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Original article

Perinatal losses in outdoor pig breeding. A survey of factors influencing piglet mortality

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Summary — Outdoor keeping of breeding sows is rapidly developing for technico-economic reasons (chiefly limited investment), as well as to provide a more 'natural' environment, thus supposed to improve the welfare of animals when compared with indoor intensive systems. However, the piglet production has been cited as impaired, due to a higher early mortality. The yearly survey of the technical results of the French national herd shows that the piglet losses of outdoor sows are significantly higher than when compared with the national records for indoor herds (21.1% vs 17.4%; 76 578 and 867 719 litters respectively, for 1994, $P < 0.001$). This difference was consistent over the last few years. Mortality decreases from the first to the second litter and increases later on, and is higher during the late autumn-early winter period, but does not depend on the level of reproductive performance. The high loss outdoor herds are characterised by the different aspects of stockman intervention around parturition. The percentage of losses increases from 18.2% to 21.2% when parturition is watched over. Among the environment characteristics, a good quality of the pasture (well established grass cover) in the paddock characterises the low loss group. The percentage of piglet loss is negatively correlated with the amount of straw available in the hut ($R = -0.355$, $P < 0.01$).

pig / outdoor housing / perinatal loss

Résumé — Les pertes de porcelets lors de l'élevage en plein air des truies reproductrices. L'entretien en plein air des truies reproductrices constitue une alternative intéressante au système classique d'élevage en bâtiments. Le faible niveau des investissements est un atout important, mais l'environnement plus naturel est supposé améliorer les conditions de vie et le bien-être des animaux

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tout en donnant au public une image positive de cet élevage. Ce système se développe, en particulier dans les pays dont le climat modéré en facilite la mise en œuvre. Toutefois, un certain nombre de difficultés sont apparues, en particulier une moindre production numérique de porcelets due pour l'essentiel à une mortalité périnatale accrue. L'existence de données enregistrées sur la gestion technique des troupeaux de truies permet de préciser la réalité de ce problème. Les pertes de porcelets au cours de la lactation y sont en effet significativement plus élevées que pour l'ensemble des élevages: 21,1 contre 17,4 % en 1994 avec $p < 0,001$ (chiffres établis sur 76 578 portées en plein air et 867 719 en bâtiment). Si l'écart est plus important pendant la mauvaise saison – automne-hiver –, il persiste tout au long de l'année. Le taux de perte décroît de la première à la seconde portée pour s'accroître à nouveau ultérieurement. La différence est la même, que l'on considère les élevages dont les performances moyennes sont les meilleures (un tiers supérieur de l'échantillon) ou les moins bonnes (un tiers inférieur). Un échantillon représentatif a fait l'objet d'une étude destinée à mettre en évidence l'influence des pratiques des éleveurs en comparant des élevages présentant des taux élevés ou faibles de pertes. Paradoxalement, les interventions de l'éleveur lors de la mise bas semblent avoir un effet nettement défavorable sur les taux de pertes. C'est ainsi qu'il s'accroît de 18,2 % lorsqu'aucune intervention n'a lieu pendant la mise bas à 21,2 % dans les troupeaux où l'éleveur intervient régulièrement. Un paillage abondant des abris réduit les pertes : le taux en est corrélé négativement avec la quantité de paille fournie ($R = -0,355$, $p < 0,01$). Enfin, la qualité de la pâture est également un facteur favorable à la survie des porcelets.

porc / élevage en plein air / mortalité périnatale

INTRODUCTION

Outdoor keeping of sows and piglets has been often used in the past, together with indoor farrowing and fattening. The modern husbandry systems have drastically accelerated the modification of all aspects of the animals' life, as the animals are generally kept permanently indoors, fed on a concentrate and balanced diet, socially isolated, in a barren environment on slatted floors. The public concern about restriction of movements, and the occurrence of obvious and apparently abnormal behaviours or stereotypes have resulted in doubts about the animals' welfare in such conditions, whereas producers argue that the level of production and the health status indicate that the animals are adapting correctly to such an environment.

A series of studies have been developed in keeping pigs permanently outdoor in a natural semi-forested area (Jensen, 1986, 1988). They have allowed a good knowledge of the natural patterns of behaviour of the domestic pig. To bridge the gap between the natural conditions of life and the modern intensive pig farming, some systems of management have been proposed such as the pig family pen (Stolba et Wood-Gush, 1989), but such an alternative system to indoor intensive housing has not reached a significant practical development.

However, a modern adaptation of outdoor keeping of sows has been first developed in United Kingdom (Thornton, 1988). The animals are kept on grass paddocks equipped with a hut provided with straw as shelter and allowing nest-building in a protected area.

Such a system concerns a growing percentage of pig production in western Europe: over 20% in United Kingdom (MLC, 1993), ca 10% in France, whereas pilot trials have been carried out in other countries in which the climate is less suitable such as Denmark (Mortensen et al, 1994), Germany or Sweden (Edwards, 1994).

In France, outdoor keeping of breeding sows is rapidly developing for technico-eco-

nomic reasons (chiefly limited investment), and reaches a satisfactory level of production. Furthermore, the awareness of the consumers, and consequently of the producers, about the welfare issue has favoured this system of production as providing a more 'natural' environment, thus supposed to improve the welfare of animals when compared with indoor intensive systems.

However, despite its success in some west-European countries, data on the different aspects of outdoor pig production compared to the classical intensive production are still limited. A series of questions have been listed in the report of S Edwards on the EAAP meeting in Edinburgh (1994): climate and the use of shelter, unadapted genotypes, unadapted facilities and insufficiently trained stockmen, but also specific clinical problems (Link, 1993). The major problem cited is an impaired piglet production, mainly due to a higher early mortality (Edwards, 1994; Berger et al, 1995). A study of the causes of piglet mortality in a herd of 80 sows kept outdoors has been published by Edwards et al (1994).

The yearly survey of the technical results of the French national herds provides important data to test the general validity of such a conclusion. As an attempt to further analyse such a phenomenon, a representative sample of herds has been studied in detail to test the consequences of the management practices in outdoor production of pigs.

MATERIALS AND METHODS

A large scale survey of the technical performances of the breeding sows has been done every year for more than 20 years in France. Data have been collected on the farm as a part of the national program of technical management for breeding herds (in French: 'Gestion Technique des Troupeaux de Truies', GTTT). They involve recording of mating, farrowing and weaning dates, the number of piglets born and weaned and the date of culling for each sow, which allows determination of the annual production per sow.

The reproduction results indoors and outdoors were compared on the 1994 sample for the national record. As outdoor housing of sows has been recently developed, we have tested the possibility for improvement by comparing the best and the worst performing herds. The sample was divided in three thirds according to the total number of piglets weaned per sow per year.

In order to analyse the effect of the season and that of the parity, we have used the reproduction data for the sows born in 1990, and followed for the successive litters until 1994 (161 962 indoors and 7787 outdoors, for a total of 713 242 and 34 306 litters respectively).

In each case, the data were compared using the F test on the herd means.

The management practices of the pig breeders have been recorded together with the level of piglet losses in two studies.

1) A sample of 51 representative outdoor herds has been selected on the basis of the GTTT results, among the best 2/3 of the national herd record, with the following criteria: i) total number of piglets born > 10; ii) total number of piglets weaned > 8.9; iii) percent of piglet loss > 10% and < 30%; and iv) average age of sows at farrowing > 20 months.

Each farmer was questioned by a technician on the basis of a questionnaire. On the basis of the GTTT results, one group of 24 herds was characterised by a relatively low average piglet loss (under 16.5%), another group of 27 herds by a relatively high level of piglet loss (superior to 22%).

2) The individual environment at farrowing has been recorded in a sample of four representative sows in each of 52 herds. The sows were chosen as one in each parity (1, 2, 3 or 4, more than 4). They farrowed within a few days in winter-early spring (January-end of April). The sows and their litter have been observed from the parturition for 3 days. In order to take into account the space available in the hut, the size of the sow was estimated from the height and the length of the animal. The environment has been described as following: description of the hut, and evaluation of the 'protected' area (total surface of the hut minus the area not directly facing the opening), place of the nest, amount of straw provided, temperature outdoor and in the hut, quality of grass in the paddock: (from 1, no grass visible to 5, complete grass cover). The occurrence and the cause of piglet death has been recorded. The

Table I. Production results of sows kept outdoors compared with indoors.

	Outdoor	*Indoor*
No litters	76 578	867 719
Interval between farrowings (days)	155.3 ± 9.2	152.9 ± 9.2***
Average age at weaning (days)	26.8 ± 2	27.2 ± 2***
Average no piglets born/litter	11.7 ± 1.1	11.7 ± 1.1 NS
Average no piglets weaned/litter	9.2 ± 0.7	9.7 ± 0.7***
Loss (%)	21.1	17.4***
Average no piglets weaned/sow/year	21.6 ± 2.2	23.1 ± 2.2***

Mean ± SD. *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$; from the national program of technical management for breeding herds (GTTT, 1994).

comparison of the number of herds in each case has been done by X^2 test.

RESULTS

Production results of the sows kept outdoors

The production of outdoor sows has been compared with the results of indoor sows from the national sample of 1994. The fertility results as measured by the interval between successive farrowings are slightly but significantly better indoors, but the litter size (number of piglets born) is similar. The age at weaning is 0.4 days later indoors, but the piglet loss is significantly higher in outdoor sows, which results in a lower number weaned and an impaired production per sow/year (table I).

The distribution of the results concerning the loss of piglets is similar in the two systems: the difference is similar when only the best and the worst third of the herds are considered (table II).

The seasonal influence on piglet loss (higher during late autumn and early winter) is especially important for outdoor sows, whereas it is limited indoors. This could reflect the direct influence of lower temperature and higher humidity for animals kept outdoors. However, the difference remains highly significant throughout the whole year (fig 1).

The parity of the sow influences the early death of piglets, which decreases from the first to the second litter and increases later on. The influence of the system remains significant throughout the reproductive life of the females (fig 2).

Management characteristics of the herds with low and high piglet loss

The herds observed are of similar size and performance (table III). Most of the

Table II. Average reproductive performance compared for the superior and inferior 1/3 of the recorded herds.

	Inferior 1/3	*Total*	*Superior 1/3*
Outdoors			
No litters	18 105	76 578	28 255
Loss (%)	23.5	21.1	19.7
Indoors			
No litters	172 764	867 719	391 758
Loss (%)	20.1***	17.4***	16.1***

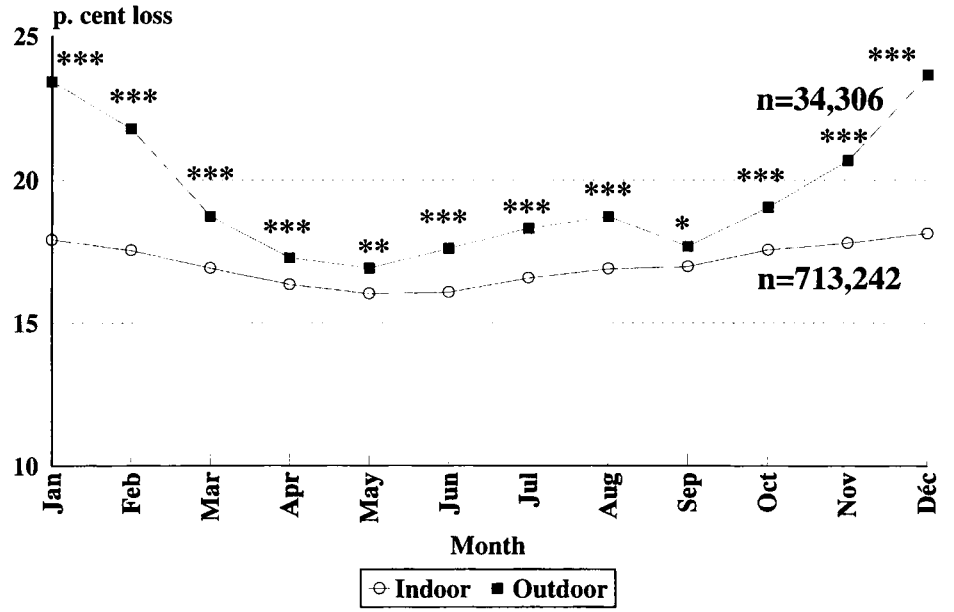

Fig 1. Seasonal evolution of piglet losses (*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$. Data collected from 1991 to 1994 on sows born in 1990; n = total number of litters).

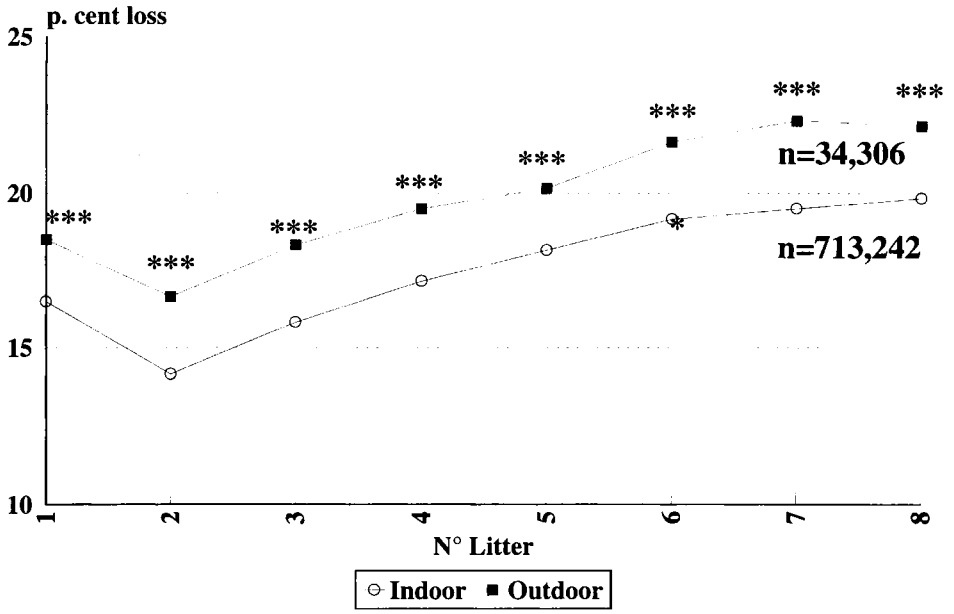

Fig 2. Evolution of piglet losses according to parity (*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$. Data obtained from 1991 to 1994 on sows born in 1990; n = total number of litters).

Table III. Performance of herds presenting High and Low piglet losses.

	Low piglet loss: *< 16.5%* *n = 24*	*High piglet loss:* *> 22.5%* *n = 27*
Average herd size (sows)	88.1 ± 34.1	84.4 ± 25.6 NS
Piglets born	11.05 ± 0.53	11.99 ± 0.76***
Weaned	9.43 ± 0.4	9.13 ± 0.45**
Loss as percentage of total born	14.36 ± 1.76	24.73 ± 2.23***

management procedures are similar: level of feeding, time of introduction of the sows in the farrowing paddock, fostering, and veterinary treatment.

The high loss herds are characterised by the different aspects of stockman intervention around parturition: watching parturition, interfering during farrowing, and an earlier human care of piglets (table IV). Caugant (1993) reports that, outdoors, the percentage of losses increases from 18.2% when the herdsman does not watch over parturition to 21.2% when parturition is watched over. Such results are opposed to what has been cited for indoor farrowing.

Among the environment characteristics, a good quality of the pasture (well established grass cover) in the paddock characterises the low loss group.

The provision of straw is similar in the two groups. The huts are made with semi-circular corrugated iron of similar design. Surprisingly, the presence of anti-crushing systems in the hut design is more frequent in the high loss group, what suggests that such systems are not adapted yet.

The protection of the hut has a complex effect on piglet survival: an interaction has been observed between the size of the sow, estimated by the lateral surface, (height × length) and the 'protected area' inside the hut (area not directly opening outside). The sows with a lateral surface superior to 0.9 m^2 have a higher piglet loss when the protected

Table IV. Effect of environment and human intervention around parturition on piglet losses.

	Number of herds in each group	
	< 16.5% loss	*> 22.5% loss*
Intervention on the nest before farrowing	18	26 NS
Any intervention during the 24 h before farrowing	16	26*
No interventions during parturition	9	1**
Watching over parturition	9	23**
Delay to intervention on a problem at parturition (h)	3.7	1
Hut equipped with anti-crushing system	4	10 NS
Well implanted grass cover	10	3*

area is inferior to 2.7 m^2, whereas such a relation does not appear with smaller sows.

Relation of the individual performance of the sows with their environment at farrowing

The major traits accounting for the loss of the piglets appear to be the following: the amount of straw provided at farrowing, the presence and quality of grass on the paddock, and the level of protection of the hut.

The percentage of piglet loss is negatively correlated to the amount of straw available ($R = -0.355$, $P < 0.01$). A minimal amount of ca 22 kg of straw seems to be necessary to reduce loss. This is in agreement with the results of Arey et al (1991) who mentioned an average of 23 kg of straw used by the sows for nest building.

Another important trait is the quality of the grass cover of the paddock. It has been estimated by a subjective note from 1 (full grass cover) to 5 (no grass visible). The sows with a high piglet loss (> 33%) were more frequently kept in paddocks with very poor grass cover, whereas those with relatively lower losses (ie > 12% but < 23%) were more frequently in better paddocks (fig 3).

DISCUSSION AND CONCLUSIONS

The large scale record of the production results of the French sow herd shows a consistently higher percentage of piglet losses for sows kept outdoor on pastures, especially for the second litter, but the difference when compared with the national performance remains of importance during the whole reproductive life of the female.

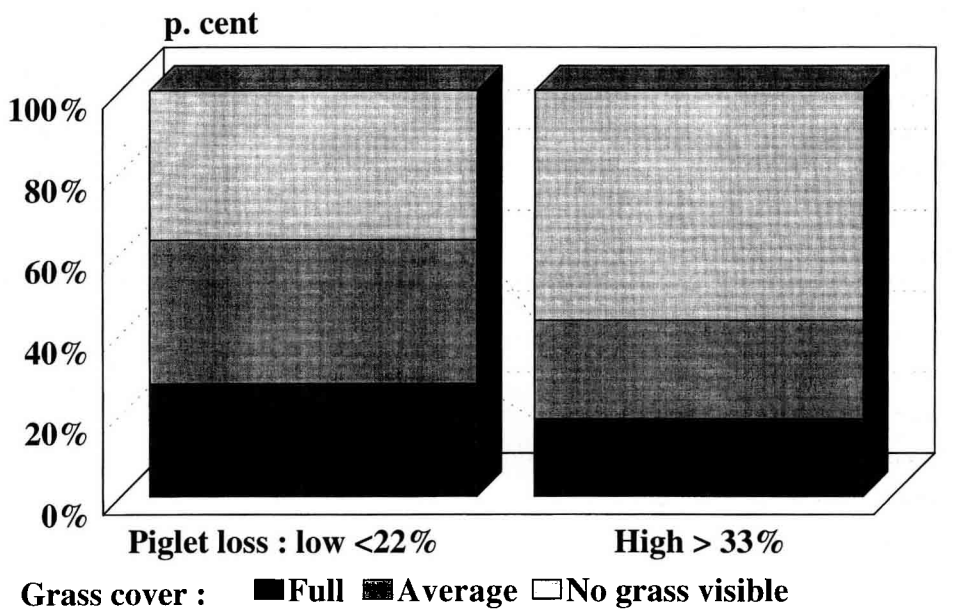

Fig 3. Percentage of herds presenting the different qualities of the grass cover in the paddock in low versus high loss herds.

Piglet losses appear to be an important and consistent problem for outdoor sows. This has been mentioned in several reports comparing different housing systems (Mortensen et al, 1994; Le Denmat et al, 1994), and is stressed as the major problem of this housing system by Edwards (1994). This is supported by the results of this large scale and long term study. In fact, the average mortality is similar to that observed by Edwards et al (1994), higher than that reported in the MLC report (1993), but not markedly different from the figures cited in the 'Easicare' report (1993).

The major reasons for such a difference between outdoor and indoor keeping of sows concern the conditions of piglets at birth and the perinatal environment. The mortality has been hypothesised to be due to some intractable climatic factors, and unadapted genotype. The increase in mortality rate in late autumn/early winter supports this hypothesis. However, it remains significantly higher than indoors throughout the whole year, even during the most favourable months of spring/summer.

The fact that the best third of the herds, as well as the worst third, present a similar difference suggests that the overall technical level of the herdsman, as well as the production capacity of the herd cannot eliminate the difference in piglet losses between the outdoor and indoor sows. It does not appear that an evolution could be expected with the present techniques allowing the outdoor sows' performance to reach the level of the indoor production.

The quality of the nest appears to improve the piglet survival outdoors. It necessitates the provision of a sufficient amount of dry straw. The design of the hut providing the sow with enough space together with protection from air flow could be important, although not objectively assessed. However, the maternal experience, that could result in increasing the efficiency of nest building in outdoor sows, does not appear to influence the mortality rate of the piglets, as its evolution with the parity is similar outdoors and indoors.

The relation between a bad grass cover of the paddock and an increased piglet loss could be due, in degraded paddocks, to the permanent presence of mud, which is brought by the sow into the hut, thus increasing humidity and bacterial pollution. Furthermore, in such a condition, the sow could eat straw instead of grass to reach hunger satiation, thus reducing the amount of straw available for the nest.

The heterogeneity in body condition of pregnant sows due to the difficulty of managing low ranking females when there is food competition (Martin et Edwards, 1994; Signoret et al, 1995) could be an additional cause of low viability of piglets.

The stockman assistance during parturition does not allow any improvement of piglet survival. Contrary to what could be expected, the most obvious result is the detrimental effect of any type of human intervention around parturition.

However, other factors have been proposed such as an inappropriate design of the huts and insufficient skill of stockmen, transferring without care the standard indoor management system (Edwards, 1994). This hypothesis does not appear to be supported by the present results as after more than 10 years of experience, the best outdoor herds maintain the same difference with the best indoor ones.

It is difficult to attribute the mortality of liveborn piglets to one single cause. It could be due to low viability at birth, starvation resulting from delayed suckling or crushing, and often several of such causes simultaneously. However, crushing appears as important for outdoor sows (Edwards et al, 1994). The present results show that any type of human intervention during farrowing could be detrimental to piglet survival. The disturbance of the freely moving sows could be an important cause of crushing piglets.

To conclude, several possibilities appear to improve piglet survival outdoors. Concerning the management, the provision of straw is an important point, whereas the lesser the stockman interferes around parturition, the better piglet survival is. A well adapted choice of the paddocks is of utmost importance (quality of soil, grass, and stocking rate). However, possibilities for improvement of the management practices could be proposed from the present results. The quality of the grass on the paddock seems to be an important factor. It could be reached in using paddocks on correct draining soils, with grass established for a sufficient long time, and a ratio of sows per hectare less than 15. The design of huts has to be improved, as the systems used (anti-crush rails or lateral niches for piglets in the hut) do not allow any protection of piglets from crushing. Some sows perform better than others, suggesting that choosing an adapted genotype, and, for the future, including in the selection programme the performance for outdoor farrowing could be important.

Such improvements would allow better conditions for outdoor farrowing sows to improve a technique that has a promising future in pig production.

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