

Livestock Improvement

ANIMAL IMPROVEMENT

Cattle

Frieswal Project: Frieswal female population at 38 Military Farms was 17,169 including 10,714 adult cows, 5,120 young stocks and 1,335 calves. The strength of elite cows at various Military Farms was 1,093. Semen doses (253,011) were produced and 53,190 were distributed during the year. The average age at first calving of Frieswal cows was 979.56 days. The effects of farm and season and year of birth were significant on age at first calving. The least squares means of service period, dry period and calving interval were 172.83, 125.14 and 449.81 days, respectively, and were significantly affected by farm, parity and season and year of calving. The overall least squares means of 300 days milk yield, total milk yield, peak yield and lactation length were 3,292.67 kg, 3,326.90 kg, 15.06 kg and 331.80 days, respectively.

Estimates of heritability for age at first calving (0.07), total milk yield (0.047), 300 days milk yield (0.050), peak yield (0.050), semen production (0.015), dry period (0.006) and calving interval (0.014) were low.

Indigenous Breeds Project

Haryana unit: The female herd strength was 1,390. The breeding population contained 844 females and 10 breeding bulls. The overall conception rate was 56.54% and 162 daughters were born during the year. The per cent cows in milk, wet average and herd average were 42.52, 4.52 kg and 1.98 kg, respectively. Average age at first calving, first lactation milk yield and peak yield, 300 days or less milk yield and lactation length were 1,369 days, 1,066 kg, 6.44 kg, 1,066 kg and 246 days, respectively. First dry period, service period and calving interval averaged 180,

138 and 428 days, respectively. The breeding value of Haryana sires for milk yield and draughtability confirmed that these 2 traits (milk and draught) are of different nature.

Ongole unit: The female herd strength was 1,250. The breeding population contained 718 females and 8 breeding bulls. The overall conception rate was 45% and 197 daughters were born. The per cent cows in milk, wet average and herd average were 30.16, 2.76 kg and 0.77 kg, respectively. Age at first calving averaged 54.36 months. Average lactation milk yield, 300 days or less milk yield, peak yield and lactation length were 441 kg, 437 kg, 2.70 kg and 155 days, respectively. The first service period, dry period and calving interval averaged 333, 385 and 598 days, respectively.

Buffalo

Field progeny testing of Frieswal bulls: The work is being undertaken at the GADVASU, Ludhiana; KAU, Mannuthy and BAIF, Urulikanchan, and overall conception rate at 3 units was 41.2, 40.5 and 50.2%, respectively. The average first lactation 305 days lactation milk yield of daughters in first five sets showed increasing trend in milk yield at GADVASU, Ludhiana (2,698 to 3,006 kg); KAU, Mannuthy (1,958 to 2,458 kg) and first four sets at BAIF, Urulikanchan (2,848 to 2,978 kg). Similarly the average age at first calving showed a decreasing trend among the progenies of different sets at GADVASU, Ludhiana (1,192 to 921 days) and BAIF, Urulikanchan (1,008 to 992 days) and KAU, Mannuthy (1,136 to 1,036 to 1,077 days).

Field progeny testing: During the year, 23,618 AIs were undertaken on farmers' animals of which 9,692 were of Murrah breed at the 4 centres, and 13,926 Jaffarabadi, Surti and Pandharpuri. Total

Network Project on Buffalo Improvement

Under seventh set, 12 bulls were progeny tested and bull No. 4915 from NDRI, Karnal, top ranked with sire index of 2,116 kg. The superiority of this bull was 17.26% over contemporary daughter's average of 1,777 kg. Bull No.1796 from GADVASU, Ludhiana ranked second with sire index of 2,092 kg with superiority of 15.81% over contemporary daughter's average of 1,790 kg.

11,005 pregnancies were obtained and 5,658 calves born during the period.

Sheep

Under the programme of genetic resource improvement, the production and reproduction traits of Malpura, Chokla, Magra and Marwari breeds are being improved. One of the tools for enhancing mutton production from native sheep is introduction of prolific gene from Garole sheep. The introduction of *FecB* gene from Garole into Malpura and backcrossing of GM with Malpura increased body weights of Garole × Malpura, Malpura, GMM lambs over GM halfbreeds at birth, 3, 6 and 12, months by 37.8, 34.9, 23.0 and 20.9% respectively. Moreover GMM ewes produced 40.00% twins in the flock.



GMM ewe

Network Project on Sheep Improvement

Chokla: The improvement programme through selective breeding is in progress to improve Chokla sheep for carpet wool production. The greasy fleece yield in first 6 monthly clips, adult 6 monthly and adult annual were 0.957, 1.101 and 2.303 kg respectively. Topping was 96.8%. Lambing on ewes available basis was 86.51%. Overall, survivability irrespective of age and sex was 93.84%. The selection differential for 6-month body weight and GFYI were 4.09 kg and 381 g, respectively, for rams.

Fat percentage in buffalo milk

The average fat percentage in Murrah buffalo milk samples from all centres was estimated as 7.88% based on 4,219 records. The average percentage of fat in different breeds varied between 6.90% in Nili-Ravi and 8.61% in Jaffarabadi breed.

Breeds	Average fat % in milk
Murrah	7.88 (4,197)
Nili Ravi	6.9 (108)
Bhadawari	8.09 (604)
Jaffarabadi	8.61 (260)
Pandharpuri	8.04 (180)
Surti	7.33 (446)
Swamp	7.73 (193)

Marwari Unit: The Marwari sheep is being improved for carpet wool production. The overall topping and lambing on ewes available basis were 96.17 and 85.04% respectively. Average annual greasy fleece yield during the year was 1,326 g.

Muzaffarnagri: The Muzaffarnagri sheep is being improved through selection for mutton production. The male lambs were selected using selection index incorporating body weight at 6 months and first 6 monthly greasy fleece weights. The least square means for birth, 3, 6, 9 and 12 month body weights were 3.71, 15.21, 21.21, 22.61 and 26.56 kg respectively. Topping was 93.7%. Lambing per cent based on ewes available and topped was 89.3 and 95.6 respectively.

Deccani: Average body weights of Deccani sheep at birth, weaning, 6, 9 and 12 months of age were 3.41, 16.40, 21.41, 22.93 and 23.98 kg, respectively. The topping percentage was 94 while the lambing based on ewes available was 88%. Average age of ewes at first lambing was 640 days.

Nellore: The Nellore sheep is being improved for mutton production using selection index incorporating body weight at 3 and 6 months of age. The overall means for body weight at birth, 3, 6, 9 and 12 months of age were 3.15, 13.97, 18.12, 21.33 and 22.81 kg respectively. Lambing percent based on ewes available basis was 81.1. Replacement rate in ewes was 28.06%.

Magra: Magra sheep is being improved through selection for carpet wool production at Norangdesar, Gadhwal, Kilchu and Kodemdesar centres. Average greasy fleece weights at 6-months of age and adult annual were 1,037 and 2,215 g, respectively. Superior Magra rams/ram lambs were distributed to registered sheep breeders at 3 different centres.

Madras Red: Madras Red sheep is being improved for mutton production. In Chengalpettu district 4 centres each having a population of about 1,500 sheep, were identified for improvement. Superior ram lambs were distributed in all centres



Madras Red

and performance of their progenies was recorded. The body weights at birth and 3 months were 2.86 and 11.35 kg, respectively. Overall 84.42% lambing was observed during the year. Superior Madras Red rams/ram lambs were distributed to registered sheep breeders at 4 different centres.

Ganjam: Eight villages were identified under 3 centres in Ganjam district to improve Ganjam sheep. Overall mean of body weights for birth, weaning, 6 and 12 months were 2.68, 11.72, 16.75 and 24.49 kg, respectively.

Goat

Jamunapari: Male kids were born with higher birth weight and maintained this superiority up to 12 months of age. Average milk yield in 90 days, 140 days, and lactation length were 75.92±9.83, 120.87±4.43 litre and 154.21±3.18 days, respectively. The average age at first kidding, weight at first kidding and kidding interval were 701.0±18.4 days, 34.46±0.28 kg and 288.0±8.18 days, respectively. The breeding efficiency and kidding per cent on the basis of does tugged were 89.21 and 106.84. The kidding rate was 1.55. Goats were supplied to farmers, SAUs, NGOs and other research institutions for improvement and conservation under field conditions.

Barbari: Overall mean for 90 days milk yield, 140 days milk yield, lactation yield, and lactation length among the Barbari does kidded during the year were 53.20±1.69, 93.76±7.99, 51.35±1.89 liters and 96.99±1.43 days respectively. The selection differential for the male kids selected was 7.1 kg for 9 months of body weight, and 6.2 liters for 90 days milk yield. Tugging percentage was 129% and kidding rate 1.48.

Sirohi: Performance of Sirohi goats with regard to body weight at birth, 3, 6, 9 and 12 months of age was 2.96±0.04, 11.14±0.16, 16.77±0.30, 21.55±0.30 and 24.52±0.36 kg, respectively. The milk yield in the does averaged 83.01±2.07 kg for 90 days, 101.99±2.62 kg for 150 days, and 100.70±2.35 kg for total lactation. Lactation length was 162.58±2.36 days. The kidding per cent on

the basis of does available and does tugged were 85.19 and 86.17 respectively. The selection differentials of selected male kids from population for 9 months body weight and their dam's first lactation at 150 days milk yield was 0.96 and 20.56 respectively.

At Sirohi Field Unit located at Livestock Research Station, Vallabhnagar, MPUAT, Udaipur (Rajasthan), population growth of 95.31% was recorded. The least square means for body weight at birth, 3, 6, 9 and 12 months of age were 2.34±0.03, 12.72±0.16, 16.19±0.17, 19.42±0.26 and 22.95±0.32 kg, respectively. The overall least square means for milk yield over 90 days, 150 days, lactational yield and lactational length were 57.40±2.18, 87.08±2.91, 89.13±2.96 litre, and 155.49±0.70 days, respectively. The kidding rate (litter size) was 1.29.

Sangamneri: The least square means for morning, evening and total milk yield of Sangamneri goats were 457.17±2.98, 421.61±2.74 and 878.82±5.68 ml, respectively. In the progeny born from elite bucks age at puberty, age at first conception and age at first kidding were 232.55±1.12, 275.33±1.69 and 420.20±2.08 days, respectively.

Malabari: The overall least square mean body weights of Malbari goats recorded were 8.28±0.18 and 15.99±0.33 kg, respectively, at 3 and 6 months of age. Peak yield of milk in Malabari goats was 1,237.62± 75.44 ml. The percentage of singles, twins, triplets and quadruplets were 24.00, 61.47, 13.19 and 1.05 respectively.

Black Bengal: The body weights of Black Bengal goats at birth, 3, 6 and 9 months of age were 1.178 ±0.019, 5.323 ±0.117, 7.788±0.298 and 10.077±0.318 kg, respectively. The average weekly milk yields for first, second and fifth week were 1.179±0.006, 1.439±0.007 and 0.819±0.006 kg respectively. This breed is highly prolific and having 82.95% multiple births. The age and weight at first kidding were 234.70±0.52 days and 11.16±0.09 kg.

Ganjam: The average body weights of male Ganjam goats at birth, 3, 6, 9 and 12 months of age were 2.30±0.01, 6.83±0.01, 9.47±0.01, 13.78±0.02 and 17.62±0.02 kg, respectively. The average daily milk yield was 441.57±3.21 ml with total milk production of 76.10±1.23 liters in 172.34±1.67 days of lactation. The kidding percentage on the basis of does tugged was 66.99. In Ganjam district of Orissa this is a primary source of income of tribals (Gola). The goat rearing contributed 70.00% to their annual income.

Marwari: Overall means for body weight at birth, 3, 6 and 12 months of age were 2.89±0.13, 14.43±2.58, 17.93±0.54 and 20.86± 0.69 kg respectively. The cumulative milk yield was

52.118±16.18 kg for 30 days, 98.22±24.18 kg for 90 days and 137.85± 32.51 kg for 90 days of lactation. The kidding interval ranged from 278.25±16.249 to 305.41±9.922 days (288.456±11.157 days). The overall kidding per cent was 74.92%.

Camel

At the NRC on Camel the average birth rate on herd basis was 14.98% with nonsignificant effect of breed. The average death rate was 6.45% with significantly higher mortality in Arab cross animals as compared to the Bikaneri, Jaisalmeri and Kachchhi camels. The average herd growth was 8.53% with nonsignificant variation among the breeds and with maximum of 37.84%. The cumulative growth analysis indicated about 200% herd growth in about 22 years in the Indian dromedary breeds.

Milk production in dromedary breeds: The average daily milk production from two teats was 3,672.10±51.46 ml with no significant effect of breed. The highest milk production was 5,878.41±249.03 ml in a third parity camel. The average daily milk production of the individuals varied significantly with the month of lactation. Peak yield (4,783.54 ml) was observed in the third month of lactation. The highest milk production was observed in third lactation (5,988.99±30.53 ml) followed by fourth (3,900.69±56.33 ml), first (3,275.54±22.33 ml) and second (3,100.43±18.19 ml).

Rabbit

German Angora rabbits raised for fine wool production under temperate climate of Kullu valley, produced 190.15, 198.86, 161.67, 181.48 and 192.68 g wool, respectively, in first, second, third, fourth, and fifth clips. Attempts are being made to achieve a target of 1,200 g wool annually in Angora rabbits.

White Giant and Soviet Chinchilla breeds of broiler rabbit attained body weight of 1.91 kg and 1.84 kg at 12 weeks of age, and attempts are being made to increase the 12 week weight to 2.00 kg. Broiler rabbits have great demand for mutton in southern parts of the country, and the regional centre at Kodaikanal is meeting the requirement by supplying elite germplasm to rabbit entrepreneurs.

Poultry

Poultry for egg: Under the AICRP on Poultry Breeding, six pure lines (IWH, IWI, IWD, IWF, IWN and IWP) of White Leghorn were improved through intra population selection. At the KAU, Mannuthy centre, the S-24 generation of IWN and IWP populations was evaluated up to 40 weeks

of age. The hen house egg production up to 40 weeks of age increased substantially over previous generation in IWN (by 16.5 eggs) and IWP (by 18.9 eggs). The average genetic response for egg production up to 64 weeks of age in IWN (8.80 eggs) was higher than IWP (4.80 eggs) in the last 5 generations.

At the AAU, Anand, the S-8 generation of IWN and IWP strains showed that average genetic response of egg production up to 64 weeks of age (0.50 in IWN and 1.93 in IWP) was positive and significant over last seven generations. The egg production up to 64 weeks of age in IWP increased (by 7.3 eggs) over the previous generation.

At SVVU, Hyderabad, the pullets of S-27 generation of IWD and S-26 generation of IWF showed average genetic response for egg production up to 64 weeks of age for last 8 generations as 1.32 egg in IWD and 0.92 eggs in IWF. At CARI, Izatnagar, average genetic response of egg production up to 64 weeks of age was higher in IWI (1.91 eggs/generation) than IWH (0.03 eggs/generation) in the last five generations. The egg production up to 64 weeks of age increased in S-29 generation over the last generation in both IWH (by 14 eggs) and IWI (by 7 eggs).

At PDP, Hyderabad, 3 pure lines of White

SUCCESS STORY

Birds laid 305 eggs up to 72 weeks of age

Pure lines, viz. IWD, IWF, IWH, IWI, IWN and IWP of White Leghorn maintained at 4 different centres of the All India Co-ordinated Research Project on Poultry Breeding were under long-term selection. Crosses involving IWD × IWF (Hyderabad), IWN × IWP (Anand), IWN × IWP (Mannuthy) and IWH × IWI (Izatnagar) were evaluated at the PD on Poultry. The layers of IWN × IWP cross of Anand centre recorded average annual egg production (up to 72 weeks of age) of 304.9 eggs with the highest individual production of 352 eggs. About 61% birds of this cross produced more than 300 eggs and about 6% produced more than 340 eggs at 72 weeks.



Layers of IWN × IWP cross of Anand centre recorded average annual production of 305 eggs

Broodstock development

Broodstock of filament barb, *Puntius filamentosus* (freshwater fish); cobia, *Rachycentron canadum*; pompano, *Trachynotus* sp; grouper, *Epinephelus tauvina*; and red snapper, *Lutjanus argentius* (marine fishes) were developed in captivity for breeding and seed production

Leghorn (IWH, IWI and IWK), showed genetic and phenotypic responses of egg production to 64 weeks of age as 0.59 and 0.15 eggs in IWH and 0.80 and 0.36 eggs in IWI, respectively, over last 5 generations. The phenotypic response of egg mass to 64 weeks of age was positive (385 g) in IWK. Backward elimination procedure could be used to predict annual egg production from part period egg production to 60 weeks of age in layer lines with more than 82% accuracy.

Poultry for meat: Synthetic broiler strains, viz. PB-1, PB-2, SDL, CSML and CSFL, were improved through intra-population selection for body weight at 5 weeks of age. At Bengaluru, the PB-2 line and PB-1 line were improved. Body

weight at 5 weeks of age increased by 155 g and 237 g in PB-2 and PB-1 populations, respectively, over previous generation. The body weight at 6 and 7 weeks of age was 1,500 g and 1,760 g in PB-2 and 1,568 g and 1,956 g in PB-1, respectively. The average genetic response for body weight at 5 weeks of age was 38.7 g/generation and the corresponding phenotypic response was 23.1 g. At GADVASU, Ludhiana centre S-33 generation of PB-2 and S-2 generation of PB-1 population at 5 weeks of age showed an improvement of 159 g in PB-1 over previous generation. The body weights of males were 1,492 and 1,980 g at 6 weeks and 1,856 and 2,005 g at 7 weeks of age in PB-2 and PB-1 population, respectively.

At the CARI, Izatnagar centre male (CSML) and female lines (CSFL) showed the phenotypic response of 5-week-body weight per generation as 19.0 and 21.9 g, and genetic response as 16.6 and 19.6 g, respectively. At PDP, Hyderabad, in S-19 generation of PB-1, body weight at 5 weeks of age was 906.8 g, which was improved by 22 g over the last generation on genetic scale. In S-18 generation of PB-2 line, the body weight at 5

Rural poultry

Four new centres for rural poultry production were added during the last part of the current year for developing location specific germplasm for rural poultry. The Agartala centre maintained and evaluated Tripura local black, CSML, CSFL and D08 variety (developed by PDP, Hyderabad) and produced 3 different types of crosses. The mean body weights of Tripura local black at 16 and 40 weeks of age were 822 and 1,444 g, respectively, and the egg production up to 40 weeks of age was 36.17 eggs. The body weight of D08 test cross at 12 weeks of age under backyard was 859 g.

At the Jabalpur centre G_0 generation of Kadaknath and Jabalpur colour line and G_3 generation of colour dwarf dam line were produced and evaluated up to 40 weeks of age. The body weights of Kadaknath \times Jabalpur colour line, Jabalpur colour line \times colour dwarf line and CSML \times Jabalpur colour line at 6 and 8 weeks of age were 274, 355 and 370 g, and 431, 600 and 590 g, respectively, under free-range condition.

At PDP, Hyderabad, C1 (Control broiler \times PD-3 Line), C2 (Pb2 line \times PD-3 Line), C3 (PD-4 line \times PD-3 Line), and C4 (PD-5 line \times PD-3 Line) were evaluated for rural and backyard poultry production along with Vanaraja and Gramapriya. The body weight and shank length of C2 at 6 weeks of age was the highest (713 g and 78.04 mm, respectively) among all the crosses. The body weights of C1, C2, C3, C4, Vanaraja and Gramapriya at 12 and 15 weeks of age varied between 838 and 1,926 g and 1,317 and 2,908 g, respectively. The body weight was the highest in C2 followed by Vanaraja, C1, Gramapriya, C3



Adult male of C1 cross



Kadaknath chicken



Adult male of C2 cross

weeks of age was 1,046.6 g and was improved by 42 g over the last generation. In G-8 generation of the control broiler, body weight at 5 weeks of age was 929.5 g.

Gramapriya backyard poultry strain: Under the collaborative project with SKUAST-K for improvement of backyard poultry in Kashmir valley, 1,429 birds of 5 weeks of age were distributed to farmers in the selected villages under backyard system. The body weights of male Gramapriya at 12 and 20 weeks of age were 1,119 and 1,394 g, respectively, while those of female birds were 784 and 1,018 g, respectively. The birds matured at 165 days of age. The Gramapriya was widely accepted by the farmers of Kashmir valley.

Fisheries

Mud crab farming: A technology package for nursery rearing and grow-out culture of hatchery-produced megalopa larva of *Scylla tranquebarica* was standardized. Rearing in soil-based open ponds with natural hideouts ensured better growth and survival. Besides artificial hideouts were more practical and viable choice in comparison to natural sea weed, without compromising on survival and growth. The grow-out culture trials of *S. tranquebarica* carried out in West Bengal yielded an average production of 1.12 tonnes/ha, and in Tamil Nadu, a production of 1.3 to 2.8 tonnes/ha in a culture period of 4 months.

SUCCESS STORY

Diagnosis of nodavirus and extra small virus

A quantitative real-time assay for the diagnosis of nodavirus (*MrNV*) and extra small virus (*XSV*) of *Macrobrachium rosenbergii* was developed and standardized by the CIFE, Mumbai. The test can be used for routine diagnosis of diseases as well as to screen the broodstock and larvae in selective breeding programme for specific pathogen-free stock development. This assay is the first of its kind developed in the country.

Resident time of antibiotic residues: Scampi (*Macrobrachium rosenbergii*) and Indian white prawn (*Fenneropenaeus indicus*) accumulated a level of 12.5 ppb of antibiotics (sulfamethoxazole and trimethoprim) after one month of feeding, which reached to 18 ppb after 70 days. After stopping administration of antibiotics, there was constant degradation of antibiotics in the meat and no traces could be detected on 25th day. Studies showed that animals can be harvested safely (free of antibiotic residue) on 25th day after the administration of antibiotics.

Off-season spawning

Off-season spawning in the Indian major carp *Cirrihinus mrigala* was achieved during February by manipulation of photoperiod and temperature.

Derivation of rough attenuated variants: Two rough attenuated variants were derived from smooth virulent *Aeromonas hydrophila* types maintained in the Fish Health Management Division, CIFA, Bhubaneswar, over a period of 8 years at 4°C. The variants were checked to be rough LPS type and attenuated since they neither produced any disease nor mortality in the injected fishes. Rather, the immunogenic potential of these variants remained unaltered as compared to parent smooth types. Fish immunized with these variants separately and upon cross challenge resisted the infection and mortality due to several *Aeromonas hydrophila* types (O11, O13, O14, O34) and virulent isolates. The virulence of these bacteria was also checked by their growth characteristics on Comassie Brilliant Blue (CBB) agar plates.

Improving sperm quality in captive broodstock of tiger shrimp: A management protocol to maintain male reproductive health/reproductive viability in hatchery systems was developed, which otherwise is a major bottleneck due to the degeneration of reproductive tract and subsequent drop in reproductive performance in commercial tiger shrimp (*Penaeus monodon*) seed

Successful breeding of rare fish species Haragi Meenu

Puntius pulchellus (locally called Haragi meenu in Karnataka), a threatened species of peninsular carp endemic to the Krishna river basin, was induced bred for the first time in 2009. Fingerlings collected from the Tunga river were acclimatized to aquaculture ponds and raised to adult size. Sexual dimorphism was observed in the adults only during the breeding season. The selected females and males were administered recommended intramuscular dosages of the synthetic hormone and pituitary glands extract (PGE) successively at an interval of 6 h, after which females were stripped and the eggs collected in a dry enamel bowl. Immediately after this, the milt from males was stripped directly on the eggs. After 15–20 minutes of fertilization, the eggs were washed and transferred to a modified glass jar type hatchery. The first larva hatched after 48 hr, laden with a heavy yolk sac. After six days, the larvae were capable of active swimming and were fed with plankton. The breeding of *Puntius pulchellus* assumes significance specifically in the context of raising a carp species diversification in aquaculture. Adult male of *P. pulchellus* showing pink papillomatous snout.

production in captivity. It was concluded that sperm quality can be maintained if the spermatophore is expelled manually as without manual expulsion of spermatophore, the mean sperm quality differed significantly between 0 day and 30th day (3.2×10^6 vs 0.1×10^6 /ml).

Spermatophore and sperm quality studied during different phases of moult cycles (post moult, inter moult and early pre-moult stages) revealed that the moult cycle has a strong influence on the quality of male gametes. Post-moult and inter moult stage males performed better than pre-moult and newly moulted shrimps.

On the basis of this information, maintenance of healthy/viable male broodstock in captive conditions in commercial hatcheries would be possible.

Epidemiology of iridovirus: Iridoviruses are one of the major threats for the aquaculture industry causing mortality in fishes. In India, iridovirus infections in fish have not been reported so far and the first case of mortality due to iridovirus was observed in a commercial seabass cage culture facility in Andhra Pradesh during summer 2008 when the salinity increased from 8 to 14 ppt and temperature from 28° to 32°C. A DNA based PCR assay for the detection of both symptomatic and asymptomatic iridovirus infection produced an amplicon of 250 bp or 1.2 kbp product with two different sets of primers. Surveys conducted in Kerala, Tamil Nadu, Andhra Pradesh, West Bengal and Puducherry revealed that sub-clinical iridovirus infection in fish is widely distributed among many species of brackishwater and marine fishes along the east coast of India. This is the first report describing the existence of iridovirus in clinical and sub-clinical form among farmed and wild marine/brackishwater fishes in India.

Diagnostics for viral nervous necrosis: Viral nervous necrosis (VNN) is caused by betanodavirus. Screening for VNN conducted in Kerala, Tamil Nadu, Andhra Pradesh, West Bengal and Puducherry during the year revealed that betanodavirus is widely distributed sub-clinically along the east coast of India in target species as well as in low value fishes. About 16% of the total analysed fishes (n=168) gave positive results for the virus by (nested) RT-PCR assay. Samples found positive with any of these primers were

further processed for confirmatory analysis. Electron microscopy of brain tissues from sub-clinically infected fish revealed multiple arrays of nodavirus like particles measuring around 35 nm in dimensions. Based on the sequence data, three primer sets were designed and are being used for the development of genome based diagnostics for betanodavirus in fishes.

Fish seed: Under ICAR Mega seed Project, seeds of Indian major carps (82.499 million), catfishes (0.909 million), ornamental fishes (0.688 million), shrimp (3.457 million), prawns (0.584 million), seabass (0.347 million), crabs (2.179 million) and molluscs and others (6.441 million) were produced during the year 2008–09.

Year-round seed production of *Lates calcarifer*: The technology for seed production of Asian seabass was developed by which its seed can be produced round the year. Successful spawnings and hatchings were observed even at 14–17 ppt (during November – December), indicating that seabass can reach maturity even in lower salinities and this is attributed to domestication and improved broodstock management protocols. A large number of natural spawnings were obtained without hormonal inducement. Out of 0.487 million fry, 0.2 million were obtained from December 2008 and January 2009, the period which is considered as off-season.

Larval rearing technology under controlled conditions, standardized by Central Institute of Research for Brackishwater, was validated. Survival rate of 58% was achieved in the larval rearing phase. This success indicated that hatcheries meant for shrimp/scampi and mudcrabs can be converted as seabass hatcheries with required modifications.

Reducing anti-nutritional factors in aquafeed: Electron beam irradiation method was devised to reduce antinutritional factors in plant-based aquafeed ingredients. The 8/12 MeV microtron delivering energetic electron @ 10 kGy is optimum for reducing tannin, HCN and phytic acid to the maximum level of 60% in soybean, rubber seed cake and cotton seed cake, which translates into higher weight gain and higher feed efficiency in fish. The technology offers a wide opportunity to replace the costly animal protein sources with low cost plant ingredients in fish feed. □

