Regional Research Centre on Foot-and-Mouth Disease, Hisar

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1. Year of establishment and history of development:

The Regional Research Centre on Foot-and-Mouth Disease (RRC on FMD), CCS HAU Hisar was originally established in 1968 in the Department of Bacteriology and Hygiene as one of the FMD virus typing units by the Indian Council of Agricultural Research (ICAR), New Delhi. Later on in 1971, the project was revised as All India Coordinated Research Project (AICRP) on FMD. The Hisar Centre was upgraded to RRC on FMD as one of the eight Regional Centres all over India catering to the need of five north-western states (Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab and Rajasthan) and Union Territory of Delhi. In the year 2001, the AICRP on FMD was upgraded to Project Directorate on FMD and now Directorate on FMD with its headquarters at IVRI Campus Mukteshwar, Kumaon, Uttarakhand.

2. Faculty:

Dr. Swati Dahiya	Scientist

3. Supporting Staff

Sh. Chandan Singh	Lab Asstt.
Ms. Meenu Kumari	Lab Attendant
Sh. Rampal	Driver

3. (a) Research Projects (on-going)

i. AICRP on Epidemiological Studies on Foot and Mouth Disease-ICAR funded (Continuing since 1971).

Since FMD is a State priority, in addition to the above project, 2017 onwards, a State funded RKVY project was also awarded.

ii. Establishment of Molecular Diagnostic Facilities and Strengthening of Sero-monitoring Activities for Foot-and-Mouth Disease, Haemorrhagic Septicaemia and Brucellosis in Haryana-RKVY funded (2017 onwards)

(b) Research Projects (completed)

i. Sero-monitoring of FMD Control Programme- Director, Animal Husbandry and Dairying, Haryana, Panchkula funded (2004-06)

ii. FMD Control Programme-ICAR funded (2010-2016)

iii. Assessment of Socio-Economic impact of FMD and its control in India (NIVEDI) -ICAR funded (2013-2015)

4. Mandate of RRC on FMD, Hisar:

The RRC on FMD, Hisar has a mandate to develop effective surveillance and control measures for one of the important diseases of livestock, i.e., FMD in Haryana and Delhi with particular reference to FMD surveillance, epidemiology and related research work. The Centre has also been assigned the objective of sero-monitoring of FMD-Control Programme in Haryana and Delhi.

5. Books/ Monographs/ Practical Manuals published:

S. No.	Title	Author	Year	Publisher
i.	Control of infectious diseases with particular emphasis on Foot and Mouth Disease	Sharma, R. and Kakker, N.K.	2012	Department of Vety. Microbiology, LUVAS, Hisar.
ii.	Current Concepts in Immunoassays for Diagnosis of Animal Diseases	Sharma, R. and Kakker, N.K.	2009	Dept. of Vety. Microbio. CCS HAU Hisar.
iii.	Current Methods in Veterinary Microbiology	Kakker, N.K., Sharma, R. and Archana	2006	Dept. of Vety. Microbio., CCS HAU Hisar.
iv.	Pashuyon Ka Muhn-va-Khur Rog (2nd Revised Edition)	Ahuja, K.L. Prasad, S. and Kumar, A.	1994	Directorate of Publications CCS HAU Hisar.
v.	Pashuyon Ka Muhn-va-Khur Rog (1st Edition)	Ahuja, K.L. Prasad, S. and Kumar, A.	1992	Dept. of Vety. Microbio. CCS HAU Hisar.

6. Research Highlights of FMD Project:

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.

1) A total of 1735 FMD outbreaks were recorded by the Regional Centre, Hisar in the Haryana state since the inception of the project (1971-2017). Maximum number (169) of outbreaks recorded during 1976 coincided with heavy rains followed by widespread floods. Likewise, the lowest number (23) of outbreaks recorded during 2004 to 2017 can be attributed to the implementation of FMD-Control Programme in Haryana since January 2004 (Fig. 1). The month-wise FMD incidences in Haryana for the period 2006-2017 has been depicted in Table 1.

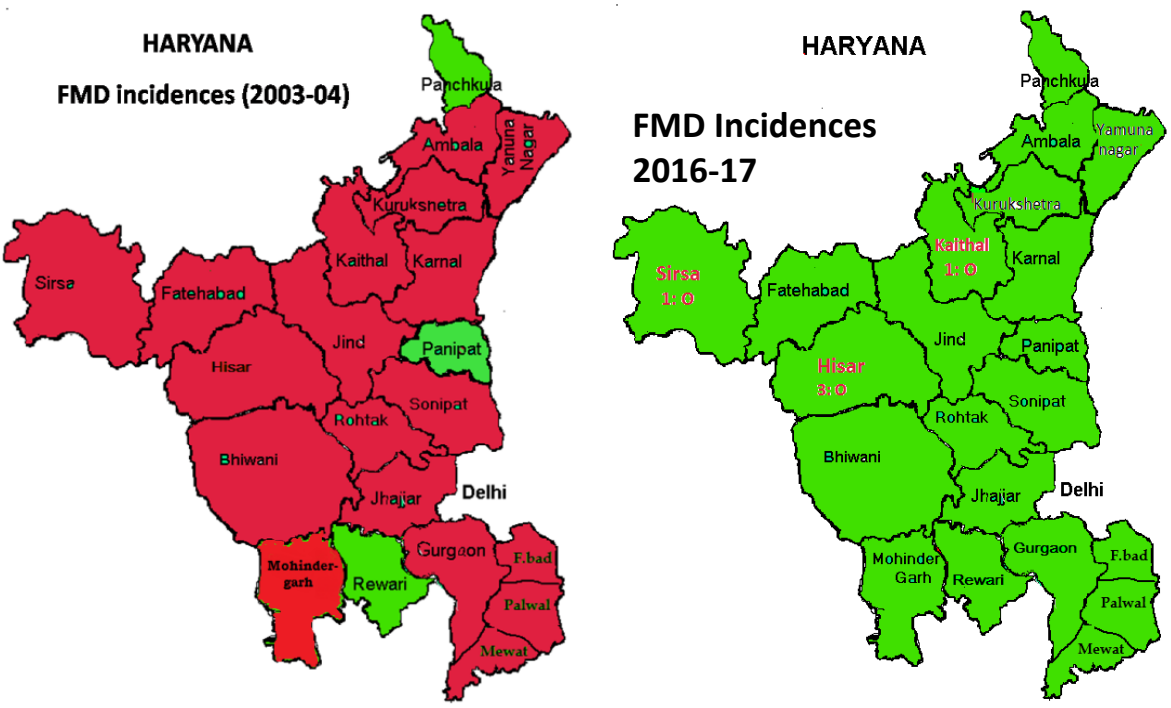

Fig. 1: Comparison of FMD incidences in Haryana (Red colour) during 2003-04 and 2016-17

Table 1: FMD incidences (month-wise) in Haryana during 2006-17

Year	March	April	May-Nov.	Dec.	Jan.	Feb.	March	Total
2006-07		-	-	-	-	1	-	**1**
2007-08		-	-	-	2	-	-	**2**
2008-09		-	-	-	-	-	1	**1**
2009-10		-	-	-	1	-	1	**2**
2010-11		1	-	-	-	-	1	**2**
2011-12		-	-	-	-	1	3	**4**
2012-13		-	-	-	-	-	-	**-**
2013-14		-	-	-	-	2		**2**
2014-15	1	1	-	-	-	-		**2**
2015-16			-	1	1	-		**2**
2016-17	2	1			1	1		**5**
Total	**3**	**3**	**0**	**1**	**5**	**5**	**6**	**23**

2) Earlier, FMD virus subtype A22 was recovered from vaccinated organized farms. The vaccine earlier did not contain this virus type. Based on the recommendations of this centre, a polyvalent FMD vaccine containing A22 virus subtype is now commercially available. The incorporation of FMD virus subtype A22 in vaccine resulted in drastic reduction of FMD outbreaks due to this subtype.

3) All the four prevalent FMD virus types (O, A, C, Asia1) besides A22 were recorded from this region. Type O virus was found to be the dominant FMD virus type during these years except in 1976 and 1984 when Asia-1 overtook other virus types. FMD virus type C has not been recorded in this region since 1991. Based on this information, Govt. of India has recommended the use of trivalent FMD vaccine (containing FMD virus types O, A and Asia-1) instead of quadrivalent vaccine (used previously) in the FMD-Control Programme. This has led to drastic reduction in the cost of FMD vaccine resulting in savings of crores of rupees in government exchequer.

4) This centre has done excellent work on immunological interventions in naturally infected/ vaccinated buffalo calves. The studies conducted on immunogenicity of FMD virus revealed the involvement of cellular immune response as revealed by an increase in T-lymphocyte population. FMD infected/vaccinated animals showed higher proportions of circulating gamma/delta T-cell population. This was the first report implicating cellular immune response in FMD infected/vaccinated buffaloes. FACS analysis of buffalo lymphocytes following FMD infection/vaccination was also reported by this Centre for the first time.

5) Only five FMD incidences were recorded during 2016-17 from Haryana, one each from Kaithal (March 2016) and Sirsa (February 2017) and three from Hisar (March 2016, April 2016 and January 2017) districts (Fig. 1).

6) A total of 20 FMD suspected specimens were collected during 2016-17 from different districts during, out of which 13 were typed as FMDV serotype O using sandwich ELISA and/or multiplex RT-PCR assay (Fig. 2).

7) The species involved in all the incidences during 2016-17 were cattle and buffaloes except one reported from pigs during April 2016 from district Hisar.

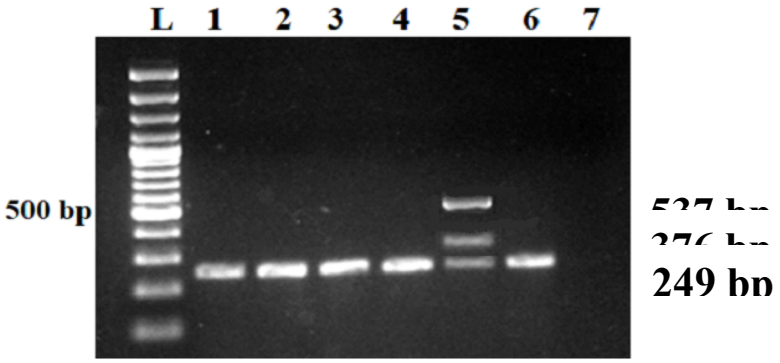

Fig. 2: Multiplex RT-PCR for FMDV typing. Lane L: 100bp DNA ladder; 1-4: Tissue samples from FMD incidences; 5: FMDV serotype O, A, & Asia-1 Positive Controls; 6: Positive Control FMDV serotype O; 7: Negative Control

B. FMD CONTROL PROGRAMME

Sero-monitoring of FMD Control programme (FMD-CP) in Haryana and Delhi:

The Government of India has launched FMD-CP during 10th Five Year Plan including eight districts of Haryana (Bhiwani, Fatehabad, Hisar, Jhajjar, Jind, Rohtak, Sirsa and Sonipat). The FMD-CP has been extended to cover all the remaining 13 districts of Haryana during 2011-12. This Centre is participating actively in implementation of FMD-CP by providing logistic support in the form of surveillance and sero-monitoring work in all the 21 districts of Haryana and Delhi. The incidence of FMD outbreaks has come down very low during the previous four years as a result of the mass vaccination programme by the Department of Animal Husbandry & Dairying, Govt. of Haryana. This Centre has taken the lead in whole of the country by achieving its targets of analyzing pre- & post-vaccination serum samples up to tenth phase of FMD vaccination in Haryana and Delhi.

1) During 2016-17, a total of 3200 (2800 pre- and 400 post-vaccination) sera sample from Haryana were processed for sero-monitoring of FMD-Control Programme (FMD-CP) Phase-XX and Extended FMD-CP Phase X against FMDV serotypes O, A and Asia-1 by single dilution liquid phase blocking ELISA (sdLPBE).
   - **FMD-CP Phase-XX:** A total of 1000 (800 pre- and 200 post-vaccination) sera sample from four districts of Haryana were processed for sero-monitoring of FMD-CP Phase-XX. The overall percent sero-conversion (animals demonstrating >1.8 $\log_{10}$ antibody titres) was 90.00, 85.00 and 97.50 against FMDV serotypes O, A and Asia-1, respectively, in cattle and buffaloes together.
   - **Extended FMD-CP Phase-X**: A total of 2200 (2000 pre- and 200, post-vaccination) sera sample from ten districts of Haryana under Extended FMD-CP Phase-X were processed. The overall percent sero-conversion (animals demonstrating >1.8 $\log_{10}$ antibody titre) was 96.00, 95.50 and 99.50 against FMDV serotypes O, A and Asia-1, respectively in cattle and buffaloes together.
2) The results of these studies revealed that animals in Haryana and Delhi state developed > 80% herd immunity against prevalent FMD virus serotypes after fourth phase of vaccination under FMD-CP/ Extended FMD-CP which are maintained up to 20th/ 10th phase of vaccination, respectively in both the states. This data provided logistic support that in the state of Haryana, mass FMD vaccinations after 20 rounds of vaccination in FMD–CP districts as well as 10 vaccinations in Extended FMD-CP/ ASCAD districts has provided sufficient protection against FMD at herd level despite the fact that the disease is present in neighboring states (Fig. 3 and 4).

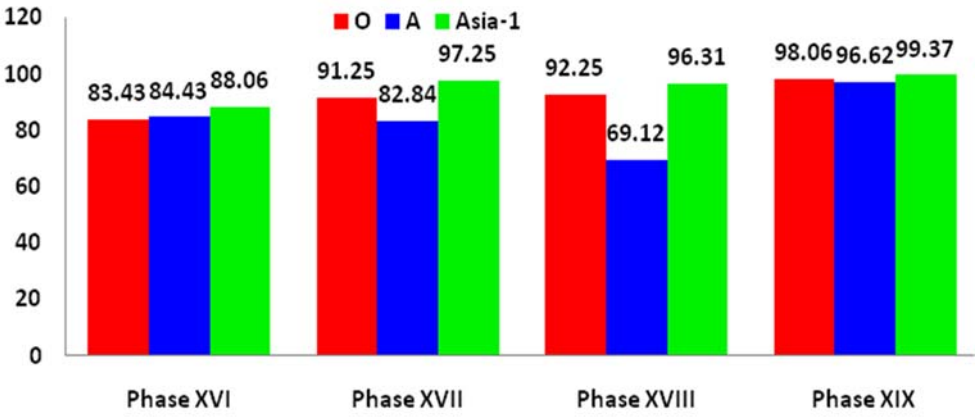

Fig. 3: Trend of FMDV post-vaccinal antibody responses in different phases of FMD-CP (XVI-XIX) in Haryana

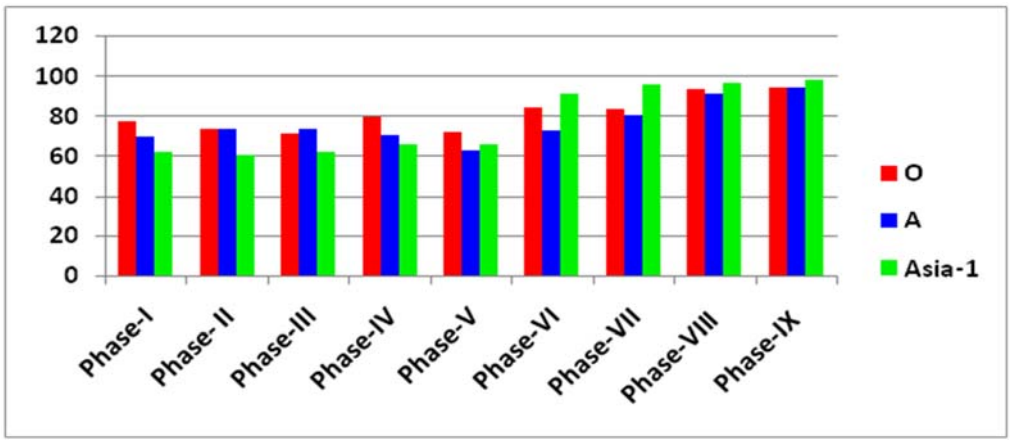

Fig. 4: Trend of FMDV post-vaccinal antibody responses in different phases of Extended FMD-CP (I-IX) in Haryana

C. NATIONAL FMD SERO-SURVEILLANCE

Under National FMD sero-surveillance, a total of 1890 serum samples (720 from FMD-CP Pre-Phase-XXI and 1170 from Extended FMD-CP Pre-Phase-XI) from all 21 districts in Haryana were processed to study the carrier status of animals. Anti-3AB3NSP antibodies against FMDV have been demonstrated in overall 15.45% (292/1890) animals i.e. 23.47% (169/720) animals in eight FMD-CP districts of Haryana and in 10.51% (123/1170) animals of thirteen Extended FMD-CP districts (Fig. 5). 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.

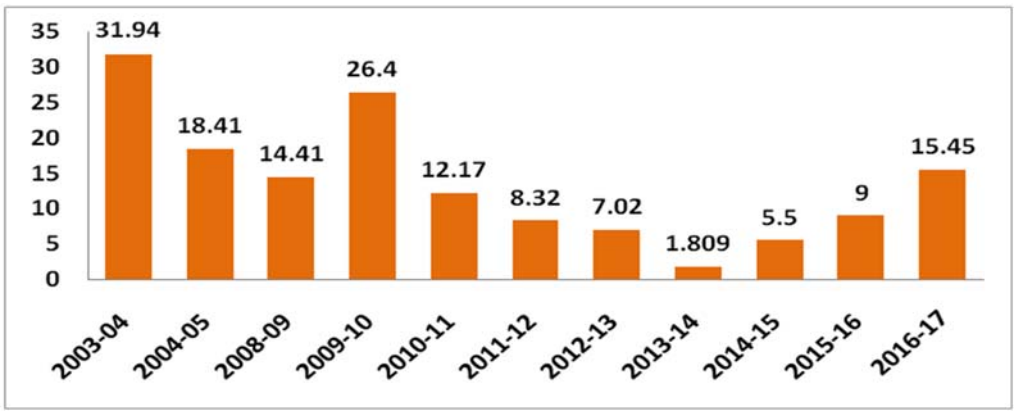

Fig. 3: Animals (pre-vaccinated) showing anti-3AB3 NSP antibodies against FMDV in Haryana (2003-2017)

7. Haryana State Emerged as a Model State for the Country:

- ❖ Reduced number of FMD incidences since start of FMD-CP in Haryana
- ❖ High post-vaccinal antibody titres against FMDV serotypes O, A, Asia-1 (80->90%)
- ❖ Herd Immunity 80-90% (Quantum sero-epidemiology)
- ❖ Low anti-NSP antibodies 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

In view of the 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. All this could be possible due to the dedication and hard work of implementing authorities ICAR, New Delhi, Directorate on FMD, Mukteswar, Uttarakhand, LUVAS and field staff of Department of Animal Husbandry and Dairying, Govt. of Haryana. It is envisaged that the success of FMD-CP will pave the way for 'FMD- Free Haryana' and launching a National FMD Eradication Programme in the country. This may further act as an incentive and booster to mimic this model for the control and eradication of many other infectious diseases prevalent in Haryana.

8. Awards/ Honours/ Recognitions

i. Certificate of Appreciation' given by the Vice-Chancellor, LUVAS in recognition of contribution made for RRC on FMD, Hisar being adjudged as best Centre of the PD on FMD in the country for the year 2011-12.

ii. Best AICRP on FMD Center for the year 2011-12 given by the Project Director on FMD, Mukteswar at DUVASU, Mathura.

iii. Letter of Appreciation' given by the Vice-Chancellor, LUVAS in recognition of contribution made for Hisar Centre being adjudged as Best Regional Centre of FMD during 2010-11.

iv. First Prize for the Best Regional Centre of FMD during 2010-11.

v. 'Letter of Appreciation' given by Project Director on FMD, Mukteswar in recognition of the research work done by Regional Research Centre on FMD, Hisar during 2008-09.

9. Number of M.V.Sc. and Ph. D. Thesis submitted (Thrust areas wise)

Thrust areas	No. of M.V.Sc. Thesis	No. of Ph. D. Thesis
FMD Research	12	4

10. Infrastructural Development:

In May 1977, a separate laboratory for FMD research work having an approximate area of 3240 sq. ft. was constructed in place of the erstwhile library of College of Vety. Sciences. The laboratory was inaugurated by Dr. B. K. Soni, the then Director General, ICAR, New Delhi. The newly constructed laboratory was equipped with air-conditioning and air-curtains system, for having working atmosphere round the year. The Hisar Centre was the first amongst the Regional Centres of FMD to have a disease security system. The laboratory was provided with all the necessary equipments for FMD research work.

In April 2002, the FMD laboratory has been shifted to ICAR building (erstwhile Blood Protista Lab.) vacated by the Project Coordinator, AICRP on Blood Protista after termination of their project. Besides, there is a provision for disease retention facilities and the premises have been divided into restricted and unrestricted areas. Further, the building is equipped with the Fire-Fighting System and CCTV cameras. The laboratory has different sections for different scientific pursuits and well equipped with specialized scientific and general research instruments like ELISA Reader, Thermocycler, Gel Documentation system, Incubators, Deep freezers, Refrigerated centrifuges, Sonicator, Liquid nitrogen cylinders, Laminar Flows, Horizontal and Vertical Electrophoresis systems with power supply, etc. for FMD research work.

11. Outcome and impact of RRC since inception

- Based on the recommendations of this centre, the incorporation of FMD virus subtype A22 in vaccine resulted in drastic reduction of FMD outbreaks due to this subtype.
- FMD virus serotype C has not been recorded in this region since 1991. Based on this information, Govt. of India has recommended the use of trivalent FMD vaccine (containing FMD virus types O, A and Asia-1) instead of quadrivalent vaccine (used previously) in the FMD-Control Programme. This has led to drastic reduction in the cost of FMD vaccine resulting in savings of crores of rupees in government exchequer.
- Molecular and serological diagnostic assays i.e. multiplex RT-PCR and sandwich ELISA are used in the Centre for diagnosis and serotyping of FMD virus from clinical samples.
- Drastic reduction in number of FMD incidences since start of FMD-CP in Haryana. FMDV serotype Asia-1 has not been detected from Haryana for the last 7 years.
- Using single dilution liquid phase blocking ELISA test, high post-vaccinal antibody titres against FMDV serotypes O, A, Asia-1 (80->90%) has been detected in the state.
- Herd Immunity 80-90% (Quantum sero-epidemiology)
- Low anti-NSP antibodies 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.
- According to the 19th Livestock Census (2012), Haryana has 8.77 million FMD susceptible livestock population and by controlling FMD alone Haryana can save economic loss to the tune of approximately Rs. 600 crores annually.

In view of the above presented data on FMD Control Programme and National sero-surveillance, Haryana state can serve as a model towards “FMD Free Haryana”. Reduced incidences of the disease in Haryana, Punjab, Himachal Pradesh, Delhi and J &K support the candidacy of these states for “Zonal freedom from FMD”. It is envisaged that the success of FMD-CP will pave the way for launching a National FMD Eradication Programme in the country.