Economic impact of an epizootic of pseudorabies in a commercial swine herd in Ohio, achieving test negative status and quarantine release by use of vaccination and test and removal

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Summary: *The effect of pseudorabies in a commercial farrow-to-finish operation on selected production and economic values was estimated. Pseudorabies was first diagnosed in this herd by circle testing done in March 1988, as a required part of follow up from another herd that had been diagnosed with pseudorabies in the area. A pseudorabies virus vaccination program was initiated in the herd at that time.*

The mean litter size of pigs born alive varied from 9.26 to 10.02 pigs/litter throughout the study period; however, there was a twofold increase in suckling pig mortality and a 2.6-fold increase in nursery pig mortality when the months of the epizootic were compared with pre-epizootic months. In the 6-month period following the epizootic, suckling pig mortality was threefold higher than that reported in the preepizootic months.

Total net loss for this operation was estimated at $99,700 from when the epizootic started until eradication, when calculating losses directly. The major economic losses (76.5% of total loss) were related to suckling pig mortality, which was $16,240 during the epizootic or $24/inventoried sow/week; $19,395 in the 6 months following the epizootic or $3.8/inventoried sow/week; and $40,628 thereafter until eradication 26 months later or $0.37/inventoried sow/week. Nursery pig mortality losses were 12.6% of total net losses; $754 during the epizootic, $357 in the 6 months after the enzootic, and $11,444 thereafter until eradication 26 months later. Sow culling and deaths accounted for 9.4% of net losses that took place from 6 months after the epizootic until eradication. In that same period, market hog deaths accounted for the remaining 1.2%, or $1,227 of the net losses.

When calculating economic losses indirectly by using hogs marketed/sow/year during, and after the pseudorabies epizootic until eradication, total net losses were $85,520. Losses from decreased hog production was $4,156 during the epizootic and $12,000 for the 6 months following the epizootic. From then until eradication, losses were $3,817 for the last 2 months in 1988, $23,969 for 1989, and $41,578 for 1990.

The national pseudorabies eradication program in the United States, implemented in 1989,[1] has reinforced the need for information about economic impacts of the disease in different swine operations. The economic losses associated with pseudorabies virus (PRV) infection, including costs of clinical epizootics, PRV serologic analysis, and vaccination has been estimated to be $32,918,376/year.[2]

Several states including Ohio have ongoing projects to study the feasibility of PRV control and eradication, aimed at estimating producer costs and costs to the state of alternative control strategies. Zimmerman et al[3] estimated the costs of eradicating PRV from 23 herds participating in the Iowa Pseudorabies Eradication Pilot Project. Cost for depopulation with repopulation was estimated at $203.66/sow, compared with $7.78/sow for test and removal and $40.87/sow by use of the offspring segregation method. Rodriques et al[4] described computerized decision-tree analysis in an attempt to identify the optimal PRV control or eradication alternative. Three alternative actions were considered for a hypothetical 100-sow, farrow-to-finish operation: depopulation/repopulation, test and removal, and vaccination. They found

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that the expected monetary values for the test and removal and vaccination alternatives were similar and higher than for depopulation/repopulation.

The economic impact of an epizootic of pseudorabies in a herd for which a vaccination program was used was investigated recently by Parsons et al.[5] They found in a 320-sow farrow-to-finish unit, a twofold increase in preweaning mortality, and a subsequent 19% decrease in the number of pigs weaned during the 5-week epizootic. Significant differences in production were not observed between the 6-month periods before and after the epizootic.

To determine the economic incentive to eradicate PRV, it is necessary to document producer losses resulting from the disease. Kliebenstein et al[6] indicated that economic loss estimates must include the measurement of losses during and immediately after clinical outbreaks. Comparing seropositive herds to seronegative herds is not sufficient, because many PRV-seropositive herds may not have had clinical losses related to PRV for months or years, and clinical losses are an important component of overall losses.

Several studies evaluating the economic analysis of pseudorabies eradication programs in commercial swine herds have been published, focusing on various aspects of this topic. In 6 large herds studied in Illinois, evidence suggested that PRV increases the risk of other viral and bacterial infections as a consequence of PRV-induced immunosuppression.[7] In Ohio, Hoblet et al[8] studied the economic effect of a pseudorabies epizootic in a herd, using test and removal in a 150-sow farrow-to-finish operation. They found a twofold increase in suckling pig mortality and a 3.5-fold increase in stillbirths when comparing the preepizootic months with the epizootic months. Following the epizootic, suckling pig mortality was 13.7% greater than observed in the months before the epizootic and the stillbirth rate was 71% higher. Total net loss for the operation was $48,175, 88% of which was related to breeding herd removal/repopulation and downtime.

Recently, Ebel et al[9] described a simulation model to calculate direct costs of pseudorabies by use of baseline, moderate, and high-impact scenarios for vaccinating pigs against pseudorabies in a population of infected farrow-to-finish herds.

The profitability from controlling pseudorabies through vaccination for all in/all out growing/finishing operation was demonstrated in a controlled field study.[a] The mean finish weight was 9.13 kg higher in vaccinated pigs, and the net profit per head was $13.15 higher in those vaccinated.

The objective of the study reported here was to estimate the economic impact from PRV infection, by measuring herd losses before and during the acute and chronic stages of PRV infection, until eradication from the herd. Partial budgeting was the economic technique used for making the evaluation.

Material and Methods

Study population—The herd (crossbred Yorkshire, Duroc, Chester White) located at 2 premises 6 km apart had an average of 241 breeding age sows in 1988, the year of the PRV outbreak, and had a yearly production of 2,970 market hogs for slaughter. Weaning age in the herd was 26 days.

Records—Detailed production records were used from the years 1987, 1988, 1989, and 1990 on animal inventory, pounds pork sold, pounds of feed fed, feed cost, feed conversions, death loss, as well as yearly summaries of variables of producer costs. These farm production data were used to establish baseline values for mean litter size of pigs born alive, mortality for suckling, weaned and finishing pigs, sow culling and deaths, and hogs to market/sow/year. In addition, changes in revenues and variable costs attributable to PRV during the epizootic and post epizootic periods were estimated. Variable costs were calculated for the hog enterprise of the farm, using farm records. Variable cost included feed costs as well as non-feed costs (fuel, supplies, veterinary costs, electricity, rent of machinery, boars, and miscellaneous costs) and were used to estimate the variable cost of 45.25 kg (100 pounds) of pork sold. Sales were from marketweight hogs and cull sows marketed.

The following definitions were used: death rate in suckling pigs (number born alive minus number weaned)/number born alive; death rate in nursery pigs = number dead/number weaned in the same time period; death rate for market hogs = number dead/number marketed; and the death rate for sows = number dead/mean number in the herd for that year.

In addition, pseudorabies test records were used. These records were available from the Ohio Department of Agriculture, Division of Animal Industry from the time the herd was tested initially (from a circle test in March 1988) and found to be PRV positive (confirmed by serum neutralization test) through quarantine release (January 1991).

Pseudorabies virus vaccination—Vaccination of sows against PRV was performed by use of killed vaccine[b] from April 1988 until August 1988; modified-live vaccine[c] was used from August to November 1988 in sows and finishers; and a modified-live gene-deleted vaccine[d] was used from November 1988 to January 1991.

Sows were also vaccinated against parvovirus/

[a]Loula T. SmithKline Beecham, Animal Health, Livestock Division, Exton, Pa. Personal communication, June 5, 1991.

[b]Killed vaccine, Norden Laboratories Inc, Lincoln, Neb.

[c]Modified-live vaccine, Norden Laboratories Inc, Lincoln, Neb.

[d]PRV—Marker, SyntroVet Inc, Lanexa, Kan.

leptospira[e] and erysipelas,[f] 2 weeks before weaning, and gilts were vaccinated 2 weeks before mating. Sows were vaccinated 2 weeks before farrowing with *Escherichia coli* bacterin-toxoid[g] and *Bordetella bronchiseptica/Erysipelothrix rhusiopathiae/Pasteurella multocida* bacterin/toxoid.[h] Killed transmissible gastroenteritis vaccine[i] was used in all gilts 2 weeks before farrowing, and in sows 2 weeks before farrowing in the fall months.

Time period studied—The economic analyses were performed during the following periods: (1) preepizootic period (Jan 1, 1987 through February 1988)-baseline data; (2) during the epizootic (Mar 1, 1988 through Apr 30, 1988); (3) the 6 months after the epizootic (May 1, 1988 through October 1988); and (4) the time from 6 months after the epizootic to eradication (November 1988 to January 1991). To encompass the time it would take for all pigs born during the epizootic to reach market weight, and the expected decrease in cash flow attributable to pig deaths, the postepizootic period was divided into parts (3) and (4) as described.

Partial budget—Partial budgeting was used to calculate the economic impact associated with the pseudorabies epizootic in each of the time periods, using period 1 as the baseline period. The causes of loss used in estimating the economic impact were changes in mean litter sizes and mortality of suckling, weaned and finishing pigs, and changes in proportion of sows culled and dead, and changes in number of hogs marketed/sow/year. In these calculations, the assumption was made that any change from the normal baseline rates (period 1) for those values were attributed to pseudorabies.

It was known that the herd had a history (none in 1987) of transmissible gastroenteritis (TGE). This disease had developed in 1982 and again in 1986. A major TGE outbreak affected all gilts in August, September, and October of 1988, the year of the pseudorabies epizootic. A TGE outbreak would normally last for about 1 week and typically cause loss of all pigs born during a 1-week period (from 8 to 12 sows), but this particular outbreak lingered on, causing death (confirmed by fluorescent antibody test[j]) in 4 market hogs in addition to suckling pig and nursery pig mortality. In March and April 1989, 9 suckling pigs and 3 market hogs were lost to TGE (identified on necropsy). In June and July 1990, 30 weaned pigs and 6 market hogs were lost to TGE (identified on necropsy).

[e]Salsbury Parvo-lepto, Solvay Animal Health Inc, Mendota Heights, Minn.

[f]Salsbury erysipelas bacterin, Solvay Animal Health, Inc, Mendota Heights, Minn.

[g]Litterguard LT, Norden Laboratories Inc, Lincoln, Neb.

[h]Rhinogen CTE 5000, Bio Vac Inc, North Sioux City, SD.

[i]TG-Emune with Imugen II, Oxford Veterinary Laboratories Inc, Worthington, Minn.

[j]Tested at the Food Animal Health Research Center, Ohio Agricultural Research and Development Center, Wooster, Ohio, in September, 1988.

Financial losses from suckling pig mortality—The increased number (number greater than baseline rates) of unweaned (younger than 26 days old) pig deaths was multiplied by the mean weight of hogs marketed from the farm (112.20 kg = 2.48 hundredweight [cwt] for 1988) times the mean price received for market hogs in the same year ($43.19/45.25 kg) from the producer records to arrive at the decreased revenues from death loss of suckling pigs, eg, (number of deaths − baseline rates) × mean weight of hogs marketed × price for market hogs. From this figure, the estimated mean decreased variable costs of production not incurred because of death were subtracted. Decreased variable costs were calculated by multiplying the increased number of suckling deaths by the mean weight gain not achieved of hogs marketed from the farm (107.7 kg = 2.38 cwt for 1988 mean death weight for suckling pigs = 4.5 kg or 10 pounds) times the estimated mean variable cost/45.25 kg (100 pounds) of pork produced taken from producer records for each year studied.

Nursery and finishing pig mortality—The increased number (number greater than baseline rates) of nursery (> 26 days of age to 22.6 kg in weight) and finishing pig (> 22.6 kg) deaths was multiplied by the mean weight for market pigs on the farm (112.20 kg = 2.48 hundredweight [cwt] for 1988) times the mean price received from the market hogs in the same year ($43.19/45.25 kg) to arrive at the decreased revenues from death loss of nursery and finishing pigs, eg, (number of deaths − baseline rates) × mean weight of hogs marketed × price for market hogs. From this figure, the estimated mean decreased variable costs of production not incurred because of death were subtracted. Decreased variable costs were calculated by multiplying the increased number of either nursery or finishing pig deaths by the mean weight gain not achieved for these pigs on the farm (98.64 kg = 2.18 cwt in 1988 (average death weight = 13.6 kg or 30 pounds) for weaned nursery pigs and 66.97 kg = 1.48 cwt (average death weight = 45.25 kg or 100 pounds) for finishing pigs) times the estimated mean variable cost/45.25 kg (100 pounds) of pork produced.

Culled and dead sows—Increased numbers of sows culled and dead per month, respectively ([postepizootic cull rate minus baseline cull rate] × the number of months from the epizootic until eradication), were multiplied by $50 (their replacement costs minus their slaughter value) to arrive at losses from culling sows, and by $126 (the mean revenue/cull sow) to calculate losses from dead sows.

An alternative way to calculate losses from PRV infection during the aforementioned time period before, during, and after the epizootic until eradication was possible from the production data available on number of hogs marketed/sow/year as follows:

Hogs marketed/sow/year—Losses from decreased hogs/sow/year to market were estimated from data in producer records by multiplying the difference between hogs marketed/sow/year before the epizootic and the number marketed for the 2 months' duration of the epizootic, for 6 months after, and yearly thereafter until eradication by the number of sows in production for the time period times the mean weight for market hogs on the farm times the mean price received for market hogs in the same year to arrive at the decreased revenues from decreased hogs/sow/year. From this figure, the estimated mean decreased variable costs of production were calculated by multiplying the increased number of hogs/sow/year lost to market by the mean weight for market hogs times the estimated mean variable cost/45.25 kg (100 pounds) of pork produced taken from producer records for each time period studied. For the purpose of these calculations, a mean death weight of 9 kg or 20 pounds was used when calculating the decreased variable costs/45.25 kg (100 pounds) of pork produced.

Events in the epizootic—Clinical infection with pseudorabies developed in a 500-sow operation in the fall of 1987, which was confirmed by the Ohio Department of Agriculture, Reynoldsburg, Ohio. The owner in the study had replacement gilts located 1.6 km due east of the 500-sow operation, on 1 of the 2 study farm premises. These gilts developed influenza-like signs on Feb 10, 1988 and were moved February 26 to the other study farm premise a few kilometers further north in the county. Within 10 days after movement of the gilts, sows developed influenza-like signs. It is believed that this was the initial exposure to PRV. Although not used for the calculations in this study, production records going back to 1982 were relatively stable until this time, giving further evidence that this was the initial exposure. Results of the serum neutralization test of 3 of 27 sows and all 13 market hogs tested were found to be positive for PRV on a circle test conducted on March 7. The epizootic on the study farm was presumed by the Ohio Department of Agriculture to be the result of area spread from the neighboring sow operation. Quarantine was issued for the premises on Mar 15, 1988.

On Dec 21, 1988, 10 crossbred gilts born between Aug 14 and 28, 1988 were diagnosed as seropositive by the gp-X test.[k] From this testing it could be concluded that the virus had been circulating in the herd, because these gilts were born in the postepizootic period.

Subsequent testing by the gp-X test in April, August, November, and December 1989 and January, February 1990 revealed between 80 and 100% seropositive pigs. However, only 1 suspect was found of 12 gilts tested in May and 1 seropositive of 30 tested in October 1990. Finally, the quarantine release complete herd test (299 animals) conducted in December had 3 suspects, 6 positives all in 1 pen, 1 positive in a neighboring pen, and 2 positives in 2 other pens. In February 1991, testing of penmates of the seropositive animals removed in December revealed another 2 positives and 1 suspect animal that were removed. The herd was released from quarantine after a second and final negative test result.

[k]HerdCheck Anti-PRV-gX. IDEXX Inc, Portland, Me.

Table 1—Summary of production data for a sow farrow-to-finish operation

Variable	Year 1990	1989	1988	1987
Total number marketed	3,344	3,037	3,094	3,647
Total tons of pork marketed	393.8	331.9	357.1	414.6
Mean market weight (kg)	111.52	110.71	112.20	111.02
Mean no. sows	279	261	241	229
Litters/sow/year	1.93	1.76	1.9	1.84
Pigs weaned/sow/year	16.05	13.87	12.7	15.07
Hogs marketed/sow/year	11.98	11.63	12.03	15.92
No. of litters farrowed	541	460	457	422
No. of litters weaned	525	446	409	414
Mean no. pigs born alive/sow farrowed	9.99	10.10	9.83	9.43
Mean no. pigs weaned/sow weaned	8.53	8.13	7.48	8.33
Mean no. pigs weaned/sow farrowed	8.27	7.88	6.69	8.18
Pigs born alive saved (%)	82	78	68	87
Total herd feed conversion*	4.053	3.84	3.92	3.87
Market hog feed conversion	3.414	3.55	3.38	3.25
Feed cost/45.25 kg of pork	$27.16	$27.21	$27.18	$20.24
Nonfeed variable cost/45.25 of pork	$5.92	$5.65	$3.74	$2.24
Total variable cost/45.25 kg of pork	$33.08	$32.86	$30.92	$22.48
Market hog price/45.25 kg of pork	$53.78	$44.65	$43.19	$50.94
Cull hog price/45.25 kg of pork	$42.74	$33.89	$29.68	$36.85
Nursery death (%)	5.91	2.67	3.1	2.28
Market hog death (%)	1.65	1.78	2.5	1.54

*Kilogram of feed fed per kg of pork produced.

Statistical analysis—The χ^2 test was used to analyze statistically significant differences between rates ($P < 0.05$). For analysis of actual losses discounted to 1988 dollar values, the following formula was used:

$$PV = \frac{FV}{(1+r)^n}$$

Table 2—Production impacts of a pseudorabies epizootic in a sow farrow-to-finish operation

Time frame	Mean litter size	Suckling pig mortality (%)	Nursery (to 22.6 kg) mortality (%)	Finishing pig (>22.6 kg) mortality (%)	Hogs marketed/ sow/y	Sows culled/mo.	Sows dead/mo.
Before epizootic (1987 & January and February 1988)	9.57	14.59[a]	2.15[a]	1.9[a]	15.14	10.8	0.18
Clinical epizootic (March and April 1988)	9.26	28.46[b]	5.5[b]	4.0[b]	12.32	11.0	0
After epizootic (6 mo [May to October 1988])	9.93	45.08[b]	2.9[a]	2.6[b]	12.42	12.6	0.17
After epizootic (26 mo [November 1988 to January 1991])	10.02	20.28[b]	4.6[b]	1.9[a]	12.55	18.0	0.27

[a,b]Rates in the same row with different superscripts are different when compared with preepizootic rate ($P < 0.05$).

where PV present values, FV = future value, r = discount rate (10%), and n = number of years.[10]

Results

Sows—Results demonstrating summary data by year on key production variables for 1988, the year of the PRV epizootic, as well as 1 year prior to that and 2 years after that are shown in Table 1. The number of pigs weaned per female per year was 12.7 in 1988, the lowest of these 4 years.

The health status in the herd was generally at a decreased level after the epizootic, compared with the period before the epizootic. There was an increased frequency of TGE, in August to October 1988, during which all gilts had signs of TGE, and suckling and weaned pig mortality increased.

Increased veterinary costs and supplies would also reflect a decreased health status of the herd in the period following the epizootic. These costs from 1987 through 1990 were $4,652; 6,867; 10,549, and 9,988, respectively.

Suckling pig mortality—An overall increased mortality attributable to pseudorabies was (4,493-3,061)/4,493 − (3,980-3,451)/3,980 = (1,432/4,493 − 529/3,980) × 4,493 = 835 excess pig deaths, comparing the difference between the number of pigs born alive and weaned for 1987 and 1988, respectively.

Mortality attributable to pseudorabies of 13.9% of the pigs farrowed alive increased during the clinical epizootic (Table 2). During the 6 months after the epizootic, mortality increased 30.5%, compared with preepizootic months. A loss of $35,634.74 {(224 + 979)/(787 + 2,187) − (529/3,980)} × 4,493 pigs × 2.38 cwt/pig × ($43.19/cwt − $30.92/cwt) was attributed to pseudorabies from increased deaths in suckling pigs (Table 3).

When recalculating the net losses associated with suckling pig mortality (which was 77% of the total losses in the 6-month period following the epizootic, and during which TGE losses took place) we assumed (scenario 1) that the suckling pig mortality during that period would remain the same as during the epizootic (28.46%). In another calculation (scenario 2), we assumed that net losses were in between the mortality during the epizootic and what it was in the last time period studied (November 1988 to to January 1991—24.37%, Table 4).

Table 3—Summary of net losses from a pseudorabies epizootic in a sow farrow-to-finish operation

Loss category	Dollar loss	Percentage of total
Suckling pig mortality		
Epizootic	$16,240	
After epizootic (6 mo.)	19,395	
After epizootic (26 mo. [November 1988 to January 1991])	40,628	
Subtotal	$76,263	76.5
Weaned pig mortality (to 22.6 kg)		
Epizootic	754	
After epizootic (6 mo.)	357	
After epizootic (26 mo. [November 1988 to January 1991])	11,444	
Subtotal	$12,555	12.6
Sow culling	$9,360	9.4
Sow death	295	0.3
Subtotal	$9,655	
Market hog deaths	1,227	1.2
Total	$99,700	100.0

Net losses associated with the 6-month postepizootic period decreased to $3,155 out of a new total net loss of $83,460 in scenario 1 (Table 4). Similarly, when using the in-between rate (24.37%), net losses for the same time period were $998 out of a new total of $81,303 (scenario 2), almost identical to the net loss results of $85,520 from the indirect calculations of losses in this study, using hogs marketed/sow/year.

Nursery pig mortality—Mortality attributable to pseudorabies of 3.3% of the nursery pigs (19 of 563) increased during the clinical epizootic (Table 2). During the 6 months after the epizootic, mortality increased by 0.75% (9 of 1,208), which is a 34% increased rate when compared with preepizootic months. A loss of $1,111.76 {(19 pigs + 9 pigs) × 2.48 cwt/pig × $43.19/cwt) − (28 pigs × 2.18 cwt/pig × $30.92/cwt)} was attributed to pseudorabies from increased deaths in nursery pigs (Table 3).

Finishing pigs—Mortality in these pigs were affected as shown in Table 2. Mortality attributable

Table 4—Analysis of impact on net losses of suckling pig mortality in 6-month period after epizootic when transmissible gastroenteritis losses took place, when changing death loss rates

Loss category	Dollar loss	Total net loss
Suckling pig mortality 6 mo after epizootic		
Actual rate: 45.08%	$19,395	$99,700
Scenario 1*: 28.46%	$ 3,116	$83,460
Scenario 2†: 24.37%	$ 998	$81,303

*Assuming same death rate (28.46) as during epizootic (period 2). †Assuming death rate (24.37), which was in-between epizootic (period 2) and after epizootic (period 4 [November 1988 to January 1991]).

to pseudorabies increased by 2.1% during the epizootic. During the 6 months after the epizootic, mortality increased by 0.7%, when compared with the preepizootic months. However, the mortality rate decreased to 1.9% in the months thereafter until eradication. Losses from increased deaths in finishing pigs were estimated to be $1,226.99—2.5 hogs/month × [($43.19/cwt × 2.48/cwt/pig) − ($30.92/cwt × 1.48 cwt/pig)] × 8 months (Table 3). Also nonvariable feed costs/cwt of pork increased from $3.74 in 1988 to $5.65 in 1989 and $5.92 in 1990, with feed costs being at $27 in each of these 3 years. The feed conversion for market hogs went from 3.38 kg of feed fed/kg of pork produced in 1988, to 3.55 in 1989 and 3.414 in 1990.

Sow culling—In the year before the epizootic, a mean of 10.8 sows were culled each month (Table 2). For the 6 months after the clinical epizootic 12.6 sows per month were culled. In the remaining 26 months after the epizootic until eradication, a mean of 18.0 sows per month were culled. Losses from increased sow culling were estimated to be $9,360 ([18.0 sows/month] − 10.8 sows/month) × 26 months × $50/sow; (Table 3).

Sow deaths—In the year before the epizootic, a mean of 0.18 sows died each month (Table 2). For the 6 months after the clinical epizootic, 0.17 sows per month died. In the remaining 26 months after the epizootic until eradication, a mean of 0.27 sows per month died. Losses from increased sow deaths were estimated to be $294.84 ([0.27 sows/month − 0.18 sows/month] × 26 months × $126/sow; Table 3).

An estimate of all the losses attributable to pseudorabies was also calculated indirectly by looking at the cost associated with a decreased number of hogs marketed during and after the epizootic. Hogs marketed sow/year in the year before the epizootic were 15.14 hogs/sow/year (Table 2). During the epizootic, 12.32 hogs/sow/year were marketed, which is 2.82 fewer (19%) than before the epizootic.

During the 6 months after the epizootic, 12.42 hogs/sow/year were marketed and 12.55 hogs/sow/year until eradication. Losses from decreased hog production were estimated to be $4,155.52 ([15.14 − 12.32] × 241 × {$43.19/cwt × 2.48 cwt/pig] − [$30.92 × 2.28 cwt/pig]} × 0.167 years) for the 2-month duration of the epizootic. Losses from decreased hogs/sow to market were estimated to be $12,000.47 ([15.14 − 12.42] × 241 × {[$43.19/cwt × 2.48 cwt/pig] − [$30.92 × 2.28 cwt/pig]} × 0.5 years) for the 6 months following the clinical epizootic. From then until eradication, losses of decreased hogs/sow/year to market were $3,816.59 ([15.14 − 12.55] × 241 sows × {[$43.19/cwt × 2.48 cwt/pig] − [$30.92/cwt × 2.28 cwt/pig]} × 0.167 years + $23,968.92 [15.14 − 12.55] × 261 sows × {[$44.65/cwt × 2.45 cwt/pig] − [$32.86/cwt × 2.25 cwt/pig]} × 1 year + $41,577.53 [15.14 − 12.55] × 279 sows × {[$53.78/cwt × 2.46 cwt/pig] − [$33.08/cwt × 2.26 cwt/pig]} × 1 year) for the last 2 months in 1988, for 1989, and for 1990, or a total of $69,363.04.

Hogs marketed/sow/year increased to 15.00 during the last 6 months of 1990, the same as before the epizootic (Table 2), suggesting that estimated losses reported in this study were attributable to a negative effect of pseudorabies virus on swine production on that farm. During this time (July to December 1990) the seropositive rate in the herd had decreased to a low value, which remained low until eradication. Although 14 of 15 sows and gilts tested positive in February 1990, only 1 of 12 tested suspect on a test in May 1990.

Similarly, suckling pig mortality was 14.59% during period 1 prior to the epizootic (Table 2). Pseudorabies was diagnosed in the herd in March 1988. Suckling pig mortality after the epizootic from November 1988 until January 1990 was 20.28%. For the first 6 months of 1990, during which time the herd was still seropositive, suckling pig mortality was 19%, decreasing to 15% during the last 6 months of 1990, the same as before the epizootic.

Discussion

Previous work done on the economic impact of PRV have shown that this disease can cause economic losses in the range of $25 to $50/sow/year.[11] These calculations only include the losses during the period of the epizootic and the direct losses attributable to death and abortions. The same investigator estimated a loss of $145/sow/year, when expanding the observation period to 3 months after the termination of the epizootic.[11] The study reported here has incorporated the production variables, on which the economic results are based. In addition, the period of observation included data from the year prior to and 2 years after the year of the epizootic.

In economic terms, the disease manifested itself by the fact that losses attributable to PRV amounted to a total of $99,700, when calculating losses directly. The major part of the loss was caused by the death of suckling pigs at a loss of $24/inventoried sow/week during the epizootic

period, decreasing to $3.80/inventoried sow/week in the 6 months postepizootic period. The same losses, but for weaning pigs were $1/inventoried sow/week and $0.06/inventoried sow/week, respectively. Recently, another study reported a decrease in net return/inventoried sow/week of $0.45 during the 5-week period of the epizootic and a $3.22 loss/inventoried sow/week in the postepizootic period (27 weeks).[5]

The indirect way of calculating losses in this study associated with PRV is illustrated in the results on hogs marketed/sow/year. Total net losses by use of this method was $85,520. The cause of the decreased production results were primarily attributable to the decreased number of hogs marketed per sow/year as shown in Table 1 for the years 1987 to 1990. The data from the years 1982 to 1986 were 17.6, 16.08, 15.38, 15.51, and 15.58, respectively.

The estimated loss for the 2-month epizootic was $4,155.52 ($49/sow). The estimated loss was $12,000.47 ($100/sow) for the 6-month period following the clinical epizootic. Losses attributable to decreased hogs marketed per sow per year was $92 for 1989 ($23,969/261 sows), primarily attributable to the relative low mean price for market hogs in 1989. However, in 1990, market hog prices went up to $53.78/45.25 kg with the mean cost for producing 45.25 kg (100 pounds) of market hog only increasing from $44.11 in 1989 to $44.87 in 1990. As a result, the mean loss per sow for 1990 was $149 ($41,578/279 sows).

Furthermore, number of pigs weaned per sow/year decreased from 15.07 in 1987 to 12.7 in 1988, the year of the clinical epizootic, attributable at least in part to an increased mortality of suckling pigs (Table 1). This is also supported by the decrease in the mean number of pigs weaned/sow farrowed from 8.18 in 1987 to 6.69 in 1988. Also, the number of litters per sow per year decreased from 1.9 in 1988 to 1.76 in 1989, suggesting an impaired reproductive performance in the herd after PRV had become established and was enzootic in the herd. Also, the percentage of pigs born alive that were saved decreased from 87% in 1987 to 68% in 1988. This figure increased to 78% in 1989 and 82% in 1990, gradually recovering to preepizootic values.

The lower market hog prices during 1988 and 1989 had the effect of ameliorating the losses of PRV. If prices for hogs were higher, losses would also be higher. Similarly, increased costs of production during 1988 and 1989 would also ameliorate losses for PRV, because these are costs not incurred when animals die.

In our estimated economic losses in this study, it was assumed that any increased loss in the variables studied were attributed to a negative impact of pseudorabies on production, including susceptibility to other infectious agents.[7] This was done by subtracting losses incurred during the 14 months prior to the epizootic (period 1), from losses incurred during (period 2), 6 months after (period 3), and an additional 26 months after the epizootic until eradication (period 4). Discounted to 1988 dollars and using a discount rate of 10%, the suckling pig mortality losses (77% of total net losses) of $76,263 in Table 3 were $71,846.[10] This adjustment (5.8%) did not substantially change the total net losses reported in the study.

These data using actual losses supports the suggestion that the estimated losses reported in this study were attributable to a negative effect of pseudorabies virus on swine production on that farm.

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