FACTORS INFLUENCING PIG DEATHS DURING TRANSIT: AN ANALYSIS OF DRIVERS' REPORTS

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A haulage company, transporting pigs for a marketing group, has monitored information about journeys and kept records of deaths in transit (DIT). These data can be used to set guidelines and they highlight those areas of pig transport that need further study.

Factors, other than genetic ones, which may contribute to the rate of DIT were considered. A strict seasonal effect was not apparent, but where conditions were hot and wet there was an increase in DIT. There was also a 'time of day' effect, with transport in the afternoon showing a higher rate of DIT than transport in the morning. It was observed that if pigs were deemed dirty at loading then DIT were more likely. Clean pigs at loading could indicate that hygienic and environmental conditions in the finishing stage were good. Individual producers showed a wide variation in their rate of DIT, with some producers regularly experiencing a high level. Routine monitoring of the rate of DIT and transport conditions could help to pinpoint the source, and possible cause, of the problem.

Information that helps in the understanding of transit deaths is important because if stress in the period from selection to slaughter can be reduced, there should be both economic as well as welfare benefits.

Keywords: *animal welfare, pigs, transport, transit deaths*

Introduction

In order to make meaningful recommendations to improve welfare of pigs in transit, information is needed about the effect of various stressors encountered during the journey. For example, the effects of weather conditions during transit have been investigated (Smith & Allen 1976), physiological reactions to transport conditions have been recorded (Augustini & Fischer 1982) and other factors such as stocking density, season, pen position (Guise 1992), driver influence and time of day have been studied (Guise 1990). These investigations have shown that high environmental temperatures and high levels of sunshine increase transport losses and afternoon journeys can show higher levels of transit deaths.

Earlier analysis of driver reports concentrated on the economic impact (Guise 1990), and it was recognized that deaths in transit (DIT) were an important ongoing problem for all parties concerned with the transport of pigs for slaughter. The driver, although incurring no direct financial loss, tends to shoulder the blame.

The problem of DIT, although occurring at a low level, is a cause of concern to those involved with the welfare and transport of pigs. In 1982 von Mickwitz stated that DIT should

be considered the worst result of an extreme physiological reaction and while one pig on a lorry might die, it is possible that the welfare of all the others might be poor. Any work that can help towards an understanding of these deaths could contribute to the development of methods which would reduce transport stress in pigs.

The transport of any live animal for slaughter is both a sensitive and emotive subject. There is a body of opinion encouraging a reduction in such transportation by limiting journey times and providing clear guidelines as to how live animals should be carried. The legislation in force at the moment is dated, but a draft Economic Community directive (91/628 EC) on the subject is currently under discussion.

Methods

Over the last 25 years, one haulage company has been responsible for the movement of over three million pigs for a pig marketing group. Pigs are transported to a meat processing plant, approximately 160km from points of production. In order to monitor the process, the drivers of the four lorries complete a report after each journey.

In this paper data have been taken from the drivers' reports from September 1990 to August 1992. The information was divided into; year 1 – September 1990 to August 1991; and year 2 – September 1991 to August 1992. During this period there have been no major changes in the Group's breeding stock or lorry design, although in June 1992 transport schedules were altered and more pigs were moved later in the day.

At the end of each journey the driver completed a form providing details of the pigs and farms involved, and an opinion of the journey conditions encountered. The following information was recorded:

day and date of journey,
time of day,
farms visited,
number of pigs collected from each farm,
hygiene of pigs,
ease of loading the pigs,
weather conditions during the journey,
good or bad journey conditions (eg traffic etc),
position on lorry, and sex, of pigs that died.

Data were collected by means of a multiple-choice questionnaire. Ease of loading and journey type were categorized as either good or bad, and cleanliness of pigs as either clean or dirty. Weather conditions were coded: 1 = hot; 2 = warm; 3 = cold; 4 = wet; and 5 = windy. The driver could tick any combination of weather codes. If wet weather was not mentioned then it was assumed that conditions were dry.

The data were compiled using a computer database for ease of analysis. Frequencies of DIT occurring under different journey conditions and for different producers, were calculated. The numbers of deaths in relation to the large number of pigs carried meant that overall proportions were low, and this made the application of traditional statistical tests difficult.

It is also important to remember that much of the information supplied was subjective – there were no objective criteria to define a bad journey and warm or hot days were difficult to categorize without recording actual temperatures. However, the information included in the database could provide guidelines and highlight areas for further study.

Results

Monthly summaries

Table 1 shows a summary of the numbers of pigs transported over the two-year period. Using average pig prices for this period the annual cost of DIT to the marketing group could amount to over £10,000.

Table 1 Number of pigs carried and number of deaths in transit (DIT).

Time period	No pigs carried	No DIT	% DIT	Significance (two-sample *t* tests)
Year 1				
spring/summer (Mar–Aug)	65,003	78	0.12	ns
autumn/winter (Sept–Feb)	69,568	58	0.08	
TOTAL	134,571	136	0.1	
Year 2				
spring/summer (Mar–Aug)	69,716	82	0.12	ns
autumn/winter (Sept–Feb)	66,606	71	0.11	
TOTAL	136,322	153	0.11	

ns not significant

The per cent DIT by month are shown in Figure 1. The graph suggests a seasonal effect, with higher DIT during the summer months. However, *t* test analysis showed no significant difference between spring/summer and autumn/winter (Table 1). A similar pattern was shown by Löhr (1970), with peaks occurring in May and June.

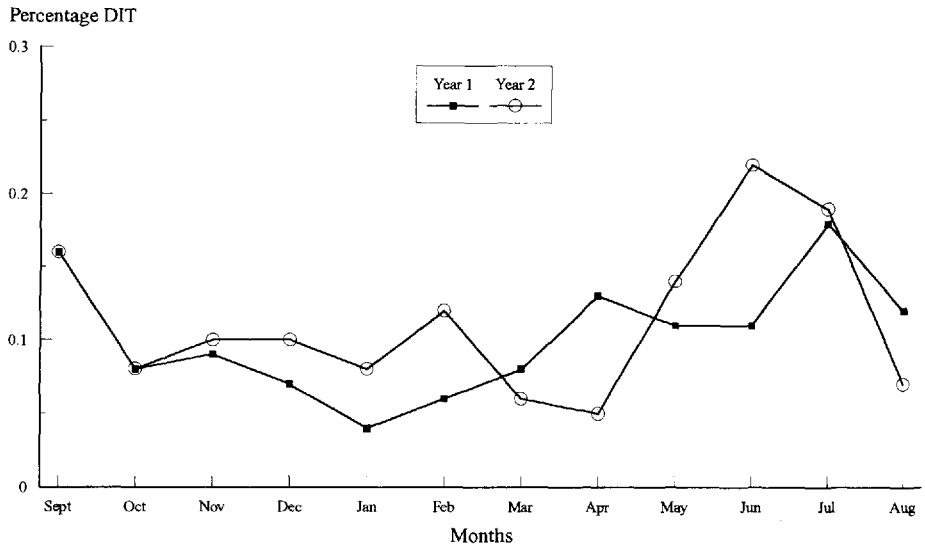

Figure 1 **Monthly percentages of deaths in transit (DIT).**

Driver opinion of the journey

Weather

The database contains information about the weather conditions on the day of the journey. From the codes provided, 15 different categories could be described. The highest rate of DIT occurred when weather was described as hot and wet. Figure 2 shows the distribution of deaths between the 15 different weather categories.

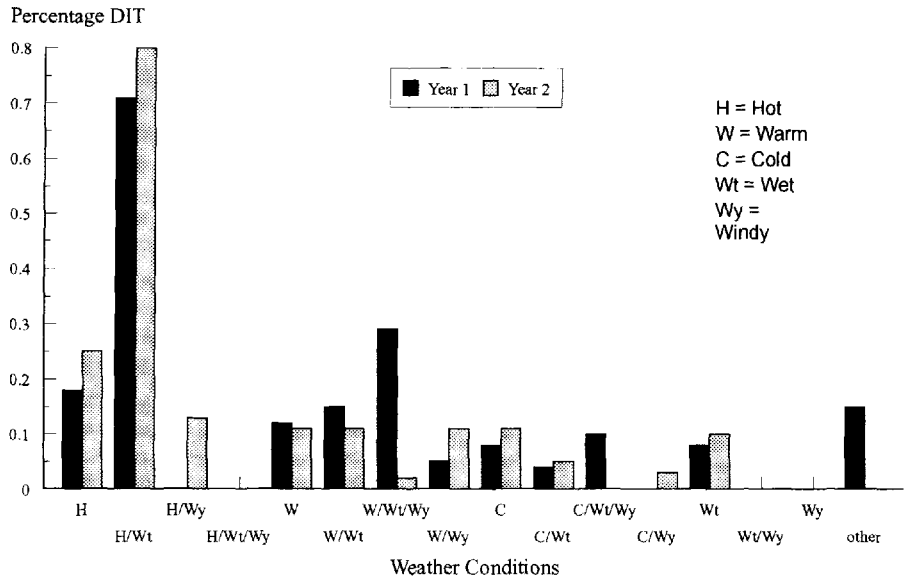

Figure 2 **Percentages of deaths in transit (DIT) relative to weather conditions.**

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Column H refers to journeys where weather was described as hot, compared to H/Wy where conditions were described as hot and windy. Where wet (Wt) was not indicated the weather was assumed to be dry, and where weather codes were not used the results were placed under the category 'other'. Comparisons were carried out for rate of DIT in wet conditions compared to dry, and for hot/warm compared to cold. There were no significant differences between these categories when a *t* test analysis was carried out.

Hygiene

Another aspect that appeared to be related to weather conditions was the cleanliness of the pigs. At loading they were classed as either clean or dirty. Overall, 61 per cent of pigs were considered clean and 39 per cent dirty. *T* test analysis showed that a higher percentage of DIT occurred when pigs were classed as dirty at loading ($P<0.05$, Table 2).

Table 2 **Number of pigs considered 'clean' or 'dirty' on loading* and the levels of death in transit (DIT) observed.**

Year	Clean pigs		Dirty pigs		Significance (two-sample *t* test)
	No carried	% DIT	No carried	% DIT	
Year 1	79,569	0.08	50,181	0.13	$P<0.05$
Year 2	72,962	0.08	58,182	0.15	$P<0.05$

* 4% of pigs each year were not given a hygiene classification, hence the number of pigs in Tables 1 and 2 differ.

There could be a number of reasons for pigs being graded dirty at loading. Any factor that influences a pig's excretory behaviour and causes it to dung in the lying area, will result in dirty conditions. An alteration in feeding pattern, such as an extra feed the night before slaughter given to meet the feed withdrawal requirements, could cause such a change. Hot, humid weather, and/or inadequate ventilation or a draught in the sleeping area, are further possibilities. The additional stressors of the journey, superimposed on the environmental stressors which include the dirty conditions, could have contributed to the increased rate of DIT.

Ease of loading

If pigs are difficult to load this adds a further stress. Drivers' reports indicated that most pigs were considered easy to load (91%), with only 9 per cent being difficult to load. However, there was no statistical difference of DIT between the two categories which suggests that this short-term stress did not have as much effect on DIT as more long-term stress, such as hygiene and weather conditions. It may be that conditions in the finishing stage determine the susceptibility of individuals to transport stress. However, ease of handling is a more subjective assessment than the hygiene of pigs at loading.

Type of journey

Journey type was described as good or bad, and this assessment included factors such as traffic and road conditions. It was found that only 2-4 per cent of pigs were carried on journeys considered 'bad', and bad journeys were not recorded in all months. There are many features of a journey that could have an influence on pig welfare. For example, stationary periods are important because internal lorry temperatures can rise rapidly if adequate ventilation is not maintained. There is evidence suggesting that pen temperatures on the lorry can influence meat quality (Guise 1992) and an increase in meat characteristics known to be associated with stress may be seen. However, driver perception of what is a 'bad' journey may not be directly related to the pigs' perception of such a journey. Further work is needed in this area and the type of journey needs to be described more objectively.

Effect of time of day

Figures 3a & b show the per cent DIT by month for morning and afternoon journeys. In year 1, 31 per cent of pigs were carried in the morning, whereas in year 2 this rose to 36 per cent because driver schedules changed towards the end of year 2.

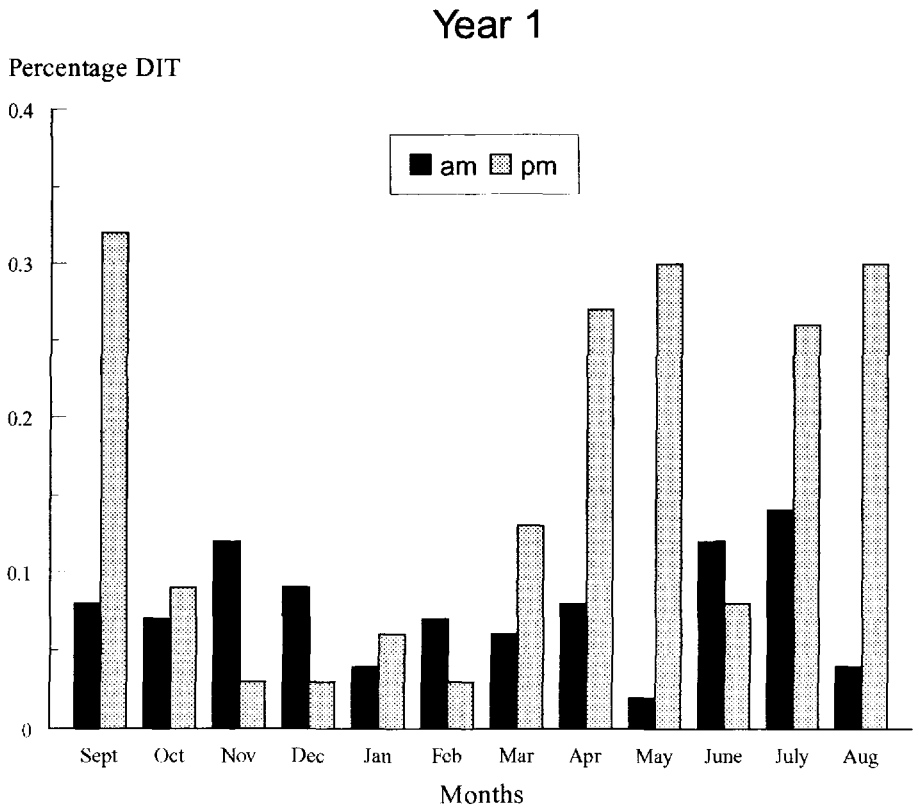

Figure 3a **Percentages of deaths in transit (DIT) relative to morning (am) or afternoon (pm) transportation for year 1.**

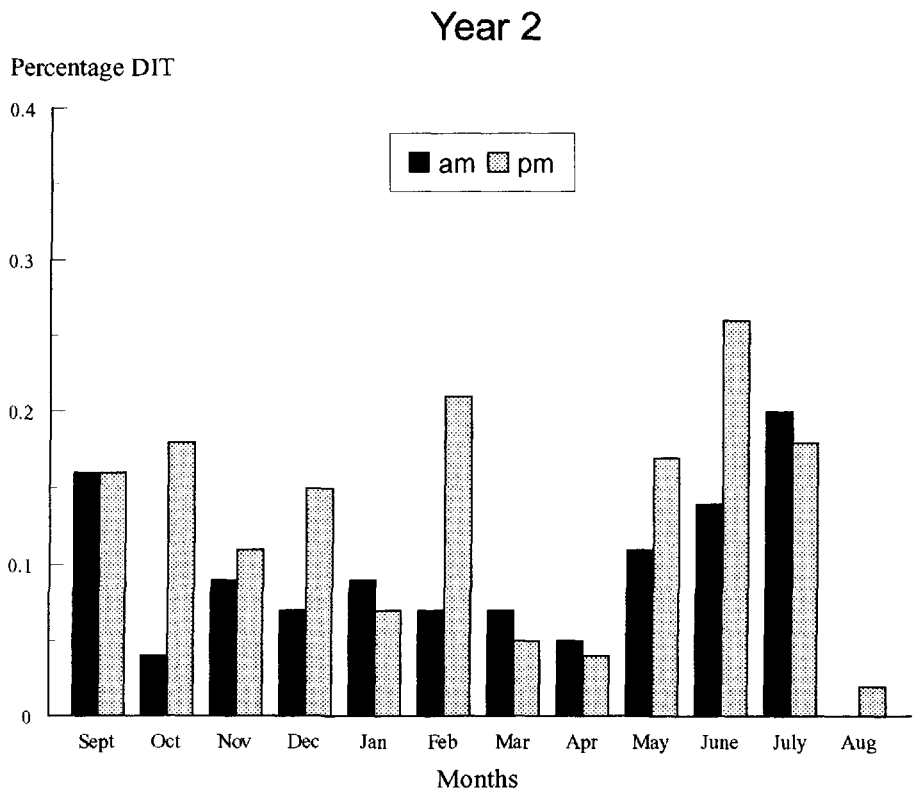

Figure 3b **Percentages of deaths in transit (DIT) relative to morning (am) or afternoon (pm) transportation for year 2.**

A two-sample *t* test showed that time of day had a significant effect on DIT in year 1; afternoon journeys showing a higher rate of DIT compared to morning journeys (Table 3). This effect was not present for year 2 and this could be due to the change in driver schedules; individual drivers may affect the rate of DIT (see next section).

When the seasonal effect was examined the trend was for a higher rate of DIT in afternoon journeys, both in summer and winter. However, the difference was not always significant (Table 3).

Table 3 **The influence of season and time of day on the percentage of deaths in transit (DIT).**

Time period	Morning % DIT	Afternoon % DIT	Significance (two-sample *t* tests)
Year 1			
spring/summer (Mar–Aug)	0.08	0.22	$P<0.05$
autumn/winter (Sept–Feb)	0.08	0.09	ns
Year 1 Mean	0.08	0.16	$P<0.05$
Year 2			
spring/summer (Mar–Aug)	0.1	0.12	ns
autumn/winter (Sept–Feb)	0.09	0.15	$P<0.05$
Year 2 Mean	0.09	0.13	ns

ns not significant

Influence of driver

Three regular drivers were involved, with a relief driver (driver 4) for holidays and sickness. Drivers 1 and 3 used a three-deck transporter, with driver 1 generally responsible for morning journeys and driver 3 the afternoon ones. Driver 2 used a two-deck transporter and in year 1 did mostly morning journeys. In June of year 2 he changed to doing mostly afternoon journeys.

Table 4 **Number of pigs carried by each driver and the percentage of deaths in transit (DIT).**

Year	Driver 1		Driver 2		Driver 3		Driver 4	
	No carried	% DIT	No carried	% DIT	No carried	% DIT	No carried	% DIT
Year 1	43,584	0.05	40,172	0.11	46,084	0.14	4,022	0.17
Year 2	35,910	0.05	47,238	0.12	49,407	0.15	3,747	0.05

Table 4 shows which drivers carried most pigs. Driver 1 carried fewer pigs in year 2 compared to year 1, whilst driver 2 carried more pigs in year 2 compared to year 1. Figure 4 shows the monthly trends for each driver for each year.

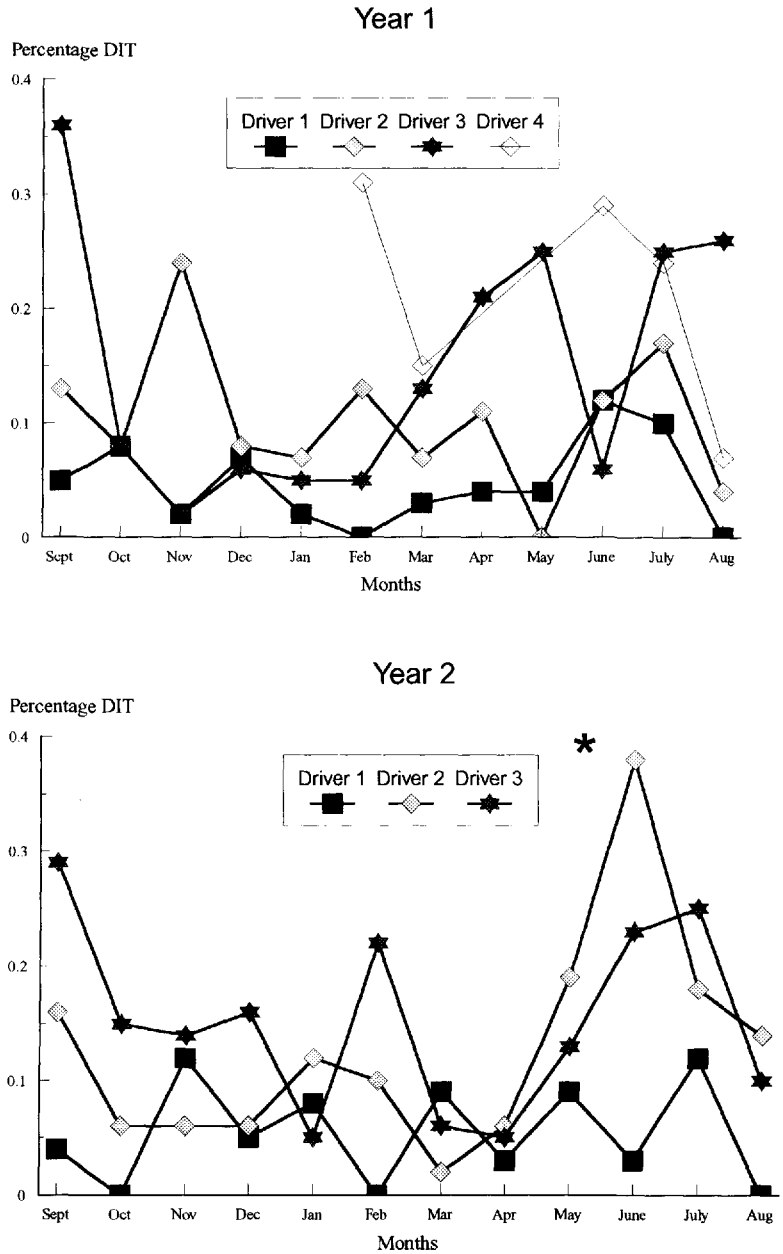

Figure 4 **Percentages of deaths in transit (DIT) relative to driver.**
* Driver 2 changed to do more afternoon loads.

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The point at which driver 2 changed to afternoon loads is clearly visible, being associated with a marked increase in the rate of DIT for that month, followed by a fall. Reasons which may explain the sudden increase include different producers being involved, and changes in route and journey conditions. It will be interesting to analyse later reports once the new schedule has become established, as this will provide more data for comparisons between time of day and driver etc.

A two-sample *t* test was carried out to compare the DIT experienced by the three main drivers. Driver 1 had a significantly lower rate of DIT, in both years, than drivers 2 and 3.

In earlier work (Guise 1990) the standard of driving for the Group's drivers was assessed by the Freight Transport Association, and all were rated high. In this study it was concluded that slight differences in technique (within driver) might account for the differences in proportions of DIT. Driver effect was noted but source farm was confounded by driver. It is more likely that other factors are involved, for example that certain drivers are more likely to collect pigs from certain farms.

Only driver 3 regularly transported loads of pigs both morning and afternoon. Therefore it is not possible to analyse the effect of time of day for each individual driver. However, the data for driver 3 showed no significant difference for year 1, but in year 2 the afternoon runs resulted in a higher rate of DIT (0.17 SD±0.03) compared to mornings (0.07 SD±0.03; $P<0.05$).

Producer

The source of the pigs has a major influence on the rate of DIT within the Group. Of the 26 farms, the eight with the highest DIT figures accounted for over 50 per cent of total DIT in both years. However, only three of the eight farms were represented in both years. The factors that can influence a producer's rate of DIT include the type of loading, the condition and breed of the pigs and the type of journey encountered.

Discussion

Summary figures, obtained from the drivers' reports, indicate that a better understanding of DIT could be of considerable economic benefit to the marketing Group.

Weather conditions, when considered as wet, dry, hot/warm or cold, did not appear to affect the rate of DIT. However, the graph showed peaks in hot weather. Other studies have shown hot weather can cause an increase in DIT (Smith & Allen 1976). Lendfers (1970) reported that raised external temperatures and vapour pressure affect the number of DIT and showed that stress levels were raised under these conditions. Van Putten & Elshof (1978) suggested that pigs should not be transported at times when weather conditions are likely to be hazardous for livestock. A more accurate description of weather in the driver's report, to include maximum and minimum temperatures, might help in the assessment of the influence of temperature in future analyses.

Factors which may stress the pigs during their finishing stage include environmental factors such as dirty pen conditions. It appears that this earlier stress may have had an influence on the reaction of pigs to transport. The short-term stress at loading did not appear to affect the rate of DIT. However, ease of handling is a more subjective measure than the

assessment of pig hygiene. More objective measures of handling at loading, such as time to empty each pen, would allow a better assessment of differences in behaviour. Such a technique has been used in other work by Cambac JMA Research (Abbott 1991). Pigs have been allowed to leave their pens in their own time in order to monitor pig handling behaviour under different housing systems. Giving the pigs experience of being handled can make loading procedures easier. Van Putten & Elshof (1978) considered the oversimplified finishing environment to provide no variation or motivation for the pig to explore. There was no opportunity for the pig to be trained to overcome the problems which would be encountered at loading and transport. The finishing environment, loading facilities and handling procedures were all shown to influence the levels of stress imposed.

Afternoon journeys showed a trend towards a higher rate of DIT, which was statistically significant for year 1 but not for year 2. This suggests interactions with other factors, such as driver and weather. The effect of driver was found to be important but the interaction between driver and time of day was not clear. There were not sufficient data as all drivers did not work both mornings and afternoons. Changing the system of drivers' schedules might make it possible in the future to compare different drivers at different times of day.

Some producers appear to have a long-term problem with DIT and this may result from a combination of the factors previously mentioned. More detailed analysis of the information for these particular producers is needed.

Conclusion

Data from the drivers' reports showed that many factors influence the rate of DIT and that interactions between these factors are important. For example, the results did not show a season effect, except when morning and afternoon loads were considered separately. During summer the temperature difference can be more marked than in the winter and so stressful factors are exaggerated.

The results suggest that if a pig has been subjected to stressful conditions before transport it will be less able to cope with further stressful demands made on it during transport. Grandin (1992) suggested that the environment in the finishing stage could affect the 'excitability' of pigs during pre-slaughter handling and this observation is supported by current studies at Cambac JMA Research. More work is needed to assess all the factors involved in stress during transport, so that modifications can be made to the environment that will help to reduce the stressors encountered.

Death represents the ultimate 'stress indicator', but other than this drivers' reports do not provide any information on the effect transport stress has on the subsequent meat quality. Meat quality defects can give a good indication of short or long term stress. Meat quality data were not available for the pigs involved in these studies but research could be initiated to allow such an analysis. The stress response of the pig has an influence on the conversion of muscle to meat (Lawrie 1991). If the stress during pre-slaughter handling and transport could be reduced, then the potential improvement of meat quality could be of economic importance to both producer and processor. More importantly, the welfare of the pigs during transport would be enhanced.

Acknowledgements

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