Regional Research Centre on Foot-and-Mouth Disease

Department of Veterinary Microbiology
College of Veterinary Sciences, LUVAS, Hisar-125004, Haryana
क्षेत्रीय मुँह-खुर रोग अनुसंधान केंद्र, पशु चिकित्सा सूक्ष्म जीव विज्ञान विभाग
पशुचिकित्सा विज्ञान महाविद्यालय
लाला लाजपत राय पशु चिकित्सा एवं पशु विज्ञान विश्वविद्यालय, हिसार-125004, हरियाणा
Phone: 01662-256131
E-mail: fmdhisar@luvas.edu.in

1. Haryana State Emerged as a Model State for the Country

In view of the timely vaccination of susceptible livestock population, data on the epidemiology (reduction in number of FMD outbreaks), increased protective antibody titres in post-vaccination serum samples and decrease in carrier status of animals for FMDV in the state, Haryana has emerged as a model for rest of the country in control of FMD with following achievements:

- Reduced FMD outbreaks since the start of FMD-CP (now NADCP/LHDCP) in Haryana
- High post-vaccinal antibody titres against FMDV serotypes O, A, Asia-1 (>72%) indicating development of herd immunity
- Low anti-NSP antibodies/ DIVA reactivity against FMDV in cattle and buffaloes of Haryana as compared to rest of the country indicating a decline in FMD virus circulation in the region
- Allowed first in the country to use FMD+HS combined vaccination programme in cattle and buffaloes on the basis of scientific data generated and presented by the Scientists of LUVAS as per the guidelines of a committee constituted by the DAHD, Govt. of India, New Delhi for "Recommendations on usage of FMD+HS combined vaccine"

For FMD sero-monitoring and sero-surveillance reporting an online module was developed under National Livestock Mission (NLM) by DAHD, GoI & NDDB through M/s TCS and E&Y on the basis of inputs given by Scientists from RRC, Hisar and ICAR-NIFMD. The RRC-FMD, Hisar scientists participated in the quality control testing of FMD+HS combined vaccine at IIL, Hyderabad.

All this could be possible due to the dedication and hard work of implementing authorities viz. Govt. of India, ICAR, New Delhi, ICAR-NIFMD, Bhubaneswar, field staff of Department of Animal Husbandry and Dairying, Govt. of Haryana and LUVAS. Active surveillance of animals without apparent clinical signs of FMD along with molecular epidemiological studies may help in identifying geographic regions for creating 'FMD controlled zones' with vaccination and appropriate zoo-sanitary measures. This will help in boosting up the economy of local farmers by creating a platform for international trade for livestock and their products.

2. Research Highlights

A. Epidemiological Studies:

The Regional Research Centre on FMD, Hisar has done a commendable work on epidemiology of FMD in north-west India. The project has contributed significantly in terms of collection of epidemiological data, distribution of virus types/subtypes and other pertinent information which may help in containment programme leading to the control of FMD (Fig. 1). In case of FMD outbreaks, the suspected clinical samples from cattle, buffaloes, sheep, goat, pigs, etc. are processed by sandwich ELISA for detection and serotyping of FMD virus (FMDV) as well as by RT-multiplex PCR (for ELISA negative samples) (Fig. 2).

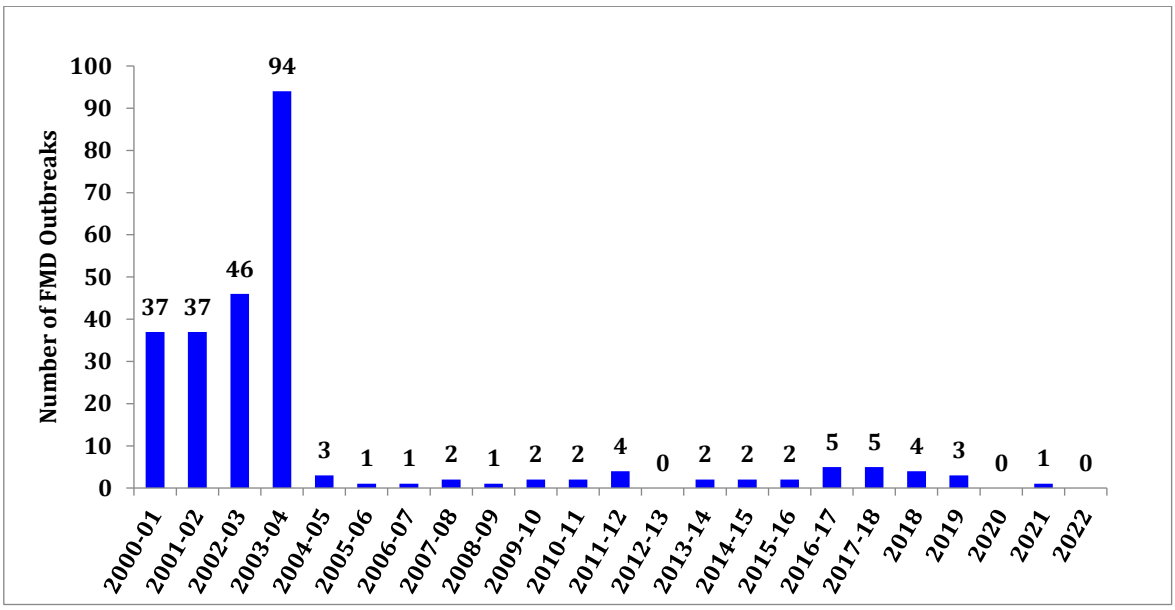

Fig. 1: Reduction in number of FMD outbreaks after the start of FMD-CP in Haryana

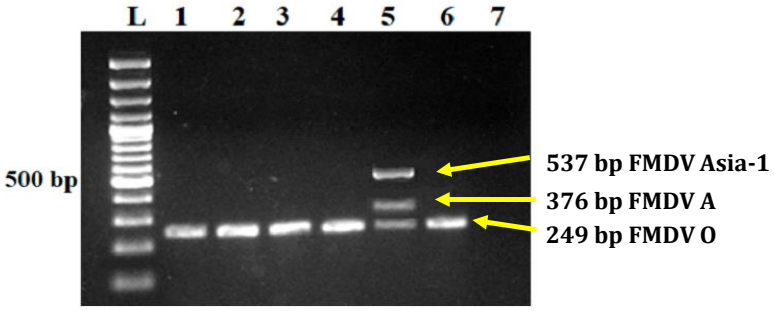

Fig. 2: Multiplex RT-PCR for FMDV typing. Lane L: 100bp DNA ladder; 1-4, 6: Tissue samples from FMD outbreaks; 5: FMDV serotype O, A, & Asia-1 Positive Controls; 7: Negative Control

B. Sero-monitoring of FMD-CP/ NADCP/ LHDCP in Haryana:

The Government of India had launched FMD Control Programme (FMD-CP) during the 10th Five Year Plan including eight districts of Haryana (Bhiwani, Fatehabad, Hisar, Jhajjar, Jind, Rohtak, Sirsa and Sonipat). The FMD-CP was extended to cover all the remaining 13 districts of Haryana during 2011-12. In order to contain the disease, mass vaccination program have been taken up on a country wide scale under the National Animal Disease Control Programme (NADCP) since 2019. Haryana state has been allowed (first in the country) by the DAHD, Govt. of India to use FMD+HS combined vaccination programme in cattle and buffaloes on pilot basis. The mass vaccination of cattle and buffaloes is taking place two times a year and so are the vaccination and post vaccination monitoring activity. This Centre is participating actively in implementation of NADCP/ LHDCP by providing logistic support in the form of surveillance and sero-monitoring work in all the 22 districts of Haryana and Delhi.

So far seven rounds of FMD+HS combined vaccinations/ five rounds of NADCP have been carried out in cattle and buffaloes of Haryana. Till date more than 25,000 serum samples of cattle and buffaloes from rural cohorts of Haryana have been tested for sero-monitoring (pre- and post-vaccination) against FMDV following combined vaccination (Table 1). Overall, >72.0% cattle and buffaloes, combined together, exhibited protective antibody titres in post-vac samples against FMDV serotypes O, A and Asia-1 when tested by Solid Phase Competitive ELISA (SPCE) after NADCP Round 4 in Haryana (Fig. 3). Since the vaccination coverage in Haryana was more than 85% during the past rounds, hence the incidences are very few (Fig. 1) in Haryana. More than 94% animals exhibited protective antibody titres against FMDV in organized farms of Govt. of Haryana including LUVAS Animal Farms, Semen Banks, ICAR-CIRB, Hisar and ICAR-NDRI, Karnal.

Table 1: Serum samples tested during different rounds of FMD+HS vaccination in Haryana

S. No.	Total serum samples tested			Districts and Rounds of vaccination (Month of vaccination)
	Total	Pre-Vac	Post-Vac	
1.	**2940**	797	2143	12 districts under FMD+HS combined vaccination Round 1 **(April-May 2019)**
2.	**5143**	2373	2770	14 districts under FMD+HS combined vaccination Round 2 **(Nov.-Dec. 2019)**
3.	**4538**	2267	2271	22 districts under FMD+HS combined vaccine Round 3/ NADCP Round 1 **(May-June 2020)**
4.	**4576**	2290	2286	22 districts under FMD+HS combined vaccine Round 4/ NADCP Round 2 **(Dec. 2020- Jan. 2021)**
5.	**4288**	2145	2143	22 districts under FMD+HS combined vaccine Round 5/ NADCP Round 3 **(Nov.-Dec. 2021)**
6.	**4290**	2145	2145	22 districts under FMD+HS combined vaccine Round 6/ NADCP Round 4 **(May-June 2022)**
Total	**25775**	**12017**	**13758**	**Six Rounds of FMD+HS combined vaccination**

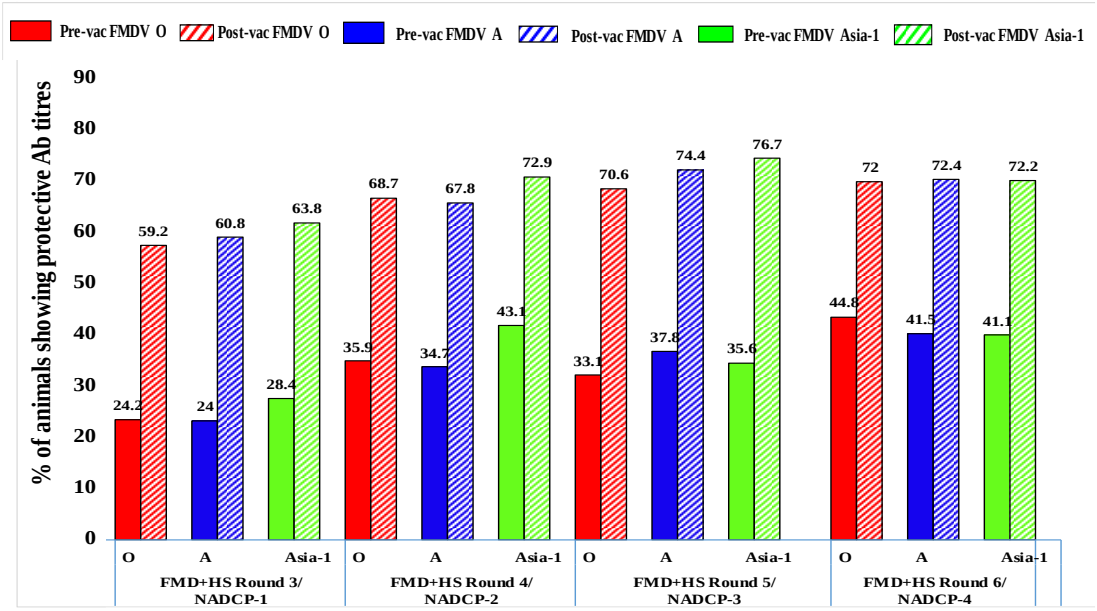

Fig. 3: Trend of FMD vaccinal antibody response in pre- and post-vac sera samples of cattle and buffaloes of Haryana under NADCP Rounds 1-4 (2020-2022)

C. NATIONAL FMD SERO-SURVEILLANCE

For identification of potential disease-free zones (DFZs) the FMDV sero-surveillance is carried out to measure the level of disease through screening the sera of cattle, buffaloes, sheep, goats and pigs against non-structural proteins (NSPs) of FMDV using 3AB3 NSP (DIVA) ELISA. As per the sampling plan devised by ICAR-NIFMD, probang sampling was recommended for States/ UTs where less than 10% NSP reactivity (DIVA ELISA positive) in cattle and buffaloes was reported over a period of time (Fig. 3). Hence, ICAR-NIFMD endorsed probang sampling from Haryana (besides Telangana and Andaman & Nicobar Islands only) for which training was imparted to the staff and Scientists of Department of Veterinary Microbiology, LUVAS and Veterinary Surgeons of Haryana, Punjab, Uttarakhand, Himachal Pradesh, Delhi, Jammu & Kashmir to collect oropharyngeal fluid (OPF) from cattle/ buffaloes in 2021 and 2023. Probang sampling from NSP sero-positive animals is done to carry out a systematic follow-up investigation to identify potential disease-controlled zones with FMD vaccination. Anti-3AB3 NSP antibodies against FMDV observed in different districts of Haryana is depicted in Fig. 4.

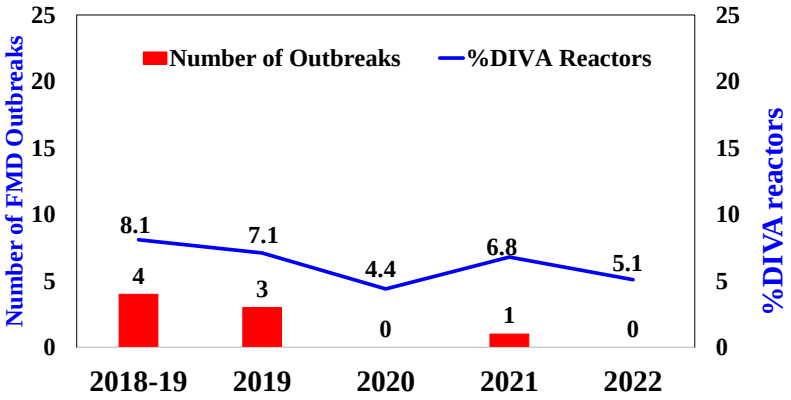

Fig. 3: Anti-3AB3 NSP DIVA reactivity and number of FMD outbreaks in Haryana (2018-2022)

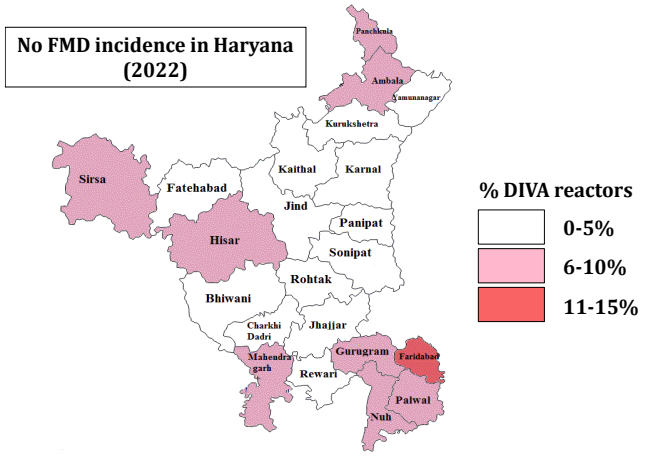

Fig. 4: NSP reactivity in cattle and buffaloes of rural cohorts of Haryana during 2022

This further supports the fact that incidence of FMD virus circulation in the state as compared to rest of the country has significantly reduced in cattle and buffaloes. NSP-ELISA is an underlying indicator of FMD virus exposure regardless of vaccination status.

3. Publications

Vijay, Dahiya, S., Budania, S., Gupta, A. K., Sangwan, P., Lather, A., Kumar, P., Kakker, N. K. and Singh, A. (2023) Characterization of foot-and-mouth disease virus serotype O-specific single domain antibody expressed in the pET expression system. Indian Journal of Microbiology (Accepted) (IF 3.00).

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