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**EFFECT OF CATTLE ENTERPRISE TYPE ON THE RATE OF
DISCLOSURE OF TUBERCULIN REACTORS AND THE GEOGRAPHICAL
DISTRIBUTION OF THE IRISH CATTLE POPULATION**

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SUMMARY

- The prevalence of tuberculin reactors in the Irish cattle population has remained constant over the past 20 years. During each year some 30,000 reactors have been identified annually.
- A study of the national cattle herd, over a 6-year period (1988-1993), was undertaken to determine the association between enterprise type and the prevalence of tuberculin reactors adjusted for herd size and geographical region.
- The data were examined on a herd (n=165,000) basis according to the following enterprise types: Dairy - herds with a milk ring test result and no cows eligible for beef cow premia in 1993; Suckler - herds eligible for beef cow premia; Drystock - herds without cows but with other cattle. Other - herds with cows but not categorised as dairy or beef.
- Herd size (no. of cattle) was categorised as: Small (<30), Medium (30 to 59), Large (60 to 99) and Very large (≥ 100). Regional categorisation was: West (Donegal, Sligo, Leitrim, Mayo, Roscommon, Galway and Clare), South West (Limerick, Kerry, Cork, Waterford and South Tipperary), East (Louth, Meath, Dublin, Kildare, Wicklow and Wexford) and Midland (Cavan, Monaghan, Longford, Westmeath, Offaly, Laois, Kilkenny, Carlow and North Tipperary).
- Enterprise type had no effect on the prevalence of tuberculin reactors for any herd size. The number of tuberculin reactors annually per 1000 animals was greatest in the Midland (7.3) and lowest in the South West (3.8).
- It is concluded that the incidence of tuberculin reactors was independent of enterprise type within each of the four regions.

INTRODUCTION

The rate of disclosure of tuberculin reactors in the Irish cattle population has remained constant over the past 20 years during which period some 30,000 reactors have been identified each year (Downey, 1992). This is considerably in excess of the proportion in other countries (Pritchard, 1988) which have operated similar bovine tuberculosis eradication programmes. Sources of infection associated with a tuberculous breakdown are often attributed to cattle production practices involving trading systems. However, during periods when 30- or 60-day pre-movement tests were being undertaken, animal purchases accounted for 7 to 11% of herd breakdowns (Griffin and Haahes, 1992; Griffin, 1993). In dairy or suckler herds which contain a high proportion of animals over 2 years of age, the hypothesis is that among older animals there may be an infected but anergic excreter which would represent an increased risk of infection.

Dairy herds would be expected to have a higher incidence of reactors than suckler herds due to more intimate contact between animals. In addition, dairy herds would be expected to have a greater percentage of reactors because of their larger herd sizes (Morris, Pfeiffer and Jackson, 1994).

The large body of field data arising from tuberculosis control programmes in cattle shows that there is substantial variation in incidence between geographical regions, and between farms within regions (Anon, 1993). One simple example of this is that incidence has typically been higher in dairy than in beef herds (Griffin and Haheesy, 1992). This finding may be confounded by herd size and by region.

The present study was undertaken over a 6-year period to determine the effect of enterprise type (dairy, drystock, suckler or unknown) on the rate of disclosure of tuberculin reactors adjusted for herd size and geographical region. The geographical distribution of the Irish cattle population was also determined.

MATERIALS AND METHODS

The national cattle population data for the period 1988-1993 were used. This data which included herd test history were obtained from the Eradication of Animal Disease (ERAD) database. The data were interrogated on a herd unit basis. A herd was defined as a unit having cattle present at a full herd tuberculin test. Herds with no test record or having no stock recorded in the period 1991-1993, were deleted from the analysis.

Cattle enterprise categories were defined as follows:

1. Dairy - herds which had:
 - a) been assigned a milk ring test (MRT) result in 1991 through 1993, based on milk supplied to a milk processing plant
 - b) did not have any cows eligible for beef cow premia

2. Suckler - herds which were:
 - a) eligible for beef cow premia payments in 1992 and/or 1993

3. Drystock - herds which had:
 - a) no cows in 1993
 - b) no MRT results in 1991 through 1993
 - c) no cows eligible for beef cow premia in 1992 and/or 1993

4. Others - herds which had:

- a) cows in 1993 but were not assigned an MRT in 1993 or were not eligible for beef cow premia in 1992 or 1993
- b) herds which had both dairy and beef cows present in 1993
- c) no TB test in 1993 and had animals present during the previous 5 years

Herd size category was determined on the basis of the largest number of animals present at a full test averaged over the six year period. Herds were categorised as:

- Small - less than 30 cattle
- Medium - 30 to 59 cattle
- Large - 60 to 99 cattle
- Very large - 100 or more cattle

Region was based on the geographic location according to county, as follows:

- Western - Donegal, Sligo, Leitrim, Mayo, Roscommon, Galway and Clare
- South West - Limerick, Kerry, Cork, Waterford and South Tipperary
- East - Louth, Meath, Dublin, Kildare, Wicklow and Wexford
- Midland - Cavan, Monaghan, Longford, Westmeath, Offaly, Laois, Kilkenny, Carlow and North Tipperary

The incidence of reactors/1000 animals was used to compare enterprise types and was based on the annual number of animals and the annual number of reactors averaged over the six year period.

The base DED map, used to prepare the thematic distribution maps, was adjusted to exclude major areas of non-agricultural land, i.e. land over 300 metres altitude, water and boglands. Mountain areas and water were corrected using Bartholomew's CHEST¹ Ireland data and corrections for boglands using CORINE² data.

These adjustments to the DED map allow a more accurate representation of the data applied to actual agricultural land area. Forestry has not been corrected for at this stage but it is proposed that this will take place in the near future.

Statistical Analysis

The data set under examination represents the total cattle population of Ireland. It was not possible to analyse the data using statistical methods.

¹ Combined Higher Education Software Team

² Correlation of Information on the Environment

RESULTS

Disclosure of tuberculin reactors

A total of 165,000 herds were included in the study. Of these 85,600 had less than 30 cattle (Table 1), this small category size was dominated by suckler enterprise which accounted for 48,200 herds with 30,600 of these herds in the Western region. In contrast, 16,900 herds had 100 or more cattle (Table 1), this very large category size was dominated by dairy enterprise which accounted for 9,700 herds with 5,100 of these herds in the South West region. The average number of animals per herd in each of the herd size categories was similar across farm enterprise type (Table 2) for medium and large sizes. However, dairy enterprise had the largest average number of cattle in both the small and very large size categories which reflected that dairy herds were on average larger than either suckler or drystock herds.

Table 1. Number of herds ('000s) within each enterprise type categorised by herd size and by region.

Size	Region	Enterprise			
		Dairy	Suckler	Drystock	Other
Small (<30)	West	1.0	30.6	8.0	3.9
	South West	2.3	7.1	5.3	3.1
	East	0.2	2.8	3.0	1.6
	Midland	0.8	7.7	5.6	2.7
Medium (30-59)	West	1.4	10.8	0.9	2.3
	South West	3.8	3.9	2.1	1.3
	East	0.5	2.3	0.9	0.6
	Midland	1.5	5.6	1.3	1.9
Large (60-99)	West	1.0	2.6	0.1	0.9
	South West	4.0	1.8	0.4	1.3
	East	0.8	1.3	0.4	0.5
	Midland	1.8	2.9	0.5	1.4
V. large (≥ 100)	West	0.6	0.7	0.1	0.2
	South West	5.1	0.9	0.3	0.8
	East	1.4	0.9	0.3	0.4
	Midland	2.6	1.7	0.2	0.7

Table 2. Average number of animals per herd within each enterprise type categorised by herd size and by region.

Size	Region	Enterprise			
		Dairy	Suckler	Drystock	Other
Small (<30)	West	19	15	11	13
	South West	18	16	11	14
	East	20	17	13	13
	Midland	19	17	13	14
Medium (30-59)	West	44	41	39	43
	South West	45	42	43	42
	East	46	43	42	42
	Midland	45	42	41	44
Large (60-99)	West	77	73	75	74
	South West	78	76	74	76
	East	80	77	76	77
	Midland	79	76	76	77
V. large (≥ 100)	West	148	136	151	135
	South West	164	148	153	154
	East	179	153	155	173
	Midland	163	112	156	141

Reactor Status

Enterprise type (dairy, beef cow, drystock or other) had no effect on the prevalence of tuberculin reactors when expressed as the number of reactors per annum per 1000 cattle (R1000) (Table 3). The R1000 values was not affected by herd size category. While the R1000 value was similar for enterprise type there was a distinct increase in values for the East and Midland regions compared with the South West and West regions (Table 3). This regional effect was similar for each enterprise type and each herd size category. Enterprise type did not appear to have any major effect on the percentage of clear herds with no reactors in the period 1988-1993 when the data was adjusted for herd size and region (Table 4). Within each size/region categories dairy enterprise categories tended to have numerically lower percentage of clear herds. However, this difference was considerably smaller than the regional differences on the herd size differences (Table 4). Farm enterprise type did not have any effect on the disclosure of 5 or more reactors in a herd within each of the four herd sizes

and within region adjusted for herd size over the six year period of 1988 to 1993 (Table 5). The percentage of farms with 5 or more reactors increased with increasing herd size. The percentage of farms with 5 or more reactors was greater in the Midland region compared to either West or South West region (Table 5).

Table 3. Cattle enterprise category and the disclosure of tuberculin reactors (R1000) over a six year period (1988-1993).

Size	Region	Enterprise			
		Dairy	Suckler	Drystock	Other
Small (<30)	West	4.3	4.1	5.7	4.9
	South West	4.0	3.5	3.8	3.9
	East	5.9	4.7	4.8	5.5
	Midland	8.3	7.7	8.4	7.7
Medium (30-59)	West	4.1	4.7	6.0	4.3
	South West	4.0	4.0	4.0	3.9
	East	6.5	4.5	5.3	4.3
	Midland	7.8	7.3	7.3	7.5
Large (60-99)	West	3.8	5.1	4.9	4.1
	South West	4.0	4.1	3.1	3.8
	East	5.6	4.7	4.7	5.0
	Midland	8.1	7.2	6.6	7.5
V. large (≥ 100)	West	3.1	6.6	2.4	5.7
	South West	3.6	3.9	3.9	3.8
	East	6.2	4.4	5.6	4.4
	Midland	7.1	6.7	6.1	7.0

Table 4. Cattle enterprise category and the percentage of clear reactor free herds over a six year period 1988-1993.

Size	Region	Enterprise			
		Dairy	Suckler	Drystock	Other
Small (<30)	West	83	87	86	86
	South West	83	88	90	88
	East	77	81	84	83
	Midland	65	74	77	76
Medium (30-59)	West	71	73	70	71
	South West	73	76	73	75
	East	58	66	63	66
	Midland	52	59	56	56
Large (60-99)	West	65	62	53	64
	South West	64	68	69	66
	East	48	55	51	47
	Midland	41	47	44	44
V. large (≥ 100)	West	60	56	73	47
	South West	55	61	59	60
	East	34	43	38	36
	Midland	29	38	33	35

Table 5. Cattle enterprise category and the percentages of farms with more than 5 reactors in six year period (1988-1993).

Size	Region	Enterprise			
		Dairy	Suckler	Drystock	Other
Small (<30)	West	2.3	1.1	1.4	1.7
	South West	1.8	1.2	0.9	0.9
	East	3.6	1.9	1.4	1.6
	Midland	3.7	3.8	2.6	2.6
Medium (30-59)	West	5.1	5.8	7.3	2.3
	South West	5.1	4.7	4.3	4.8
	East	8.6	5.9	6.1	5.2
	Midland	11	9.4	8.7	10.5
Large (60-99)	West	10	11	12.7	8.4
	South West	10.2	9.7	7.2	8.2
	East	9.3	11.9	11.4	11.5
	Midland	15.3	16.9	16.8	16.3
V. large (≥ 100)	West	13.2	16	12.5	18.7
	South West	15.7	15.8	16.3	15.2
	East	29.3	21.2	27.6	23.1
	Midland	31.8	28.8	25.8	27.7

Geographical Distribution

The cattle population of some seven million cattle was accommodated in 165,000 herds in 1993. There were considerable regional variations with regard to herd size and distribution of the cattle population. The West (Donegal, Sligo, Leitrim, Roscommon, Galway, Mayo, Clare) has 26% of the cattle population while the Mid South (Cork, Limerick, Tipperary and Waterford) has 33% of the cattle population. The West had a predominance of small cow herds (Figure 1). Of the 54,600 herds in the country with less than ten cows, 58% were in the West. In contrast, the Mid South had a predominance of large cow herds (Figure 2). Of the 5,500 herds in the country with 60 cows or more, 54% were in the mid South. Again small herds were associated with the West, with 51% of the 86,000 herds in the country with less than 30 cattle located in this region (Figure 3). Large herds were associated with the Mid South, 38% of the 39,000 herds in the country with more than 60 cattle are to be found in the Mid South (Figure 4). When the distribution of dairy and beef cows is examined, in Figures

5 and 6, it is clear that beef cows predominated in the West; in contrast, dairy cows predominated in the Mid South. Forty three percent of all beef cows were found in the West while the Mid South accounted for 19% of beef cows. Fifty eight percent of all dairy cows were in the mid South, while the West accounted for 11% of the dairy cows. The contrast between the West and Mid South is summarised in Table 6.

Table 6. Regional differences in cattle herd structure expressed as % of national base (Ireland 1993).

	West	Mid South
% of herds	50	23
% of cattle	26	33
% of tuberculin reactors in 1993	22	27

DISCUSSION

Disclosure of tuberculin reactors

The rate of disclosure of tuberculin reactors was independent of cattle enterprise type in all four regions. This finding was unexpected as a higher proportion of older animals in dairy and suckler herds, would be much greater than in a drystock herd. The higher age profile of the herds would increase the risk of a TB infected but anergic excreter being present. The use of the single intradermal comparative tuberculin test (SICTT) as the principle method of tuberculin diagnosis was successful in Ireland from 1954 to 1965 when it was used annually, but that early progress was not sustained subsequently (Downey, 1992). Epidemiological evidence indicated that a similar tuberculin testing regime in Great Britain was successful in identifying all tuberculosis cattle which were then slaughtered at an early stage of the disease before they became infective (Dolan, 1994).

In the present study, the only indication of the presence of older animals in the herd was the decrease in the proportion of clear herds in the dairy category compared with the older three enterprise categories.

It can be argued that a lower incidence of reactors would be expected in drystock herds compared with either dairy or suckling as there would be a shorter period between tests due to the operation of either a 30 or 60 day pre-movement test. The expectation was that dairy herds would produce a higher prevalence of reactors compared to suckler herds. The logic for this was that dairy herds had a greater herd size and were also managed more intensively leading to a greater proportion of infected animals (Francis, 1947). However, it could be

argued that the current low levels of infection and animal infectivity in the Irish cattle population did not meet the criteria for spread of infection detailed by Francis (1947).

Badgers (*Meles meles*) and deer are prone to infection with *M. bovis* and each can serve both as a reservoir host and as an active disseminator of the tubercle bacillus. The potential for cross infection within and between each of these two animal species and cattle under Irish conditions is high, given the degree of direct and indirect contact that occurs (Collins, 1994).

It is therefore conceivable that a reservoir host and an active disseminator of disease may override the influence of animal enterprise category. In fact the results demonstrated a clear regional effect on the rate of disclosure of reactors, with the highest prevalence of reactor herds in the Midland region and lowest in the South West. Smals (1995) survey of the badger population would support the badger cattle interactions insofar as the Midland (0.59) region had the highest proportion of badgers/kilometre² and the West (0.36) had the lowest.

The observation that reactor disclosure rate was independent of herd size was unexpected, as it was anticipated that in the extra large herds (>100 cattle), there would be greater opportunity for animal to animal transmission compared with small herds (<30 animals). However, the data presented in Table 5 show no differences between herds with >100 animals and herds with <30 animals when expressed as number of reactors per 1000 animals. Examination of disease prevalence in the context of the effectiveness of the SICTT operated on an animal basis on all herds, would support this outcome. These findings support the findings of Griffin and Dolan (1994) that bovine to bovine is no longer the primary source of new outbreaks in Ireland. The percentage of clean herds decreases as herd size increases supports the observation of O’Keeffe (1993), that the change of reactor disclosure increases as herd size increases. However, the risk of reactor disclosure is similar for any individual animal irrespective of whether it is in a large or small herd. Similarly, the risk of reactor disclosure is similar for any individual animal irrespective of enterprise type.

Geographical distribution

Herd size and the geographic distribution of herds have implications for many agencies servicing the cattle industry. Out of the 165,000 herds, 86,000 have less than 30 cattle and 56,000 of the cow herds have less than 10 cows. Many of these herds are located in the Western half of the country which has hilly regions with a low population density. In addition to the small number of cattle per farm the geographic location makes it difficult to service

these farms with respect to disease eradication, headage inspection, artificial inseminations, private veterinary services and the supply of purchased feed.

The herd size and geographic location may influence the type of cattle enterprise selected for the farm. The small farms in the West operated small beef cow herds while the dairy herds and, in particular, the large dairy herds were located in counties Cork, Limerick, Tipperary, Waterford, Laois and Kilkenny. These counties with a larger farm size, are located in general on good quality land, correlated with larger cow number/herd and the region has a good infrastructure of roads. Not surprisingly much of Ireland's milk processing facilities are also located in these latter counties.

CONCLUSIONS

An examination of the National Cattle population over a 6 year period failed to show any association between cattle enterprise type and rate of disclosure of tuberculin reactors. An increase in herd size did not increase the proportion of reactors disclosed. There was a definite regional influence on the number of reactors disclosed which was independent of enterprise type. The Midlands had the highest incidence (7.29) and the South West the lowest incidence (3.81) of reactors annually per 1000 animals indicating that there may be a reservoir host and an active disseminator of *tubercule bacillus*.

The data presented in Figures 1-4, illustrate the divergence in the distribution pattern of cattle farm sizes and confirms the logic of not describing the prevalence of tuberculin reactors in terms of numbers of farms with reactors. The description of numbers of farms with reactors would be seriously confounded with herd size, if the West and Mid South regions were thus compared.

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Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6