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ANALYSIS OF ROUTINELY COLLECTED REPRODUCTIVE PERFORMANCE DATA TO INVESTIGATE THE EPIDEMIOLOGY OF SEASONAL INFERTILITY IN SOWS IN NEW ZEALAND

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Les données collectées en routine pendant de nombreuses années dans 20 porcheries sur l'ensemble de la Nouvelle Zélande ont été utilisées pour décrire quantitativement l'occurrence de l'infertilité saisonnière et pour analyser l'importance et les interrelations de chacune de ses manifestations.

La conclusion issue de l'analyse de ces données longitudinales est que l'infertilité saisonnière ne paraît pas avoir été un problème important dans les élevages suivis dans l'étude durant la période considérée et qu'elle n'a pas engendré de pertes économiques majeures. Cette pathologie, ainsi que définie dans l'étude, est apparue sporadiquement et, bien que les taux de mise bas aient été moins élevés en été et automne qu'en hiver et printemps dans les élevages à problèmes dans l'année en question, à la fois les taux de retour réguliers et irréguliers étaient supérieurs pendant les périodes concernées d'été et d'automne que pendant l'hiver et le printemps.

Les erreurs de saisie, les données manquantes et la multicolinéarité entre variables ont compliqué l'analyse. Dans cet exemple particulier, la situation était encore compliquée par le fait que le syndrome tel qu'il se présente en Nouvelle Zélande ne permettait pas une définition claire des cas.

L'extraction des données nécessaires n'était pas facile et il est apparu pendant l'opération que les méthodes habituelles de recueil des données sur la performance des animaux ne permettent pas l'évaluation rapide et facile des phénomènes complexes tels que l'infertilité estivale, ni la comparaison entre élevages. D'autres méthodes, telles que les diagrammes de contrôle de procédures (process control charts), qui sont largement utilisés en industrie, pourraient aider grandement à l'identification précoce des désordres et améliorer l'efficacité des programmes de suivi de la performance des élevages en ce qui concerne la surveillance épidémiologique.

INTRODUCTION

Summer-autumn infertility is a collective term which conveniently describes a wide range of infertility manifestations in the summer and autumn period and includes increased weaning to mating intervals, delayed onset of puberty and/or poor oestrus expression in gilts, decreased litter size and increased prevalence of stillborn and/or mummified foetuses. In this study, the contribution which those components made separately and collectively to reduced fertility in the summer-autumn period in selected herds in New Zealand, was examined and measured.

MATERIALS AND METHODS

The database application option of PigCHAMP® (University of Minnesota, College of Veterinary Medicine, St. Paul, Minnesota) was used to extract productivity records of 20 farms with relatively constant numbers of served females for the periods under consideration.

Monthly farrowing rates (proportion of gilts or sows farrowed from the service during a particular month) and the proportions of regular returns, irregular returns, negative pregnancy tests, abortions and not-in-pig sows were calculated based on the number of gilts or sows served in each month. Sows which were removed from herds were excluded from the calculations. Farms were designated as having a summer-autumn infertility problem if the difference between the average farrowing rate during winter-spring (May-November) and summer-autumn (December-April) was more than 0.01 for a particular year. The farrowing rate was required to be below the median of the farrowing rate recorded for the whole of the year for at least 3 months during summer-autumn. An additional restriction was that the farrowing rate over the winter-spring period was not allowed to fall below the annual rate for more than 1 month to ensure that herds classified as having summer-autumn infertility did not include herds which had a non-specific drop in reproductive performance. Annual farrowing rates ranged from 0.638 to 0.976 about a median of 0.878.

For the purposes of this study, some farms were classified as having no problems in one year (NPY) but as problem farms when summer-autumn infertility occurred in another year(PY). The interaction term between PY and summer-autumn was coded as PYS, and all other farm and season interactions (PY in winter-spring + NPY in summer-autumn + NPY in winter-spring) were coded as NPYS. Between season comparisons were used in preference to monthly comparisons to smooth out effects of any short duration farrowing rate reductions in winter-spring which

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occurred in PY. All variables were derived from the same PigCHAMP® database but farrowing rates and other rates and proportions were calculated as monthly averages for each farm in each year.

STATISTICAL ANALYSIS
Stepwise logistic regression (Statistix® version 4.1, Analytical Software, Tallahassee, Florida) was used to explain PY and NPY status from farrowing rates, return rates, abortion rates, negative pregnancy test rates, not-in-pig rates in summer-autumn or winter-spring, and to examine the effects of season, PY and NPY, interaction of PY and summer-autumn, and return, abortion, negative pregnancy test and not-in-pig rates on farrowing rate. ANOVA and Mann-Whitney U tests (Statistica® for Windows version 5, StatSoft Inc, Tulsa, Oklahoma) were used for comparisons of production indices between problem and non-problem herds for whole years, for summer-autumn seasons, and for all herds between summer-autumn and winter-spring. As the range of weaning-to-first-service intervals was large (1-189 days, most likely due to missing data), comparisons were also constructed for weaning-to-first-service intervals <19 days, because weaning-to-first-service intervals >19 days were unlikely to represent the first oestrus.

RESULTS
The explanatory variables, monthly farrowing rate, regular return rate, irregular return rate, negative pregnancy test rate, not-in-pig rate, abortion rate, and season (summer-autumn vs winter-spring) were included in the stepwise logistic regression for explanation of the outcome variable, summer-autumn infertility farm status during a particular year (PY or NPY). The odds ratios for monthly farrowing rate, irregular return rate, and negative pregnancy test rate (see Table I) were not large but indicated that problem herds were more likely to have higher monthly farrowing rates over the whole year and higher rates of irregular returns and negative pregnancy tests.

Table I
Final unweighted logistic regression model for explanation of summer-autumn infertility status

Predictor variables	Coefficient	Standard error	p-value	Odds ratio (95% CL)
Constant	-7.94	2.12	0.002	
Farrowing rate	0.07	0.02	0.001	1.07 (1.03-1.12)
Irregular return rate	0.15	0.03	<0.001	1.16 (1.09-1.23)
Negative preg test rate	0.09	0.03	0.005	1.09 (1.03-1.16)

Deviance = 520.15, p = 0.0023, df = 432, n = 436; Hosmer-Lemeshow statistic (C) = 10.38, p = 0.24, df = 8

Table II presents the final stepwise logistic regression model for monthly farrowing rate resulting from offering the variables regular return rate, irregular return rate, negative pregnancy test rate, not-in-pig rate, abortion rate, season of the year (summer-autumn vs winter-spring), PY/NPY farm-year status, and interaction between PY/NPY farm-year status and season to the selection algorithm. The model indicates that increases in abortion and irregular return rates were associated with lower farrowing rates. The interaction between PY/NPY farm year status and season (PYS/NPYS) suggests reduced monthly farrowing rates for PY farm year status during summer-autumn (PYS). The model indicates that a farm year status classified as PY had higher monthly farrowing rates overall but lower farrowing rates in the summer-autumn period than a farm-year status classified as NPY.

Table II
Unweighted logistic regression model for prediction of farrowing rate

Predictor variables	Coefficient	Standard error	p-value	Odds ratio (95% CL)
Constant	2.34	0.04	<0.001	
Abortion rate	-0.09	0.02	<0.001	0.92 (0.89-0.95)
Irregular return rate	-0.07	0.003	<0.001	0.93 (0.93-0.94)
PY/NPY	0.2	0.07	0.003	1.22 (1.07-1.39)
Season	-0.002	0.06	0.97	1 (0.89-1.12)
PYS/NPYS interaction term	-0.29	0.1	0.003	0.75 (0.62-0.90)

Deviance = 608.21, p = <0.001, df = 432, n = 430; Hosmer-Lemeshow statistic (C) = 10.03, p = 0.26, df = 8

Univariate analyses
No differences were found between annual farrowing rates in problem and non-problem herds, but the expected differences were evident at seasonal level with problem herds having the lowest rates in summer-autumn. Similar patterns were found for irregular return rates, but regular return rates were higher in NPY than PY overall (p = 0.008), higher for all herds in summer-autumn (p = 0.06) and higher in PY than NPY in summer-autumn (p = 0.006).
Abortion rates, not-in-pig rates and negative pregnancy test rates were relatively constant over all combinations of groups and seasons.

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Non-problem herds experienced significantly longer weaning-to-first-service intervals than did problem herds in winter-spring and in summer-autumn and that association stayed constant when the data was stratified to intervals <19 days for all sows, and to parity 1 sows, and to parity 1 sows with intervals <19 days. The number of NPD per parity of PY were significantly greater than for NPY.

The average number of pigs born and pigs born alive per litter was significantly higher in winter-spring than in summer-autumn and higher in non-problem farms (11.76 and 10.85 respectively) than in problem farms(11.54 and 10.58).

No significant differences were found in the rates of mummies per litter between PY and NPY years and seasons but higher rates of still-born piglets per litter occurred on problem farms over both seasons although there was no seasonal differences within PY and NPY groups.

DISCUSSION

Summer-autumn infertility, as defined for the purpose of this study occurred sporadically in the study set of 20 farms with records for multiple years. Although the criteria for designation of problem farms or non-problem farms within each year introduced some loss of independence in the observations for the 3 farms which had dual classifications through their history, that deficiency should have been amply compensated for by the number of farms (20) in the study and the number of farm years (37).

Farrowing rates were lower in summer-autumn than in winter-spring on problem farms of that year, but during affected summer-autumn periods, both regular and irregular return rates were higher than during winter-spring. No differences were found when negative pregnancy test rates, abortion rates and not-in-pig rates were similarly compared.

A finding of longer weaning-to-first-service intervals in the winter-spring than in summer-autumn was unexpected and contrary to commonly held views of the nature of the syndrome (Leman, 1992). Analyses carried out on intervals of < 19 days provided some evidence, albeit not at a high level of statistical significance, of the weaning-to-first-service intervals being longer in parity 1 sows in summer-autumn than in winter-spring - another unexpected finding (Hurtgen et al., 1980).

The number of non-productive days per parity was greater on problem farms in summer-autumn than in winter-spring and on non-problem farms over both seasons. This effect was not a consequence of long weaning-to-first-service intervals, but rather was due to the lengths of the «service to detected open» period and the «detected open to removal» period. Our examination of non-productive days per parity was restricted to parities >1 as the mating to removal interval showed wide variation for gilts due to influences of factors such as the value of gilts and the market price of culls.

Between season differences were detected for both the numbers of pigs born and the numbers born alive per litter but the differences were small and were not evident when problem and non-problem farms were compared by themselves or in combination with seasons.

Reduced litter size has been linked with summer-autumn infertility but Love (1980) suggested that any reductions in litter size should not be considered as indicators of the syndrome but rather as a reflection of other factors, such as management practices and increased stress.

This descriptive and analytical study provides an insight into reproductive performance in New Zealand pig herds and indicates that summer-autumn infertility is not a major health and production problem for the herds and years considered in this study. This contrasts with Australia, where summer-autumn infertility is seen as a serious production-limiting problem.

The study provides an example where routinely collected production data was used to investigate a complex disease syndrome. Issues complicating the analysis included data entry errors, missing values and multicollinearity between variables. In this particular example, the situation was further complicated by the fact that the syndrome in its presentation in New Zealand did not allow a clear case definition. As there were no obvious and consistent seasonal patterns in the data, it was relatively difficult to classify individual observation periods (summer-autumn and winter-spring) into problem and non-problem intervals. Extracting the relevant data was not easy and it became apparent during that process that current methods of reporting herd performance data do not allow easy or rapid assessment of complex conditions such as summer infertility or allow between herd comparisons. Other methods, such as process control charts which are used widely in industry, could greatly assist early recognition of disorders and improve the epidemiological surveillance functions of herd performance recording programs

BIBLIOGRAPHY

Hurtgen, JP, Leman, AD, Crabo, B, (1980) Seasonal influence on oestrus activity in sows and gilts. Journal of the American Veterinary Medical Association, 176: 119-123.

Leman, A, (1992) Seasonal infertility patterns In Pig Production Proceedings, No. 186, University of Sydney Post Graduate Foundation in Veterinary Science, University of Sydney.

Love, RJ, (1981) Seasonal infertility in pigs. Veterinary Record, 109: 407-409..