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EVALUATION OF PROGRESS OF THE PSEUDORABIES VIRUS ERADICATION CAMPAIGN IN THE NETHERLANDS

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Au début des années 1995 et 1996, de 5 à 12 échantillons de sérum (selon la taille du cheptel) ont été prélevés dans chaque troupeau de porcs aux Pays-Bas, en vue de la recherche d'anticorps spécifiques du virus d'Aujeszky (VA). Le programme hollandais d'éradication du VA, commencé en septembre 1993, a été évalué à partir de cette information sérologique sur la base du taux d'introduction du virus dans les porcheries d'engraissement. Les Pays-Bas ont été divisés en 8 régions, selon leur densité de population porcine. Ce taux moyen d'introduction du VA a été estimé en combinant la présence ou l'absence d'un foyer majeur avec l'immunité de troupeau induite par le programme de vaccination.

Dans la plupart des régions, le taux moyen d'introduction du VA dans les porcheries d'engraissement était significativement (p < 0,0001) plus faible en 1996 qu'en 1995. Bien qu'il soit possible de constater sur cette période une évolution favorable de la situation, il n'en demeure pas moins qu'il convient de rester vigilant sur le fait que dans plusieurs régions le taux d'infection de ces porcheries semble se stabiliser en 1996 à une valeur certes faible mais non nulle. Sans doute la persistance à bas bruit du virus joue-t-elle un rôle dans ces troupeaux ou groupes de troupeaux (troupeaux contigus, ou naisseurs ne procédant pas à la vaccination) ; des recherches complémentaires dans ces zones sont par conséquent nécessaires.

INTRODUCTION

In recent years, several studies have indicated the feasibility of pseudorabies virus (PRV, Aujeszky's disease virus) eradication by area-wide vaccination (6). On the basis of these results, vaccination-eradication programmes have been started in several member states of the European Union. An essential part of such a programme is the evaluation of progress of the eradication programme by serological monitoring of the prevalence of PRV-infected pigs in time (2, 3), or even better monitoring the rate of new infections per herd per period of time if possible (8). In well immunized pig breeding herds, only minor outbreaks of PRV occur (9). In spite of vaccination, major outbreaks may still occur in finishing herds (8). The rate of occurrence of major outbreaks depends on herd immunity (5, 8). The degree of herd immunity to PRV has recently been quantified in once and twice vaccinated and non-vaccinated pig finishing populations (1, 7). Routinely, in each Dutch pig herd, 5-12 pigs (according to herd size) are sampled at intervals of 4 months for detection of antibodies to Swine Vesicular Disease Virus (SVDV) (4). We used these sera to estimate the mean rate of PRV introductions in Dutch pig finishing herds in 1995 and 1996.

MATERIALS AND METHODS

The Netherlands were subdivided into 8 regions on the basis of pig density. Briefly, municipalities with a pig density $\geq$ 1,000 pigs/km^2 were combined into pig-dense regions. Municipalities with < 1,000 pigs/km^2, but surrounded by densly populated manicipalities were included in the pig-dense regions. When needed, natural boarders like rivers were used to separate the regions. Figure 1 shows the three pig-dense regions that can be distinguished (regions 2, 4, and 7) and the five less densely populated regions (regions 1, 3, 5, 6 and 8). Pig keepers are obliged to have their pigs vaccinated against PRV according to the following schedule: breeding stock are vaccinated simultaneously three times a year; replacement stock are vaccinated three times before the first service; finishing pigs are vaccinated at least once within 6 weeks after the start of the finishing period. However, a second vaccination, 4 weeks after the first vaccination, is recommended for finishing pigs. A nation-wide vaccination campaign to eradicate PRV was started in September 1993. Only marker vaccines, from which glycoprotein E (gE) has been deleted, are used. All pig keepers are obliged to have their pigs vaccinated against PRV. Approximately 190 pig keepers are allowed not to comply with these regulations, because they oppose against vaccination for religious reasons.

Most of these herds are located in region 4.

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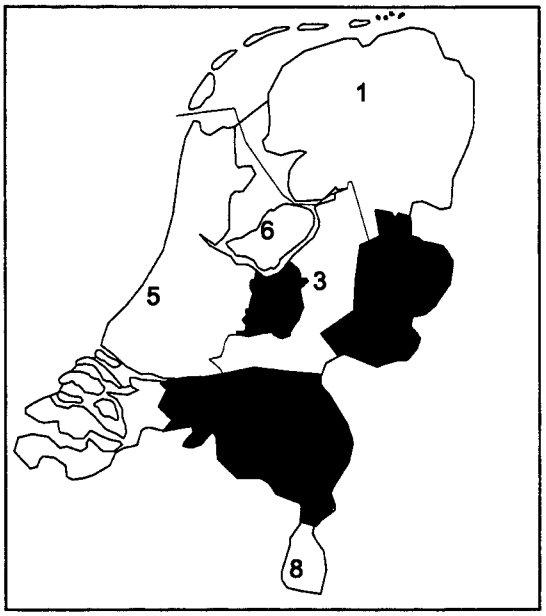
In all Dutch pig herds (³ 5 pigs) blood samples from 5 to 12 pigs are routinely collected at intervals of 4 months for detection of antibodies against SVDV, as described earlier (2, 4). All serum samples collected for the SVDV surveillance program between January and May 1996 were also tested for antibodies against PRV (gE-Elisa, Herdcheck®, Idexx S.A., Cergy Pontoise Cedex, France). The serological test results of a total of 10,934 sera from pig finishing herds in 1996 with consistent data on applied PRV vaccination scheme and demographic information (postal code) were used, compared to a total of 10,505 sera from pig finishing herds in 1995 (Table I).

Figure 1 : Subdivision of the Netherlands in three high, and five low pig density areas



The background of modelling PRV introduction into pig finishing herds was described earlier (8). Briefly, the sample size of the SVDV surveillance allows the detection of major outbreaks only, and because major outbreaks do not occur in well-immunized sow herds, only PRV introduction into pig finishing herds can be estimated. The total number of PRV introductions into pig finishing herds in a region can be estimated by dividing the number of major outbreaks by the fraction of PRV introductions that will result in a major outbreak.

The number of PRV vaccinations given to the finishing pigs was stored per herd in a central database. Because the number of compartments in which the blood samples were collected was not electronically stored in this database, a random sample of approximately 1,000 forms was examined that accompanied the blood samples of the pig finishing herds and registered the number of compartments from which the samples originated in order to get an impression of the distribution of the number of compartments in which blood samples were collected. The serological results and vaccination data were used to estimate the mean number of PRV introductions into pig finishing herds in the eight regions. In order to examine differences in mean rate of PRV introduction between 1995 and 1996 of the regions, the regions were subdivided on the basis of postal codes into 166 subregions containing on average 65 herds (range 10 - 228), and the mean rate of PRV introduction was estimated for each subregion. In order to have sufficient experimental units (subregions) in the analysis for differences in mean rate of PRV introduction between 1995 and 1996, several regions were collapsed (region 7 and 8 together, region 2 and 3, and regions 1, 5 and 6 together). Differences in mean rate of PRV introduction between 1995 and 1996 of regions was tested with the non-parametric Mann-Whitney U test.

Table I
General characteristics of the eight regions in the Netherlands, according to pig density.

Region	Mean pig density (pigs/km²)	Mean herd density (herds/km²)	no. herds (1995)	no. herds (1996)	no. of sub-regions
1	136	0.35	538	672	17
2	1,341	3.73	3,602	3,531	46
3	522	1.46	629	657	9
4	2,107	7.04	1,489	1,457	23
5	154	0.66	933	1,029	23
6	11	0.02	18	20	1
7	2,767	4.03	3,271	3,518	46
8	262	0.57	25	50	1

RESULTS AND DISCUSSION

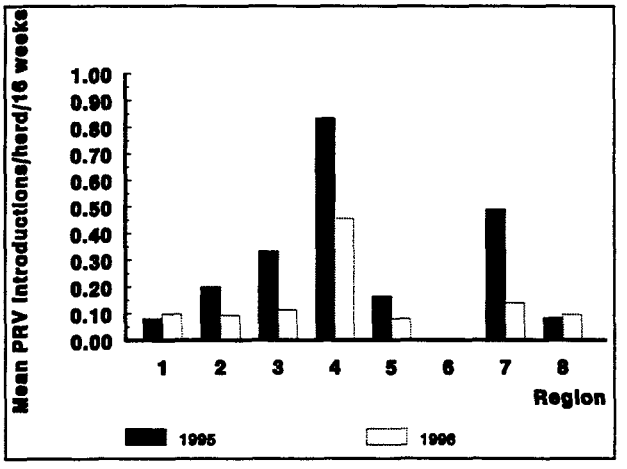
In all regions the mean rate of PRV introduction was approximately 2-3 times lower ($p < 0.001$) in 1996 compared to 1995, except for the regions 1 and 8 in which the mean rate of PRV introduction seems to stabilize on a certain level (Figure 2). The mean rate of PRV introduction is the highest in region 4 (in 1995 as well as in 1996).

Because introduction of PRV does not always result in a major outbreak, the rate of PRV introduction into pig finishing herds is a better measure of the virus circulation in a region than is the incidence of major outbreaks (8).

The classification of the herd immunity on the basis of the information of the herd vaccination strategy may be critized. In the Netherlands, from november 1995 on, only a few specific vaccines are allowed for vaccination. These vaccines were investigated and compared in laboratory experiments to a golden standard vaccine with respect to differences in viral excretion of vaccinated pigs upon challenge with a field strain. However, lack of differences in viral excretion does not neces-sarily mean that R is the same for these vaccines. Using the model developed to estimate the mean regional rate of PRV introduction into pig finishing herds (8), we were able to classify regions according to the incidence of PRV introductions.

This can be meaningful because it is possible to monitor progress of the eradication campaign through time. The monitoring results are potentially capable of giving indications for regional adaptations of the programme.

Figure 2 : Estimated mean rate of pseudorabies virus in troduction into Dutch pig finishing herds in eight regions



Although overall a significant improvement over time can be seen in the eradication programme, attention should be paid to the fact that in several regions with a low average rate of PRV introduction in pig finishing herds in 1995, this rate seems to stabilize on the same low, but not zero, level in 1996. If the herd immunity induced by the vaccination programme equals out against the load of new introductions before the rate of PRV introduction is zero, PRV will not be eradicated. In region 1 and 8 there are indications for this phenomenon, therefore more effective vaccination programmes, additional sanitary measures or taking out (buying + destroying) the last infected herds should be considered to accomplish complete eradiation of PRV. It may be that persistance of the virus plays a role in these herds or subclusters of herds (geographic, or non-vaccinating breeders), further research in this area is therefore necessary. Especially region 4 still suffers from a high rate of PRV introduction per herd.

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