

EPIDEMIC OF FOOT-AND-MOUTH DISEASE IN BAGE, RS, BRAZIL, 1980. EVALUATION OF TWO SYSTEMS OF VACCINATION

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SUMMARY

The foot-and-mouth disease-control program in Rio Grande do Sul (RS), Brazil, began in 1965. Since 1979 a large part of the county of Bage, RS, has had a demonstration program of vaccination with inactivated oil-adjuvanted foot-and-mouth disease vaccine produced by the Pan American Foot-and-Mouth Disease Center (PAFMDC).

In 1980 the county of Bage was affected by a foot-and-mouth disease epidemic caused by virus type O₁. This study analyzes the occurrence of the disease in the herds included in the demonstrative vaccination program using the oil-adjuvanted vaccine in comparison to the rest of the county's herds which were vaccinated with inactivated aluminum hydroxide-saponin vaccine (called the "commercial" system). The disease was recorded in 73 of the 1813 herds under the "commercial" system and in 20 of the 620 herds vaccinated under the oil-adjuvanted vaccine system. The affected herd rates, adjusted for herd size, were 5% and 2%, respectively. The morbidity rates for the county's cattle population were 45 and 6 per thousand head, respectively, for the two systems of vaccination.

When the population that had received only one oil-adjuvanted vaccination at the beginning of the epidemic were distinguished from those that had received 2 or more, the differences in the morbidity and mortality rates between the groups were more striking. Per thousand cattle, those rates were 323 and 9.7 for cattle under the "commercial" system, 216 and 3.9 for cattle

given only one oil-adjuvanted vaccination, and 29 and 0.08 for those that had received two or more oil-adjuvanted vaccinations. The oil-adjuvanted vaccine applied by the official veterinary service yielded highly satisfactory results, considering the high viral exposure to which the cattle population in the county was subjected.

INTRODUCTION

The Foot-and-Mouth Disease (FMD) Control Campaign in the state of Rio Grande do Sul (RS) began in 1965. It included the systematic and periodic vaccination every four months of the cattle population over four months of age. The control program began in the southern section of the state in the region called "Campana", which includes the county of Bage.

From the beginning the vaccination were directed and controlled by veterinarians and field assistants from the State Department of Agriculture (SDA-RS). The inactivated aluminum hydroxide-saponin vaccines used were produced by several private Brazilian laboratories. The virus was cultivated in baby rabbits as well as in Frenkel cultures and, in recent years, in cell cultures (BHK-21).

In 1972, the Pan American Foot-and-Mouth Disease Center (PAFMDC) undertook field research with oil-adjuvanted vaccines, with the support of the Brazilian Ministry of Agriculture and the SDA-RS. The initial experiments included a group of cattle from the Ministry of Agriculture's Experimental Station "Cinco Cruzes" in Bage (3, 4). In succeeding years the experiments were extended to the Station's entire cattle population. A subsequent agreement between the SDA-RS and the PAFMDC gradually extended the official application of oil-adjuvanted FMD vaccine to other parts of the county of Bage.

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In March and April 1979, this vaccine was administered to 152,785 cattle on 304 properties out of a total of 460,000 cattle in 2433 herds in the county.

In March, 1980, the program was extended to 620 herds and a population of 240,166 cattle distributed throughout the entire county. The rest of the population continued receiving aluminum hydroxide-saponin vaccine.

During that same year the cattle population in Bage was affected by an FMD epidemic caused by O₁ virus. The epidemic spread throughout the major portion of the State. The purpose of this study is to evaluate the incidence of the disease in the cattle population submitted to those two systems of vaccination.

MATERIALS AND METHODS

Bage is a county located in the extreme southern section of Brazil (Figure 1) near the Republic of Uruguay. Its area covers 6700 km² and lies approximately 100 meters above sea level.

The predominant activity is livestock raising, conducted on a semi-extensive basis mainly for beef production. The herds include 461,148 cattle (6) and 792,993 sheep (7) on 2433 properties. Other species of domestic animals are of insignificant importance in the county. With respect to FMD, the county is part of the state's primary endemic ecosystem.

Vaccination systems

The vaccines utilized are "commercial" and "oil-adjuvanted" vaccines. The former are inactivated aluminum hydroxide-saponin vaccines produced by private laboratories. The viruses are replicated in cell cultures (5) and the vaccines are available commercially and are subject to inspection by the official veterinary services. These "commercial" vaccines are administered by the livestock owners under control and inspection of the FMD program staff. The oil-adjuvanted vaccines are prepared with virus replicated in cell cultures and inactivated with binary ethylenimine (BEI). The vaccine is produced by the PAFMDC (5), but its distribution and application is the

direct responsibility of the SDA-RS. "Commercial" vaccine is administered to cattle every 4 months and "oil-adjuvanted" vaccine every 6 months in young cattle and yearly in adult revaccinated animals. Figure 1 shows the distribution of the herds vaccinated with "oil-adjuvanted" and "commercial" vaccines in 1979 and 1980. The livestock owners themselves bore the expense of vaccine acquisition and administration.

Both vaccines were prepared from the O₁ Campos, A₂₄ Cruzeiro, A Venceslau and C₃ Indaial virus strains (1, 2).

Epidemiological surveillance

The control program in Bage has a permanent staff of three veterinarians and 25 field assistants who perform activities related to animal health education and organization and execution of the vaccination stages and the national epidemiological surveillance system. In this regard they periodically visit the county's various rural areas.

All notifications of a suspected case of vesicular disease are quickly followed up by the official services. The notifications may originate from persons responsible for the animals (70% of the cases), from third parties (10%), or from surveillance by the official services (20%). It is estimated that very close to 100% of the occurrences of foci or affected herds are normally reported.

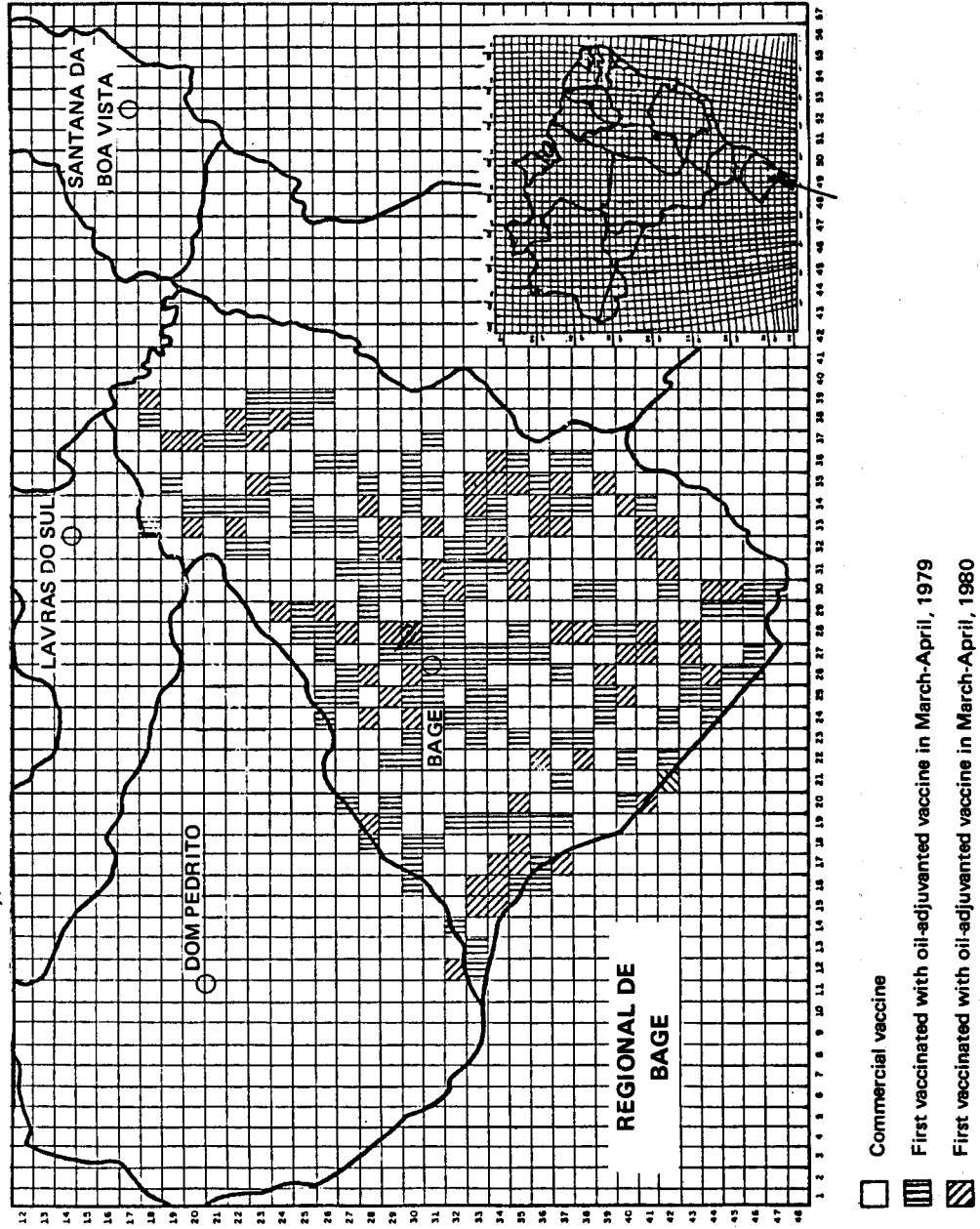
The disease is diagnosed through clinical examination by an official veterinarian and, subsequent, laboratory examination of tissue material. Each focus is visited at least twice, and frequently three or four times. At each visit forms are filled out to summarize the pertinent observations made by the persons responsible for the animals and by the official veterinary services personnel.

RESULTS

The FMD epidemic caused by virus type O, which affected the state of Rio Grande do Sul, was first recorded in the county of Bage in late January, 1980. That first report involved a herd covered by the "commercial" system of vaccination. Until the month of April the outbreak was restricted to a small sector of the extreme northeastern part of the county. The source were

FIGURE 1. Grid squares showing bovine herds vaccinated with oil-adjuvanted vaccine. Bagé, Rio Grande do Sul, Brazil.

Note: The remaining herds in the county were vaccinated with "commercial" vaccine every 4 months, in February, June and October.



probably outbreaks that had occurred in preceding months in other counties also belonging to the state's primary endemic area. Its spread was noticed in the county in early April of that year, when a quarter of the properties in Bage, containing half of the county's cattle population, had been subjected to at least one vaccination with oil-adjuvanted vaccine (Table 1). The herds in the "oil-adjuvanted" vaccination program (Figure 1) were distributed throughout the county. The distribution of affected herds was likewise widespread (Figure 2).

Up to October 1980, when the last focus was detected, 93 herds had been recorded as affected (3.82% of the total in Bage). Of that total, 73 herds were under the "commercial" vaccination system (4.03% of the herds vaccinated

the "commercial" system and in 8.4% of those receiving oil-adjuvanted vaccines (Table 3).

More striking differences were observed between the respective morbidity rates in both the county's total cattle population (45 per thousand and 6 per thousand) and in the exposed population of affected herds (32% and 9%), in terms of the "commercial" and "oil-adjuvanted" vaccination system respectively (Table 4).

Table 5 summarizes the morbidity and mortality rates by system of vaccination and age of the affected animals. In general, the animals over 2 years of age were most affected, mainly with respect to mortality. The risk that the animals submitted to only one application of oil-adjuvanted vaccination would be diseased or died was almost half that of the animals under the

TABLE 1. Number of existing, exposed and affected herds and bovines, by vaccination system. Bage, Rio Grande do Sul, Brazil, 1980

Vaccination system	Number of vaccination	Herds		Bovines		
		existing	affected	existing	exposed	diseased
Aluminum hydroxide ^a	Various	1,813	73	220,532	30,780	9,958
Oil-adjuvanted ^b	1	316	9	87,831	5,647	1,218
	2 or more	304	11	152,785	11,517	328 ^c
	Subtotal	620	20	240,616	17,164	1,546
Total		2,433	93	461,148	47,944	11,504

^aVaccination in February, 1980.

^bVaccination in March/April, 1980.

^cNot included 163 diseased calves from nonvaccinated experimental groups, of which two died.

under that system) and 20 herds were under the "oil-adjuvanted" vaccination system (3.23%) (Table 1 and 3). After adjustment for herd size, those figures yield affected herd rates of 5% and 2%, respectively (Table 2). The rates for herds with less than 200 head were respectively 2% and 0.5%. But in herds having more than 200 head, FMD was recorded in 17.7% of herds under

TABLE 2. Rates of affected bovine herds, adjusted for herd size, by vaccination system. Bage, Rio Grande do Sul, Brazil, 1980

Vaccination system	Rate (%)
Aluminum-hydroxide	5
Oil-adjuvanted	2

FIGURE 2. Grid squares showing bovine herds affected by foot-and-mouth disease. Bage, Rio Grande do Sul, Brazil.

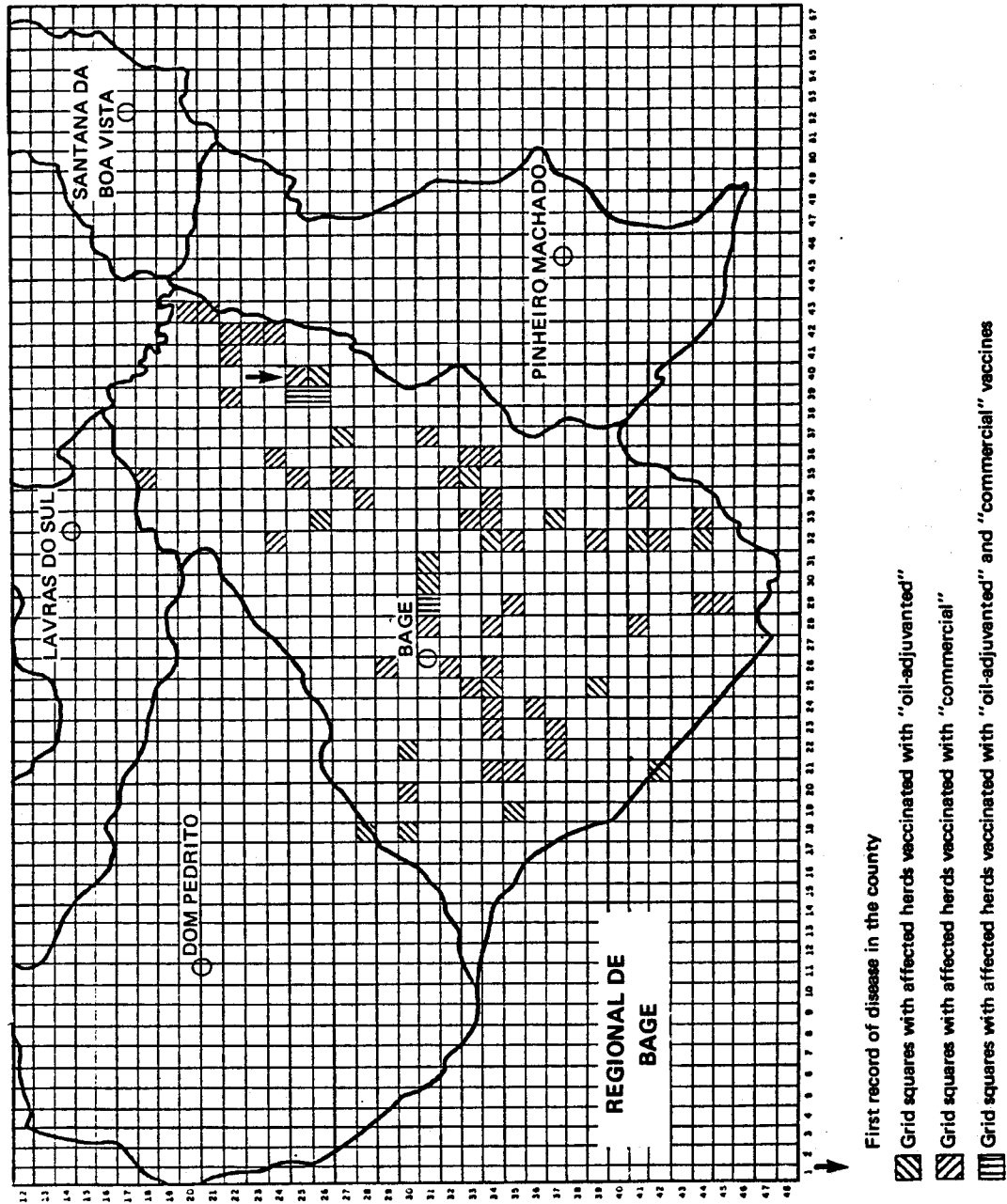


TABLE 3. Bovine herds affected by FMD, according to herd size and vaccination system.
Bage, Rio Grande do Sul, Brazil, 1980

No. of bovines (range)	Aluminum hydroxide				Oil-adjuvanted			
	Total	%	Affected	%	Total	%	Affected	%
< 200	1.581	65.0	32	2.0	405	16.7	2	0.5
≥ 200	232	9.5	41	17.7	215	8.8	18	8.4
Total	1.813	74.5	73	4.03	620	25.5	20	3.23

"commercial" system, but from 4 to 10 times higher than among those that had been given at least two vaccinations of oil-adjuvanted vaccine. In this last group, overall mortality was only 0.08 per thousand, as compared to 3.9 for those that had been given only one vaccination of oil-adjuvanted vaccine and 9.7 for those under the "commercial" system.

3 times larger than the herds under the "commercial" system. That difference becomes even clearer when the herds are divided into those under 200 head and those over 200 head. Under the "oil-adjuvanted" vaccine system, 35% of the herds have over 200 head, whereas only 13% of the herds vaccinated with "commercial" vaccines

DISCUSSION

The geographic distribution of the vaccinated herds under both vaccination systems, as well as of the distribution of the foci, indicate that the risk of exposure to the disease was similar for both groups of herds. But the herd size under the two systems differed significantly; the herds given oil-adjuvanted vaccines were on the average

TABLE 4. Foot-and-mouth disease morbidity rates in bovines, by vaccination systems.
Bage, Rio Grande do Sul, Brazil, 1980

Vaccination system	Morbidity rates %o	
	Total pop.	Total herd
Aluminum-hydroxide	45	320
Oil-adjuvanted	6	90

TABLE 5. Internal rates of morbidity, mortality and lethality in bovines, per thousand, according to age and vaccination system, Bagé, Rio Grande do Sul, Brazil, 1980

Age (years)	Vaccination System								
	Aluminum-hydroxide			Oil-adjuvanted					
	Rates of			Rates of					
	Morbid.	Mortal.	Lethal.	Morbid. ^a	Mortal. ^a	Lethal. ^a	Morbid. ^b	Mortal. ^b	Lethal. ^b
< 1	287	5.1	17	168	0.9	5	43	.0	.0
1-2	290	4.1	14	143	.0	0	14	.0	.0
> 2	342	12.5	36	257	6.3	24	29	0.13	5
Total	323	9.7	30	216	3.9	18	29	0.08	3

^a One vaccination.

^b Two or more vaccinations.

have 200 head or more. This difference is considered of great importance, since the risk that the larger herds would be affected was from 9 (commercial) to 16 (oil) times greater than the risk among herds with less than 200 head. Therefore, the risk that a herd receiving oil-adjuvanted vaccines would become diseased was even lower than the risk in a similar herd receiving the "commercial" vaccines when adjusted for size.

The differences between the two types of herds are more striking when the morbidity rates are compared. It was noted that the herds subjected to at least two cycles of oil-adjuvanted vaccine had rates almost 8 times lower than those given only one such vaccination, and 11 times lower than herds under the "commercial" vaccination system. The mortality rates exhibit the most significant difference: in the group having received 2 or more oil-adjuvanted vaccinations, only one animal died for every 328 diseased and 11,577 exposed (0.08 per thousand). The "commercial" group, however, recorded 304 deaths out of 9958 diseased and 30,700 exposed (9.7 per thousand). The latter rate was therefore 100 times higher (Table 5).

The excellent comparative results obtained in favor of the oil-adjuvanted vaccine undoubtedly cannot be attributed solely to the type of vaccine utilized and must take into account that the oil-adjuvanted vaccine was administered by the official services. The fact that this latter group received special attention seems to have significantly influenced the levels recorded in both groups.

A survey conducted among the cattlemen after the epidemic had been brought under control found no additional foci in the herds of the "oil-adjuvanted" system. However, among the herds given "commercial" vaccines, it appears that 110 herds had FMD which had not been appropriately recorded by the epidemiological surveillance system.

The disease in Rio Grande do Sul spread from the south into the east and north, heavily affecting the cattle herds in approximately 100 of the state's 232 counties.

Regardless of the factors that might have influenced the disease's high frequency and

severely in herds under the "commercial" system (including deficient vaccination), the system of official application of oil-adjuvanted vaccines yielded highly satisfactory results, particularly after at least two vaccinations. Taking into account the high viral exposure existing in the county of Bage between January and October, 1980 it can be speculated that if the entire county had been under the oil-adjuvanted vaccine system, the occurrence of FMD there might have been insignificant.

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