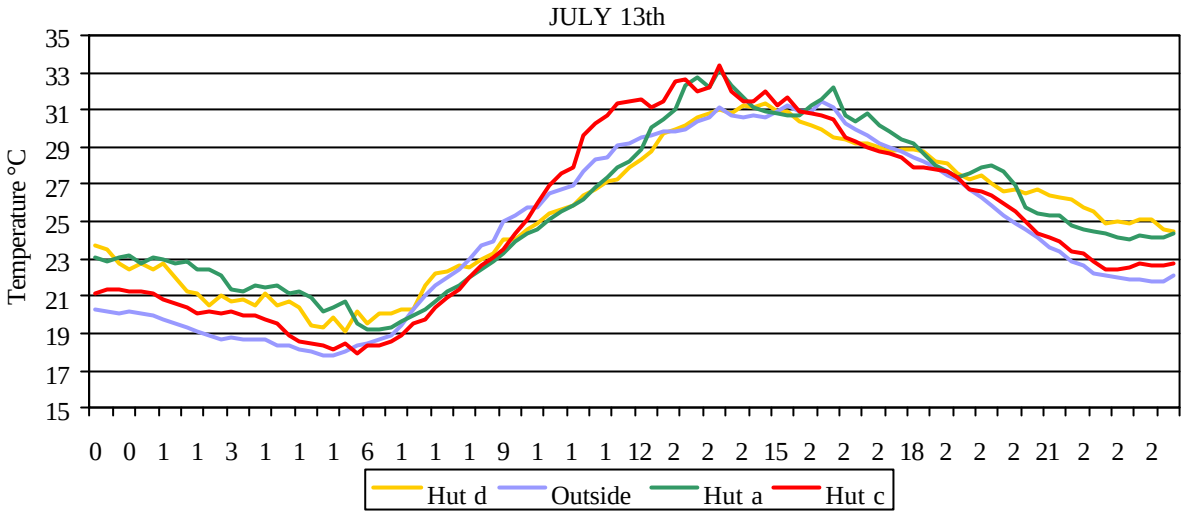

Fig. 9 : Temperatures in different experimental huts (hut "a" and hut "c" are arranged with reed-mat on the outside)

Tables 1 and 2 summarize the values of average, minimum and maximum temperature in the different compared huts (farm B), respectively before and after the application of reed-mats to the pyramidal hut (a) and to the timber one (c).

Table 1: Temperatures in different experimental huts (hut "a" and hut "c" are not arranged with reed-matting on the outside; July, 12-15th)

	Daily temperatures (°C)			Temperatures period 12 a.m.–5 p.m. (°C)		
	Highest Value	Lowest Value	Mean Value	Highest Value	Lowest Value	Mean Value
Hut a	33.83	19.28	25.62 ± 3.88	33.83	28.14	31.15 ± 1.44
Hut c	33.53	18.34	25.09 ± 4.72	33.53	28.98	31.44 ± 1.25
Hut d	31.31	19.40	25.36 ± 3.53	31.31	28.09	29.99 ± 0.89
Outdoor	32.06	18.37	24.58 ± 4.40	32.06	28.65	30.41 ± 0.85

Table 2: Temperatures in different experimental huts (hut "a" and hut "c" are arranged with reed-matting on the outside; July, 16-18th)

	Daily temperatures (°C)			Temperatures period 12 a.m.–5 p.m. (°C)		
	Highest Value	Lowest Value	Mean Value	Highest Value	Lowest Value	Mean Value
Hut a	29.56	20.27	24.85 ± 0.80	29.56	27.03	28.83 ± 0.67
Hut c	30.47	20.49	24.61 ± 3.24	30.47	28.01	29.38 ± 0.77
Hut d	30.14	21.59	25.03 ± 2.78	30.14	27.54	29.31 ± 0.72
Outdoor	31.12	19.27	24.19 ± 3.73	31.12	28.02	29.67 ± 0.89

DISCUSSION

The experimental activity carried out in the two farms allows us to treat some important considerations.

From the tests on the use of huts a clear preference of the sows towards the straw hut is emerged: this hut is used by the sows for more than 55% of time. It should be noted that even when 2 sows are put into the enclosure, with an interval of some days, both of them prefer to use the straw hut, although other 2 huts are available.

This latter aspect, that is the simultaneous use of the hut by the 2 sows, probably caused by the gregarious instinct of the animals of Cinta Senese breed, has to be taken into proper account during the design of outdoor pig farms. It is far better to arrange single enclosures, that is one hut for each single sow, than to realize collective enclosures with as many huts as the sows of the group (solution widespread in Centre-North Europe). The simultaneous presence of 2 or more sows in a single hut must be prevented, to reduce the losses of piglets for crushing.

From the tests carried out in the timber hut (c) it has been possible to verify that the sow in the first 3 days after farrowing remains inside the hut for almost the 90% of daily time (89.2%), devoting to suckling the 29.3% of time. At 20 days from farrowing, when the piglets are able to get over the little step present on the door of the hut (0.25 m), the sow tends to use mainly the outside areas and to suckle outdoor. However in the evening and night hours the sow mainly remains inside the hut (about 35% of total time) and gladly suckles inside (13.4%).

The behaviour is obviously influenced by the season, the microclimatic conditions and the systems adopted outside to protect from heat stress (shading, water holes, etc.). The latter aspect is surely decisive to affect the behaviour of the sows and then the higher or lower use of the huts.

The thermal performances of the different compared huts are very different from each other. In winter period great thermal excursions are noted in pyramidal hut (a) and in trapezoid one (b), with peaks of temperature particularly high during the middle hours of the day. The straw hut has a more constant trend of temperatures, with night values generally higher than the ones of the other huts, but lower daily peaks.

The advantages of straw employment are even more pointed out in summer, when inside the hut the temperature remains lower than outside during the hottest hours of the day, on the contrary of the other 2 compared huts (a, c).

The importance of the use of vegetable materials to mitigate temperature peaks inside the huts is particularly clear. The experimental trials have demonstrated how the temperature in the hottest hours of the day is decidedly more favourable in the straw hut, remaining below the outside temperature (- 0.42°C) and below the temperature recorded in the other two huts (- 1.16° compared to hut a; - 1.45° compared to hut c, as average values of hot period; - 2.62° and - 2.32° respectively, as maximum values). After the application of reed-matting the above-said differences completely disappear and still better the pyramidal hut can have values lightly lower in the hottest periods.

On the basis of experimental tests it should be remarked that the materials used for the construction of huts play a decisive role in order to realize suitable conditions of thermal comfort for the sows.

CONCLUSIONS

The strong boost given to the breeding of pigs of Cinta Senese race in the last years has brought many farmers to turn breeders, without taking a specific care. Therefore a lot of managerial lacks can be noted in the existing pig farms, which often give poor productive performances.

The structures employed for the pig breeding are generally run-down and obsolete, without particular constructive or equipment devices able to guarantee the efficiency of the breeding and

suitable life conditions for the animals. The latter observation is particularly important in the most delicate phases of the productive cycle, that is farrowing phase and post-weaning phase. In the extensive pig farms with Cinta Senese sows the farrowing-suckling period is often neglected by the breeders, who accept almost resigned low productive performances.

The farrowing phase can be improved in a considerable way by a good organization and simple constructive solutions.

The farrowing huts can be realized at very low costs, for example making the huts with an electro welded metallic frame covered with straw bales. The realization of such structures can occur at very low costs (not more than 100 euro for the materials) and having recourse to farm labour.

The structure used in the experimental trials has been very appreciated by the sows, which clearly prefer this solution to the other ones in comparison, how the preference tests have demonstrated.

Also from the point of view of thermal performances the straw solution has proved to be surely suitable, both in the cold season and especially in the hot one.

The pig breeders during the experimental tests have expressed a great interest towards the proposed solutions and generally towards the researches aimed at favouring the development and the rationalisation of extensive breeding systems, clearly pointing out the requirement to be informed on structures, equipment, plant and management.

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