# Prevalence of Respiratory Diseases and their Association with Growth Rate and Space in Randomly Selected Swine Herds

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## ABSTRACT

**The prevalence and extent of respiratory tract lesions were measured in 1425 pigs from 27 randomly selected herds in the summer of 1982 and winter of 1983. About 75% of pigs had lesions of enzootic pneumonia, approximately 60% had atrophic rhinitis and approximately 11% had pleuropneumonia and/or pleuritis.**

**Individual pig growth rate was recorded on two of the farms, and it was found that the correlations between growth rate and severity of enzootic pneumonia lesions were positive on one farm and negative on the other. Negative correlations between severity of turbinate atrophy and growth rate existed in one of the two herds. Extent of pneumonia and severity of turbinate atrophy were poorly related in individual pigs but herd averages were moderately and positively correlated. Prevalence of diffuse pleuritis and of pleuropneumonia were positively related, as were the extent of pneumonia and prevalence of localized pleuritis. Prevalence of pleuropneumonia was strongly correlated with increased days-to-market. A method of estimating the average days-to-market using weekly herd data (inventory) was developed.**

**Key words:** Swine, enzootic pneumonia, atrophic rhinitis, pleuropneumonia, pleurisy, growth-rate, mortality, space.

## RÉSUMÉ

**Cette expérience consistait à déterminer la prévalence et l'ampleur des lésions des voies respiratoires, chez 1425 porcs issus de 27 troupeaux choisis au hasard, au cours de l'été 1982 et de l'hiver 1983. Environ 75% de ces porcs arboraient des lésions de pneumonie enzootique; à peu près 60% étaient atteints de rhinite atrophique, tandis qu'environ 11% souffraient de pleuro-pneumonie et/ou de pleurésie. Après avoir déterminé le taux de croissance individuel des sujets de deux troupeaux, on constata que la relation entre le taux de croissance et la gravité de la pneumonie enzootique se révélait positive dans l'un de ces troupeaux, mais négative dans l'autre. Une relation négative entre la gravité de l'atrophie des cornets nasaux et le taux de croissance existait aussi dans un des deux troupeaux. La relation entre la gravité de la pneumonie et celle de l'atrophie des cornets s'avéra négligeable, sur une base individuelle, mais plus ou moins significative, sur l'ensemble des sujets d'un troupeau. On constata une relation positive entre la prévalence de la pleurésie diffuse et celle de la pleuro-pneumonie, tout comme entre l'étendue de la pneumonie et la pleurésie localisée. La prévalence de la pleuro-pneumonie s'accrut, à mesure que les porcs s'approchaient du poids du marché. L'utilisation des données hebdomaidaires d'un troupeau permit de développer une méthode d'évaluer la moyenne, en jours, de l'approche du poids du marché.**

**Mots clés:** porcs, pneumonie enzootique, rhinite atrophique, pleuropneumonie, pleurésie, taux de croissance, mortalité, espace.

## INTRODUCTION

Swine respiratory diseases in the form of enzootic pneumonia, atrophic rhinitis, pleuritis and pleuropneumonia are common in all swine rearing areas of the world. These conditions are considered to be of great economic importance; however the literature contains conflicting reports concerning their effect on productivity and their interrelationships (1).

Enzootic pneumonia, a term often associated with lesions present in the anterior-ventral lobes of the lungs, is a bronchopneumonia with a complex etiology (2-8). *Mycoplasma hyopneumoniae* is considered to be the inciting agent in the condition (9,10). Pneumonia resulting solely from *Mycoplasma* infection is, however, rare (11), and secondary organisms such as *Pasteurella multocida, M. hyorrhinis* and *Streptococcus* spp. are common (11,12,13).

Atrophic rhinitis, characterized by turbinate atrophy can be reproduced with some strains of *Bordetella bronchiseptica* (14) or dermo necrotic toxin producing strains of *P. multocida* (15).

Pleuritis is easily observed in slaughtered pigs; it has been related to infections with *M. hyorrhinis* (11), *P. multocida* (16), *Haemophilus parasuis* and *H. pleuropneumoniae* (17). The prevalence reported from abattoir surveys varies from 2.8% (18) to 18.5% (19).

Pleuropneumonia, a pulmonary necrosis accompanied by pleurisy, is a frequent consequence of infection with *H. pleuropneumoniae*. Lesions may occur in any or all lobes of the lungs (20-23). Acute forms of the

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disease are associated with high mortality fibrinohemorrhagic pneumonia, epistaxis and blood stained fluid in the pleural cavities and trachea (16). *Pasteurella* and *Actinobacillus* spp. induce similar gross and histological lesions in lungs to those seen after infection with *H. pleuropneumoniae* (24-27), but the latter bacterium is the most common organism isolated from the condition (28).

The aim of this study was to investigate the association between these respiratory conditions and growth rates in a number of Ontario swine herds. At the same time, interrelationships between the prevalence or severity of the various lesions and some managerial practices were to be determined.

## MATERIALS AND METHODS

Lungs and nasal structures from pigs weighing approximately 100 kg live weight were examined at an abattoir. Pigs were from 27 herds selected randomly from the 905 Ontario herds marketing more than 1000 pigs per year in 1982. Twenty-five to 30 heads and lungs were examined from each of the 27 herds in the summer of 1982 and from 18 of the same herds in the winter of 1983. In total, 1425 respiratory tracts were studied. Twenty-one of the 27 herds were farrow-to-finish operations, the remaining six bought weaned pigs from various sources. The pigs from the herds reexamined in 1983 were all from farrow-to-finish farms. All of the herds operated continuous-use finishing barns.

Production data and descriptions of management procedures were collected on a weekly or biweekly basis as described by Wilson *et al* (29).

Lung scores were tabulated according to the method described by Hilley *et al* (30). Lesions were defined as areas of the lung which were darker, firmer or more friable in consistency than the remainder of the lung. Apical, cardiac and accessory lobes were considered to each make up 10% and each diaphragmatic lobe was assigned 25% of the lung total. For example, if an entire apical and half of a cardiac lobe were involved with lesions then the lung score would be 15.

Localized or diffuse pleurisy and pleuropneumonia were recorded along with the lung scores. Diffuse pleurisy, for this study, was defined as extensive pleurisy with no obvious severe pulmonary changes. Localized pleuritis was defined as the presence of pleurisy on one (or part of) lobe, or, of small adhesions between lobes or between the visceral and parietal pleura with no underlying lung pathology. Pleuropneumonia was any pleuritis associated with well demarcated areas of pulmonary necrosis and, or, fibrosis.

Snout scores to reflect the degree of turbinate atrophy in atrophic rhinitis were recorded using a modification (31) of the system of Bendixen (32).

Calculation of average time taken to reach market weight (days to market) (DTM) was from the following formula:

$$\text{Average weaning age} + \frac{7 \times \text{Average weekly inventory in nursery}}{\text{Number of pigs moved to nursery each week}} + \frac{7 \times \text{Average weekly inventory in grower/finisher barn}}{\text{Number of pigs moved to grower/finisher barn each week}}$$

A comparison was made on 15 farms between the results of DTM calculated using the above formula, and actual DTM obtained where pigs were ear tagged at weaning and read on marketing. In two herds pigs were tattooed at birth and this information recorded at marketing to give DTM information on each pig to use alongside snout and lung data obtained from slaughter information on the individual pigs. Where an individual pig's DTM was available the average daily gain (ADG) was derived from carcass weights divided by DTM.

Analysis of data was performed using the Statistical Package for Social Sciences (33) and the Statistical Analysis System (34) computer programs. Correlation coefficients, linear regressions and descriptive statistics of data were calculated.

## RESULTS

In the summer slaughter check, 688 of 846 lungs (81.3%) from 27 herds examined had evidence of pneumonia (Table I). In the winter slaughter check, 442 of 579 lungs (76.3%) from 18 of the 27 herds had similar lesions; 79.3% of pigs in these 18 herds had pneumonia in the summer survey. The prevalence of pneumonia was therefore only slightly less for winter slaughtered pigs (76.3%) compared to summer slaughtered pigs (79.3%) and this difference was not statistically significant.

Figure 1 graphically presents the

**TABLE I. Prevalence Rates of Respiratory Tract Lesions at Slaughter in Pigs from 27 Herds**

| | Summer (846 pigs) | Winter (579 pigs) |
|---|---|---|
| Pneumonia | 81.3% (79.3%) | 76.3% |
| Atrophic rhinitis (Scores 2-4) | 66.2% (62.4%) | 56.0% |
| Pleuropneumonia | 11.0% ( 9.4%) | 11.6% |
| Pleuritis | 11.5%[a] (12.1%) | 13.6%[a] |
| localized | 8.7% ( 8.9%) | 11.7% |
| diffuse | 2.8% ( 3.2%) | 1.9% |

( )Prevalence rates in herds checked in both summer and winter
[a]Includes diffuse and localized pleuritis

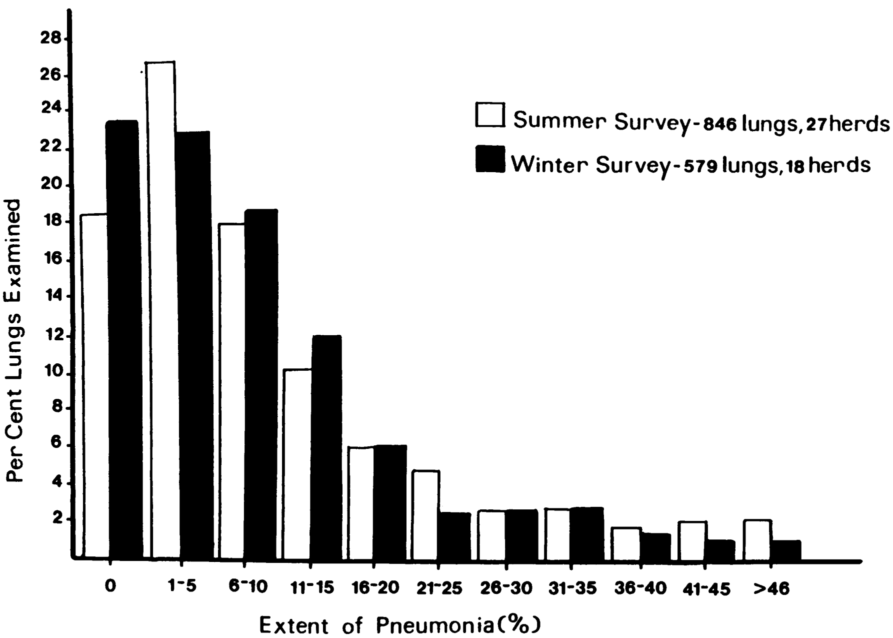


**Fig. 1. Distribution of extent of pneumonia in 1425 slaughter pigs.**

percentage of lungs examined against the extent of pneumonia for the summer and winter surveys. The distribution of extent of pneumonia was similar in both studies. Forty-four percent of the pigs with pneumonia had lung scores (extent of pneumonia) of ten and under.

Table II contains average lung scores for each of the herds examined. The overall summer average lung score (12.1) is not significantly higher than the winter average lung score (9.7). However, eight of the 18 herds had significant differences between average lung scores in the winter compared to the summer. Herds #107, #116 and #216 had significantly higher scores, whereas herds #202, #302, #304, #307 and #333 had significantly lower scores in the winter survey. Differences were not significant ($p > 0.1$) in the other ten herds surveyed.

**TABLE II. Herd Respiratory Disease Findings in 27 Swine Herds in Winter and 18 Herds in Summer**

| | Average | | | | Prevalence (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lung Score | | Snout Score | | Pleuropneumonia | | Diffuse Pleuritis | | Localized Pleuritis | |
| Herd | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| 103 | 5.7 | 5.5 | 2.1[a] | 1.6[a] | 37 | 22 | 18 | 9 | 5 | 28 |
| 106 | 4.4 | 4.2 | 1.6 | 1.5 | 0 | 3 | 0 | 0 | 9 | 3 |
| 107 | 1.8[a] | 4.4[a] | 1.1 | 1.0 | 0 | 0 | 0 | 0 | 6 | 4 |
| 108F | 16.1 | — | 2.5 | — | 31 | — | 12 | — | 19 | — |
| 111 | 9.4 | — | 1.7 | — | 4 | — | 0 | — | 8 | — |
| 113 | 15.8 | 10.0 | 1.7 | 1.7 | 3 | 13 | 0 | 0 | 17 | 3 |
| 115F | 9.7 | — | 1.6 | — | 20 | — | 0 | — | 16 | — |
| 116 | 4.6[c] | 12.5[c] | 0.9[c] | 1.6[c] | 21 | 22 | 5 | 3 | 3 | 25 |
| 202 | 14.9[c] | 5.7[c] | 1.6[c] | 0.8[c] | 0 | 0 | 0 | 0 | 12 | 0 |
| 205F | 9.8 | — | 1.3 | — | 3 | — | 0 | — | 3 | — |
| 206 | 8.8 | — | 2.9 | — | 0 | — | 0 | — | 0 | — |
| 207 | 26.3 | — | 1.8 | — | 3 | — | 0 | — | 17 | — |
| 208 | 7.1 | 9.0 | 2.4[a] | 1.9[a] | 14 | 7 | 3 | 0 | 6 | 10 |
| 209 | 13.2 | 9.4 | 1.5 | 1.2 | 35 | 62 | 2 | 3 | 11 | 10 |
| 212 | 4.0 | 4.9 | 1.9 | 1.9 | 7 | 0 | 14 | 0 | 0 | 4 |
| 213 | 9.8 | 14.0 | 1.5 | 1.8 | 0 | 13 | 0 | 3 | 17 | 12 |
| 216 | 5.1[c] | 18.2[c] | 1.7 | 2.0 | 7 | 7 | 4 | 0 | 7 | 17 |
| 218 | 9.8 | 7.1 | 2.0 | 2.2 | 8 | 6 | 0 | 3 | 8 | 6 |
| 302 | 17.5[c] | 8.3[c] | 2.3 | 2.2 | 5 | 10 | 5 | 0 | 5 | 30 |
| 304 | 9.5[a] | 5.7[a] | 1.9[b] | 1.2[b] | 0 | 3 | 0 | 3 | 8 | 14 |
| 305F | 19.7 | — | 1.9 | — | 10 | — | 0 | — | 3 | — |
| 307 | 28.8[b] | 14.1[b] | 3.6[c] | 1.7[c] | 17 | 13 | 0 | 0 | 0 | 20 |
| 308 | 2.9 | 3.9 | 0.2 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 312F | 9.8 | — | 1.7 | — | 31 | — | 6 | — | 6 | — |
| 316 | 14.9 | 16.4 | 2.1[b] | 1.7[b] | 0 | 3 | 0 | 0 | 19 | 13 |
| 317F | 16.2 | — | 1.0 | — | 18 | — | 0 | — | 9 | — |
| 333 | 30.2[b] | 21.0[b] | 2.4[c] | 1.4[c] | 13 | 25 | 3 | 7 | 20 | 14 |
| Average | 12.1 | 9.7 | 1.8[a] | 1.5[a] | 9.3 | 11.6 | 3.0 | 1.7 | 8.5 | 11.8 |

[a] $p < 0.10$
[b] $p < 0.05$
[c] $p < 0.01$
F — finishing operations

Pigs with pleuropneumonia lesions were observed on 19 (70%) of the 27 herds examined. In the summer slaughter check, 93 or 846 lungs (11.0%) were found to have lesions of pleuropneumonia (Table I). In the winter slaughter check, 67 of 579 lungs (11.6%) examined had similar lesions. The mean prevalence rate of pleuropneumonia was greater ($p < 0.06$) in finishing herds (18.8%) compared to farrow-to-finish herds (8.3%). Of the herds examined both in the summer and the winter the average prevalence of pigs with pleuropneumonia per herd was similar in both surveys (9.3% in summer and 11.6% in winter).

In the summer slaughter check, 97 of 846 lungs (11.5%) examined had pleuritis (3.0% local and 8.5% diffuse) at slaughter compared to 79 of 579 lungs (13.6%) examined in the winter slaughter check (1.7% local and 11.8% diffuse) (Table I).

In the summer slaughter check 560 of 846 pigs (66.2%) from 27 herds had atrophic rhinitis (snout scores 2-4) compared to 324 of 579 pigs (56.0%) from 18 of these herds in the winter survey. In the summer survey 62.4% of pigs in these 18 herds had atrophic rhinitis (Table I).

Figure 2 is a histogram illustrating the distribution of snout scores for the summer and winter surveys. The prevalence of atrophic rhinitis (snout scores 2-4) and the average snout score were greater in the summer survey ($p < 0.05$). Some herds sampled had differences in average snout scores for the two surveys. Seven herds (#103, #202, #208, #304, #307, #316 and #333) had lower scores in contrast to one herd (#116) which had a higher average snout score in the winter survey.

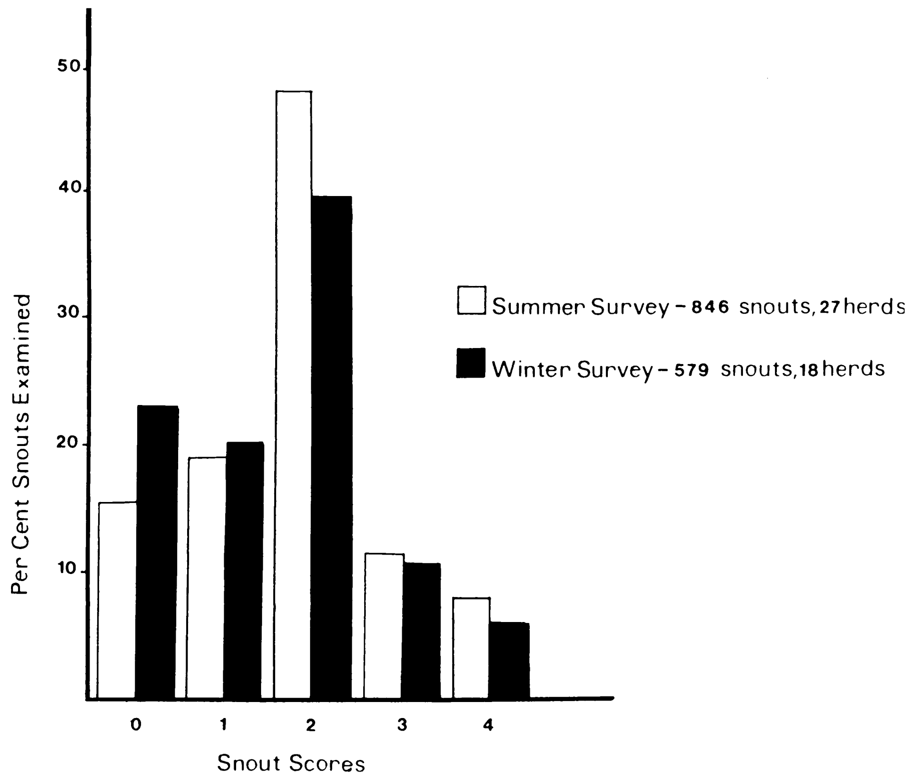


**Fig. 2. Distribution of snout scores in 1425 slaughter pigs.**

Correlation coefficients demonstrating the relationship between lesions at each of two slaughter checks as well as a correlation coefficient for the combined data are presented in Table III. Lung scores were weakly but positively associated with pleuropneumonia and localized pleuritis in both slaughter checks. Snout scores were weakly correlated with lung scores in a positive manner.

Figure 3 shows graphs obtained from regressions of ADG on lung score in each of the two herds where individual DTM data were available. Average daily gain was positively associated with lung score in pigs from herd #213, but negatively associated with lung scores in pigs from herd #218. Figure 4 shows the graphs obtained for regression of ADG on snout score in each of the two herds.

Table IV contains correlation coefficients between recorded respira-

**TABLE III. Correlation Coefficients for Lesions Recorded in Two Slaughter Checks (Performed in Summer [846 Pigs] and Winter [579 Pigs] in Individual Pigs from 27 Herds**

| | Lung Score (LS) | | | Snout Score (SS) | | |
|---|---|---|---|---|---|---|
| | Summer | Winter | Combined | Summer | Winter | Combined |
| Lung score (LS) | | | | 0.08[a] | 0.16[c] | 0.16[c] |
| Snout score (SS) | 0.08[a] | 0.16[c] | 0.16[c] | | | |
| Localized pleuritis (LP) | 0.14[c] | 0.11[b] | 0.13[c] | 0.05 | 0.01 | 0.02 |
| Diffuse pleuritis (DP) | -0.06 | 0.05 | 0.01 | 0.01 | -0.03 | -0.01 |
| Pleuropneumonia (PLPN) | 0.13[c] | 0.20[c] | 0.20[c] | 0.01 | 0.05 | 0.03 |

[a] $p < 0.05$
[b] $p < 0.01$
[c] $p < 0.001$

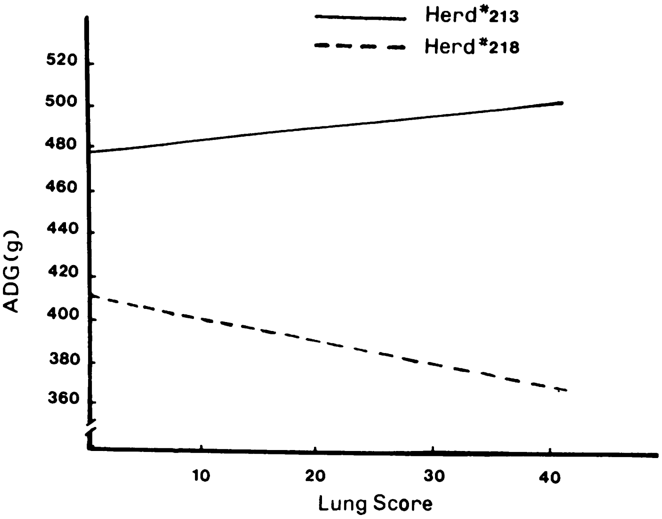


**Fig. 3. Regression of average daily gain on extent of pneumonic lesions in slaughter pigs from two herds.**

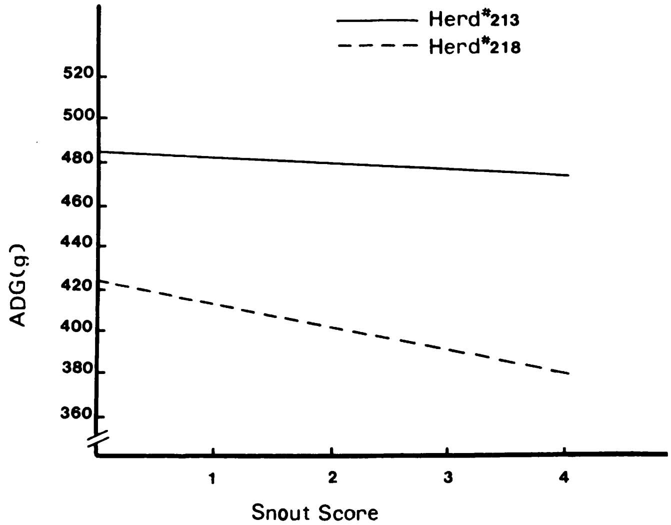


**Fig. 4. Regression of average daily gain on severity of turbinate atrophy in slaughter pigs from two herds.**

**TABLE IV. Correlation Coefficients for Respiratory Diseases Based on Averages of Each Parameter in 27 Herds**

| | LS | SS | PLPN | DP |
|---|---|---|---|---|
| SS | 0.49[c] | | | |
| PLPN | 0.14 | 0.09 | | |
| DP | -0.10 | 0.16 | 0.51[c] | |
| LP | 0.32[a] | 0.15 | 0.09 | 0.04 |

[a]$p < 0.05$
[b]$p < 0.01$
[c]$p < 0.001$
LS = average lung score
DP = diffuse pleuritis rate
SS = average snout score
LP = localized pleuritis rate
PLPN = pleuropneumonia rate

**TABLE V. A Comparison of Days to Market Estimations Using Inventory and Tagging Methods on 15 Farms**

| Herd Number | Inventory DTM | Tagging DTM (± SD) |
|---|---|---|
| 103 | 284 | 261 ± 37 |
| 106 | 198 | 205 ± 15 |
| 107 | 221 | 208 ± 25 |
| 113 | 192 | 193 ± 16 |
| 116 | 217 | 216 ± 13 |
| 202 | 214 | 202 ± 20 |
| 206 | 183 | 182 ± 21 |
| 208 | 202 | 216 ± 21 |
| 209 | 229 | 222 ± 32 |
| 216 | 191 | 188 ± 18 |
| 218 | 205 | 200 ± 16 |
| 304 | 236 | 242 ± 28 |
| 307 | 242 | 265 ± 30 |
| 308 | 227 | 232 ± 32 |
| 316 | 188 | 195 ± 21 |
| Mean | 215.3 | 215.1 |

Paired t-test — $t = 0.045$ $p > 0.1$

tory disease levels based on summer and winter data. Herd average lung and snout scores were significantly correlated ($r = 0.49$, $p < 0.001$) as were herd pleuropneumonia and diffuse pleuritis prevalence rates ($r = 0.51$, $p < 0.001$). Herd average lung scores and prevalence of localized pleuritis were significantly correlated ($r = 0.32$, $p < 0.03$).

Table V contains comparisons of DTM figures for 15 herds calculated from inventory and tagging data. The average number of pigs shipped with plastic ear tags was 183 and ranged from 30 to 438 pigs per herd. These figures represent actual tag return rates ranging from 30 to 90%. The standard deviation in days to market within individual herds was large with some pigs taking over 300 days to reach market weight. There were no differences between inventory and tagging DTM statistics.

Table VI contains the correlation coefficients for herd respiratory disease levels taken from Table II and space per feeder pig, feeder deaths and DTM on each of the farms. Increased herd average lung scores and average snout scores were both correlated with decreased space per feeder pig ($p < 0.05$).

The average feeder pig mortality rate was 3.4% (± 2.5) and ranged from 0.4 to 12.7%. Herd average lung scores

TABLE VI. Correlation Coefficients for Herd Respiratory Disease Levels, Growth Rate, Space per Feeder Pig and Mortality Rate of Feeder Pigs in 27 Herds (Summer) and 18 Herds (Winter)

| | Average | | Prevalence | | |
|---|---|---|---|---|---|
| | Lung Score | Snout Score | Pleuro-pneumonia | Diffuse Pleuritis | Localized Pleuritis |
| SPFP | | | | | |
| summer | -0.47[b] | -0.31 | -0.14 | -0.08 | -0.12 |
| winter | -0.57[b] | -0.40 | -0.33 | 0.21 | -0.40 |
| combined | -0.48[c] | -0.33[a] | -0.22 | -0.01 | -0.24 |
| Feeder deaths (%) | 0.55[b] | 0.26 | 0.15 | -0.05 | 0.24 |
| DTM | 0.03 | 0.09 | 0.62[b] | 0.51[a] | -0.44[a] |

[a] $p < 0.05$
[b] $p < 0.01$
[c] $p < 0.001$
SPFP = Space per feeder pig
DTM = Days to market

were strongly correlated with feeder deaths ($r = 0.55$, $p < 0.01$).

Prevalence rates for pleuropneumonia and diffuse pleuritis were strongly correlated with days to market statistics ($r = 0.62$, $p < 0.01$) but were not correlated with feeder pig mortality. The prevalence of localized pleuritis was negatively correlated to DTM ($r = -0.44$, $p < 0.05$). Days to market were not correlated with the average lung scores ($r = 0.03$, $p > 0.1$) or the average snout scores ($r = 0.09$, $p > 0.1$).

## DISCUSSION

We were able to study individual pig growth rates in two herds and to correlate them with the severity of pneumonia in the same pigs. In one herd the most rapidly growing pigs had the most severe pneumonia, the reverse occurred in the other herd with slowest growing animals having the most extensive lesions. This diversity in relationship between extent of pneumonia and growth rate may explain our findings that no correlation existed between average lung scores and average growth rates in pigs in 27 herds. Similar findings were reported by Lindqvist (35). In five of the 27 herds that he studied ADG was greater in pigs with mild pneumonia than in pigs with no pneumonia and in four of the 27 the reverse was the case.

Simple explanations for these conflicting findings are not readily apparent. Madsen (36) reported that pigs artificially infected with *M. hyopneumonia* grew more rapidly than uninfected controls. However, factors such as lesion regression, time of infection relative to slaughter and animal-organism-environment interactions must be considered and will be involved to varying degrees on different farms. It would appear therefore that one cannot assume that enzootic pneumonia necessarily reduces growth rate and that the economic relevance of enzootic pneumonia should be assessed on each farm.

It has been suggested that atrophic rhinitis predisposes pigs to enzootic pneumonia (14). The low correlation coefficient between individual pig lung and snout scores indicates that rhinitis played only a minor role in susceptibility to pneumonia in pigs in this study. Similar complex environmental factors may be involved in the etiology of the two diseases (5,6). Support for this was found through the correlation between herd average lung and snout scores viewed alongside the low correlation in lesion scores within individuals in those herds. Further support for this suggestion comes from our finding of a negative correlation between both lung scores and rhinitis scores and space available per pig.

There was no correlation between herd growth rate and herd average snout scores whereas in one of the two herds where individual ADG and snout scores were available, a correlation did exist. Atrophic rhinitis is one of the many factors involved in determining growth rate. However, the range of ADG in the 27 herds was so great that the effect of atrophic rhinitis, if any, was lost in determining correlations between average snout scores and average growth rate.

The prevalence of diffuse pleuritis and of pleuropneumonia were correlated with each other. Feeder pig mortality was not correlated with the prevalance of either of these two disease entities. More than 70% of the study herds had evidence of these lesions in the pleura and lungs at slaughter. This indicates that subclinical diffuse pleuritis and pleuropneumonia, without high mortalities, are widespread and potentially significant diseases through their effect on growth rate (37,38,39).

The apparent lack of correlation between mortality rates and pleuropneumonia presence or prevalence is in sharp contrast to the high mortality often associated with this condition. Pleuropneumonia associated with *Hemophilus pleuropneumoniae* was recognized clinically in only four of the study herds even though 70% showed gross pathological signs of pleuropneumonia. Most herds tested serologically were classified as positive and the organism was shown to be present in four herds (unpublished data). These findings would suggest that environmental or management factors or other infectious organisms are necessary triggering agents in producing the high mortality seen in some herds in association with pleuropneumonia.

Localized pleurisy prevalence was correlated negatively with ADG suggesting that the herds where pigs grew more rapidly had a higher prevalence of localized pleurisy. The herd average prevalance of this condition was also correlated with the herd average severity of enzootic pneumonia lesions. These two correlations tend to confirm the dichotomous effect on growth rate that we found with the pneumonic condition.

Feeder pig mortality was associated positively with the severity of enzootic pneumonia scores. It should be emphasized that it is not known whether the mortality was caused by the pneumonia, by the same conditions which led to the severity of pneumonia, or by some other factor.

Productivity in grower-finisher pigs in most herds is far from satisfactory and will only improve with a knowledge of it which comes from records. The method of estimating time taken to reach slaughter weight utilizing inventory data was found to give accurate information and should prove a useful first step in determining and improving productivity for most farms.

This study indicates that diseases associated with growth rate behave differently in differing environments and are associated with different effects on individual farms. This warrants an evaluation of the situation on each farm as general conclusions are not warranted other than the observation that the relationships between disease and productivity are inconsistent.

## ACKNOWLEDGMENTS

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