Introduction
The bovine viral-diarrhoea virus (BVDV) is widespread in many countries and induces production losses in infected herds. Different strategies to control infection by the BVDV within a herd are available to farmers: either protection by vaccination, or strategies combining monitoring, screening and elimination of Persistently Infected (PI) animals with biosecurity actions (prevention of virus introduction into the herd and of transmission between animals in the herd). Strategies without vaccination (zoo-sanitary schemes) are generally preferred in areas where the risk of new introduction of the virus in a herd is lowered by collective programmes. The efficiency of control measures can be assessed ex-ante using epidemiological models. In the criteria of interest to evaluate the efficiency of a strategy, the ability to eliminate the virus in infected herds can be measured by the probability of and the time to clearance, and the extent of infection. Among the previously published by the probability of and the time to clearance, and the extent of infection. Among the previously published studies using epidemiological models, one concluded that the virus could be eliminated in most herds by the BVDV within a herd is cleared at time of bulk-milk antibody detection were excluded from this latter analysis. The extent of the infection in the herd context, the most probable remaining origin of virus introduction is the purchase of an immune dam carrying a PI foetus which cannot be detected by available tests. The virus introduction was simulated as the purchase of an immune heifer carrying a PI foetus, 20 days before calving. No virus reintroduction over time was simulated. Four scenarios representing four strategies were studied: (1) no other action, (2) prevention of contacts between animals of different groups of age, (3) test-and-cull of PI animals, and (4) combination of (2) and (3). The prevention of contacts between animals was modelled by setting transmission rates between different groups to zero. The test-and-cull consisted of monitoring the herd, and, in case of a positive result, screening for detecting and eliminating PI animals. Every 6 months, the antibody level in the bulk-milk was measured by an ELISA test. If the percentage inhibition was higher than 60% (corresponding to a prevalence of immune cows higher than 30%), a virus spread was assumed. Then, screening for PI animals was based on consecutive combined tests for antibody and virus detection, defined per category of animals, in order to mimic existing zoo-sanitary schemes. Specificity of antibody ELISA, antigen ELISA and PCR were set to 0.978, 0.99 and 0.99, and sensitivities to 0.969, 0.97 and 1, respectively.

The initial herd consisted of 38 cows, 13 bred heifers, 18 heifers before breeding and 3 calves, all of which were susceptible. The virus spread was simulated over 10 years. For each strategy, 600 replications were run.

Effects of strategies on virus elimination considered three categories of criteria:
- The interval between virus introduction in the herd and detection of infection from bulk-milk antibodies
- The occurrence of and time to virus clearance
- The extent of the infection in the herd

The total number of contaminated animals in the herd during 10 years was calculated for each replication.

Results
Monitoring bulk-milk antibodies every 6 months allowed the detection of BVDV infection within one year after virus introduction in most cases when there were contacts between groups of animals of different ages, but could also result in very late detection (Table 1). In the latter case, the herd was often already cleared from the virus when seroconversion was evidenced.
Clearance occurred earlier with test-and-cull than with do-nothing, but persistence was further reduced by prevention of contacts in the herd (Fig. 1). Extent of infection was only slightly reduced by test-and-cull, whereas prevention of contacts resulted in a drop in the number of contaminated animals (Fig. 2). Test-and-cull mainly reduced time to clearance (Fig. 3 and 4), but, in case of prevention of contacts, for only 7% replications.

**Discussion**

After a purchase of a non-PI dam carrying a PI foetus, a zoo-sanitary scheme based on test-and-cull generally reduces persistence of BVDV in a herd, but this effect may be largely delayed due to late detection of infection. If late detected, the herd is likely to be free of PI animals at cows’ seroconversion. In Bretagne, PI animals were found in only 28% of seroconverting herds (Joly, unpublished data), suggesting that virus introduction may often have occurred more than one year before. Prevention of contacts between groups appears to be very efficient in limiting both duration and extent of infection, as compared to test-and-cull. Nevertheless, in many commercial herds, total prevention of contacts (assumed here) may not be possible. BVDV infection in herds where virus transmission between groups is only partly prevented could be further investigated.

**References**