Questionnaire survey of foot and mouth disease (FMD) and of FMD control by vaccination in villages in northern Thailand

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Summary: The authors describe a questionnaire survey of foot and mouth disease (FMD) and of FMD control by vaccination in sixty villages in northern Thailand. FMD was found to be common, with 90% of the villages surveyed reporting one or more outbreaks in the five years prior to interview, and 28% of villages reporting outbreaks every year. Outbreaks were more common in the wet season (June to September) and most outbreaks lasted for four weeks or less. The common sources of the most recent outbreak were the introduction of infected cattle and buffalo from a public market or surrounding village (25 of 60 cases), and commingling of cattle and buffalo with those of an infected neighbouring village (24/60). FMD was not perceived to be a major animal health problem, and there was substantial variation between villages in the percentage of animals vaccinated. The main reasons for not vaccinating were the fear that vaccination caused abortion, and the fact that animals were difficult to assemble for vaccination. It was concluded that vaccination cover needs to be raised significantly if FMD is to be effectively controlled.


INTRODUCTION

Foot and mouth disease (FMD) is endemic in northern Thailand, where the circulating viruses are serotypes O, A and Asia 1. The FMD control programme is based primarily on six-monthly vaccination, using a trivalent vaccine, of at least 70% of village cattle and buffalo (but not pigs), combined with movement controls, complementary animal health measures and ring vaccination in response to outbreaks (5). The Royal Thai Government has recently allocated substantially increased funds for FMD control to the Department of Livestock Development (DLD), with the aim of eradicating the disease within the next ten years.

There is general acceptance of the need for a more precise understanding of the occurrence, relative importance and other attributes of FMD in northern Thailand.

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Official reports of the disease in Thailand are based on the number of confirmed laboratory submissions received at regional laboratories, and it is likely that additional unreported outbreaks occur. Without accurate data on incidence of the disease and the resulting production losses, the benefits of control procedures cannot be accurately assessed. Disease control authorities also require that both the level of vaccination cover achieved and the distribution of cover among villages be monitored.

A questionnaire survey was undertaken to indicate the prevalence, relative importance and general features of FMD in northern Thailand, and to obtain information on the vaccination cover achieved in the surveyed villages. This paper describes the results of the survey.

**MATERIALS AND METHODS**

A cross-sectional study was undertaken in region 5 of northern Thailand, which comprises approximately 5,000 villages in eight provinces. A purposive sample of sixty villages (twenty villages in each of three provinces, namely Lampang, Lamphun and Chiang Mai) was chosen. Criteria for enrolment of villages were the willingness of livestock owners to co-operate, a history of the participation of villages in DLD programmes, and physical accessibility of the villages during all seasons of the year.

Interviews were conducted in the sixty selected villages, between 1991 and 1992, by a single team using a standard questionnaire. The recorded responses comprised the collective opinions of the ‘headman’, ‘keyman’ and other influential farmers in the village. The headman is the senior Government official in a Thai village, and the keyman is a volunteer who assists in implementing DLD programmes.

A record was made of the number of outbreaks of FMD which had occurred in the five years prior to interview. A history of the most recent outbreak was recorded, including the month and year it began, how long it lasted, and the opinion of the villagers on the likely source of the outbreak. Responses were obtained regarding whether FMD occurred in other villages within a five-kilometre radius at approximately the same time as the most recent outbreak, and whether animals which had been vaccinated against FMD became sick. Villagers were asked whether or not epithelial samples for virus typing were collected from infected animals by local DLD officers to confirm the diagnosis, and these responses were cross-checked with laboratory records. Estimated morbidity rates for cattle, buffalo and pigs, and the number of livestock dying or aborting in the outbreak were recorded. Villagers were then asked to describe the major effects of the outbreak on village activities and to rank the two most important animal health problems of the village.

FMD vaccination history was obtained, including the dates of the two most recent vaccination visits, the percentage of work cattle, beef cattle and buffalo vaccinated during the most recent visit, and the reasons why some livestock were not vaccinated. To estimate the vaccination cover across all villages, the current livestock inventory was assumed to be equal to the number of animals present at the most recent vaccination visit. The number of animals vaccinated in each village was then calculated by multiplying the reported percentage vaccinated by the current inventory total for that particular class of stock.
RESULTS

Of the 60 villages chosen for the survey, 54 (90%) reported one or more outbreaks of FMD in the five years prior to the interview, and 67% (40/60) reported at least one outbreak in the previous two-year period, while 45% (27/60) had experienced an outbreak of FMD in the twelve months prior to interview. Seventeen villages (28%) reported annual outbreaks.

A frequency distribution and three-month rolling average of the month when the most recent outbreak commenced is shown in Figure 1. Most outbreaks began during the wet season (June to September). Interviewees in two villages could not recall when the most recent outbreak occurred, as it was so long ago, while interviewees in a further three villages were unable to provide information about the duration of the outbreak. In 69% (38/55) of the remaining villages, interviewees stated that during the most recent outbreak, the time from when the first cases were noticed to when all animals had recovered was four weeks or less (mean 4.4 weeks; median 4; range 1-12).

The most common responses regarding the source of the most recent outbreak were that it was due to a recent introduction of infected cattle or buffalo from a public market or surrounding village (25/60), or due to commingling of cattle and buffalo with those of an infected neighbouring village while grazing or watering (24/60). One outbreak was attributed to the introduction of infected pigs. In other cases, villagers were unsure of the source of the outbreak (9/60) or believed that the outbreak was due to non-animal transmission via the movement of livestock trucks (1/60).

![Frequency distribution and three-month rolling average of the month in which the most recent foot and mouth disease outbreak began in a purposive sample of 60 villages in northern Thailand](image-url)

**FIG. 1**

Frequency distribution and three-month rolling average of the month in which the most recent foot and mouth disease outbreak began in a purposive sample of 60 villages in northern Thailand
Eighty percent (48/60) of villages responded that FMD also occurred in villages within a five-kilometre radius at the time of the most recent outbreak. FMD cases in vaccinated livestock were reported in 36% (21/59) of villages which were undergoing routine FMD vaccination at the time of the most recent outbreak, while eight villages did not know whether vaccinated animals had been affected by FMD in the outbreak. In only one of the sixty villages were epithelial samples submitted to the regional diagnostic laboratory for virus typing of the outbreak.

Estimated morbidity and mortality during the most recent outbreak are given in Table I. Morbidity was highest in cattle and lowest in pigs. Mortality was not common, and the actual numbers of deaths were reported, rather than mortality rates. Only two villages reported mortality in pigs. Thirteen villages reported abortions in cattle during the most recent outbreak. In 11 of these villages, 10 cows or less had aborted, while two villages experienced 20 or more abortions in cows. One village reported two cases of abortion in buffalo, and another village reported five cases of abortion in sows.

Figure 2 shows the percentage frequency distribution of the major effects of the most recent outbreak on village activities. Some villagers reported a number of effects which they believed were important. Loss of condition in animals, and the cost and inconvenience of nursing sick animals were the most frequent responses given. The recorded inability of animals to work was associated with outbreaks occurring in the wet season in villages preparing fields for rice planting. In 19% of villages, the most recent outbreak was reported as having only mild effects or no effect on village activities. Overall, FMD was not seen as a major animal health problem in the villages surveyed. Insufficient availability of pasture during the dry season was the most important livestock problem reported in 34 of the 58 villages which responded to this question. Other concerns about livestock production identified by the survey were poor reproductive performance in cattle, and mortality in calves, piglets and chickens.

In the previous year, 48 of the 60 study villages vaccinated their livestock at the recommended six-monthly intervals. For two villages, the two most recent visits were only three months apart, while the remaining ten villages had vaccination intervals of between nine and fifteen months. The overall percentage of animals vaccinated at the most recent vaccination visit is shown in Table II. Vaccination cover was highest in work cattle and lowest in buffalo. Across all villages, vaccination cover was slightly less than the minimum stipulated by the official control policy, and there was significant variation between villages in the percentage of animals vaccinated.

<table>
<thead>
<tr>
<th>Species</th>
<th>Morbidity rate</th>
<th>No. of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
<td>1-10%</td>
</tr>
<tr>
<td>Cattle</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Buffalo</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>Pigs</td>
<td>53</td>
<td>2</td>
</tr>
</tbody>
</table>

* figures represent numbers of villages

### Table I

Distribution * of morbidity rates and numbers of deaths among animals in a purposive sample of 60 villages during the most recent outbreak of foot and mouth disease in northern Thailand (no data were available for some villages)
Cost of nursing/treatment: 25.0%
Loss of condition: 39.3%
Death in piglets: 2.4%
Death in calves: 3.6%
Animals unable to work: 10.7%
Zero/mild effect: 19.0%

FIG. 2

Percentage frequency distribution of the reported major effects of the most recent outbreak of foot and mouth disease on village activities in a purposive sample of 60 villages in northern Thailand

Figure 3 shows the percentage frequency distribution of village responses regarding the reasons for non-vaccination of some livestock. The most common response given for failure to vaccinate some animals was that some villagers believed that FMD vaccination caused abortion. Other reasons included the difficulty of presenting animals for vaccination, the fact that some livestock were pastured away from the village for part of the year, and the lack of enthusiasm among villagers for the DLD vaccination programme. Less common responses included villagers working outside the village on vaccination day, unweaned calves not being presented for vaccination, and the belief that vaccination was ineffective.

DISCUSSION

FMD appears to be very common in the study area, and while the data were obtained from a purposive sample over a two-year period only, 45% of villages responded that an FMD outbreak occurred in the twelve months prior to interview, 28% reporting outbreaks every year. These estimates of annual FMD incidence in the study villages are

| TABLE II |
|---|---|---|

<table>
<thead>
<tr>
<th>Animals</th>
<th>No. of villages *</th>
<th>No. of animals</th>
<th>Percentage of animals vaccinated **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work cattle</td>
<td>27</td>
<td>1,000</td>
<td>73 (25-100)</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>60</td>
<td>18,593</td>
<td>68 (20-100)</td>
</tr>
<tr>
<td>Buffalo</td>
<td>36</td>
<td>1,993</td>
<td>63 (0-100)</td>
</tr>
</tbody>
</table>

* some classes of livestock were not present in certain villages
** figures in brackets represent the range of values for individual villages
Percentage frequency distribution of the reported reasons for non-vaccination of some livestock against foot and mouth disease in a purposive sample of 60 villages in northern Thailand

potentially conservative, due to the inherent bias in the village selection procedure towards villages with a known positive attitude towards Government livestock programmes. Although Government policy requires confirmation of the causative serotype in all FMD outbreaks, the survey indicated that this rarely happened (only one of the sixty villages reported that specimens for laboratory confirmation were collected by local DLD officers). If this is indicative of the probability that specimens will be collected and submitted to the laboratory if a village has an outbreak in any given year, then the 114 FMD submissions received during 1991 (C. Chamnanpood, personal communication) actually represent approximately 6,800 outbreaks in the 11,000 villages in regions 5 and 6 of northern Thailand which are serviced by the laboratory, or a village annual incidence in excess of 60%.

Most FMD outbreaks in the survey sample occurred during the wet season. This matches findings that relative humidity was directly correlated with the number of outbreaks in a similar monsoonal climate in west Bengal (3). This seasonality may reflect increased movement of animals, increased susceptibility of animals, or improved environmental survival of virus during the wetter months of the year. An implication of this finding is that village vaccination should be timed to occur just before the onset of the wet season, so that maximum herd immunity coincides with the period of greatest risk of exposure to virus.

The most commonly-reported sources of village outbreaks were purchases of infected cattle and buffalo from public markets or surrounding villages, and lateral spread from nearby infected villages. This is consistent with the findings of the authors from prospective outbreak investigations undertaken in the area (4).

It is also consistent with the findings of a risk factor study undertaken in the area, which indicated that the number of cattle and buffalo purchases and the number of neighbouring villages sharing common resources (such as watering points and pasture) were important in explaining the differences in risk of FMD between villages (1). These findings suggest that close contact between animals associated with animal movement is the main means of spread in the monsoonal climate of South-East Asia, and that indirect methods – such as mechanical and airborne spread or spread by fomites – are less important.
FMD morbidity was found to be highest in cattle and lowest in pigs, and mortality in any species was uncommon. Although a number of villages reported severe outbreaks where morbidity in cattle and buffalo exceeded 50%, FMD was generally regarded as a low priority problem in terms of lost production and livestock deaths. Of much greater importance to villagers was the need to improve pasture availability in the dry season. The finding that pigs were rarely involved in outbreaks is probably due to the pig-feeding and -housing practices employed by villagers, which are likely to protect pigs from exposure to virus (2). Villagers do not feed raw meat, offal, bone marrow or unpasteurised milk to pigs, and these animals are usually housed in individual pens which effectively quarantine them from each other and from infected cattle and buffalo. Species adaptation of FMD strains might also be a factor in the morbidity patterns observed (6).

There may be several reasons for the apparent failure of vaccination in the past to adequately control FMD in northern Thailand. First, until 1991 vaccination was mainly performed using a type O vaccine, while type Asia 1 emerged as the most prevalent serotype causing outbreaks in 1991 and 1992 (C. Chamnanpood, unpublished findings, 1992). Second, the herd immunity conferred by twice-yearly vaccination of approximately 70% of the cattle and buffalo population was probably insufficient for effective control. The variable vaccination cover observed between villages would be expected to produce a ‘patchwork’ of immune village herds in the overall population. In this circumstance, disease outbreaks in unvaccinated herds could provide sufficient challenge to overcome herd immunity in well-vaccinated contact herds. Success of the FMD control programme in Thailand will depend, at least in the early stages, on the DLD achieving a uniform, appropriate level of vaccination across all village herds. An important reason for not vaccinating some stock was the unfounded fear that vaccination caused abortion. In a separate study, the efficacy of a new trivalent vaccine was investigated over eighteen months in 21 of the 60 study villages. In the study, post-vaccinal abortion occurred only once in 755 cattle and buffalo reported by their owners to be pregnant at the time of vaccination. Future extension (farmer training) programmes aimed at increasing the current vaccination cover in villages must address this fear of abortion. Such extension must also emphasise the benefits likely to accrue to villagers in the future if FMD is successfully controlled.

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Résumé : Les auteurs décrivent une enquête par questionnaire sur la fièvre aphteuse et son contrôle par la vaccination dans soixante villages du nord de la
Thaïlande. L’enquête montre que la fièvre aphteuse y est répandue : 90 % des villages interrogés ont signalé un ou plusieurs cas dans les cinq années précédentes et 28 % ont constaté l’apparition de nouveaux foyers chaque année. La maladie est plus fréquente en saison humide (de juin à septembre) et, dans la plupart des cas, elle dure, au plus, quatre semaines. Les foyers les plus récents étaient dus à l’introduction de bovins et de buffles infectés provenant d’un marché ou d’un village des environs (25 cas sur 60), ou au fait de mettre en pâturage des bovins et des buffles sains avec d’autres infectés appartenant à un village voisin (24/60). La fièvre aphteuse n’est pas perçue comme un problème majeur de santé animale et le pourcentage d’animaux vaccinés varie d’un village à l’autre. L’absence de vaccination s’explique essentiellement par le fait que les éleveurs redoutent les risques d’avortement liés au vaccin et par la difficulté de rassembler le bétail. Les auteurs aboutissent à la conclusion que la vaccination doit être sensiblement étendue pour une prévention efficace de la maladie.


Resumen: Los autores describen una encuesta mediante cuestionario sobre la fiebre aftosa y su control por vacunación que se llevó a cabo en sesenta pueblos del norte de Tailandia. Se descubrió que la fiebre aftosa estaba muy difundida: el 90% de los pueblos investigados refería uno o más brotes de esta enfermedad durante los cinco años previos al estudio, y en el 28% de ellos se registraban brotes cada año. Éstos eran más frecuentes en la estación húmeda (de junio a septiembre), y duraban en su mayoría un máximo de cuatro semanas. El brote más reciente fue causado generalmente por la introducción de bovinos y búfalos infectados procedentes de un mercado público o de un pueblo cercano (25 de los 60 casos), y por la mezcla de bovinos y búfalos sanos con los de un pueblo vecino infectado (24/60). La fiebre aftosa no era percibida como un problema grave de sanidad animal, y se observó una considerable variación entre los diferentes pueblos en cuanto al porcentaje de animales vacunados. Las principales razones aducidas para la no vacunación eran el temor que a la vacuna pudiera causar aborto y la dificultad de reunir a los animales para vacunálos. El estudio concluye que, para un control efectivo de la fiebre aftosa, será necesario incrementar de forma significativa la cobertura de las vacunaciones.

REFERENCES


