AN EMERGING THREAT: BTV-3 IN EUROPE

The emergence of BTV-8 in northern Europe has represented a significant shift in the epidemiology of the bluetongue virus. In this article, Sioned Timothy BVSc MSc MRCVS, technical services manager - livestock at Boehringer Ingelheim Animal Health, discusses the spread of the virus, including the incursion of other BTV serotypes, BTV-1, BTV-4, and latterly BTV-3, disease transmission factors, and control strategies to prevent its advance

Bluetongue (BT) is an arthropod-borne viral disease that affects ruminants and camelids. It is not zoonotic. BT is caused by bluetongue virus (BTV), an orbivirus. Over 30 serotypes of the virus have been identified, each having distinct clinical and epidemiological profiles. Serotypes 1-24 are classified as notifiable diseases by the World Organisation for Animal Health (WOAH). Outbreaks of the disease can cause significant losses to the livestock industry through morbidity, mortality, production losses, and trade restrictions (Maclachlan *et al*, 2015).

First recognised in Africa over 200 years ago, BTV is now endemic across large parts of the world, but recent decades have seen marked changes in its global distribution. The emergence and rapid spread of BTV-8 in northern Europe in 2006 represented a significant shift in the epidemiology of the disease. BTV had not been reported in such a northerly location, nor had its spread by the Palearctic *Culicoides* species present in this region previously been documented. In addition, this strain of BTV-8 showed a high level of virulence in sheep, but also caused disease in cattle, wild ruminants, and camelids (Maclachlan, 2009). Since then, BTV outbreaks have continued to occur in Northern mainland Europe, associated with BTV-8 re-emergence and the incursion of other BTV serotypes including BTV-1 and BTV-4, and latterly BTV-3. BTV has never been detected in Ireland.

The emergence of BTV-3 in Northern Europe

Clinical cases of BT were detected in sheep in the Netherlands in early September 2023 and diagnostic testing identified BTV-3 infection as the cause. Phylogenetic analysis of the strain demonstrated a high level of genetic similarity to virus previously isolated in Sardinia and Tunisia, but it has not been possible to determine how the virus arrived in the Netherlands (Holwerda *et al*, 2023). BTV-3 strains circulating in North Africa and Southern Europe produce relatively mild clinical disease in small ruminants, while in the Netherlands infection was associated with severe clinical disease and rapid spread (Holwerda *et al*, 2023).

During 2024 BTV-3 case numbers continued to increase within the Netherlands and more widely, with the virus spreading to countries within mainland Europe – including Germany, France, Belgium, Denmark, Spain, and Portugal – and to the UK.

Clinical disease and its impact

The clinical signs (Figures 1 and 2) associated with BTV infection result from endothelial damage caused by the virus which results in oedema, haemorrhage, and coagulopathy (Maclachlan *et al*, 2009).

Figure 1: Crusting and ulceration of the lips and soft palate in a sheep.

Clinical disease is typically most severe in sheep and clinical signs include fever, conjunctivitis, congestion of nasal and oral mucosa, and oedema of the face and lips. Cases may progress to show severe facial oedema and erosions, ulcerations, and haemorrhages of the muzzle and tongue, and some will develop cyanosis of the tongue. In the most severe cases, pharyngeal and oesophageal paresis and respiratory distress are observed. Coronitis can occur eight to 14 days after infection, resulting in lameness and recumbency, and in some cases, shedding of the hoof capsule (Holwerda *et al*, 2023; Maclachlan *et al*, 2009; van den Brink *et al*, 2024).

During the 2023 outbreak in the Netherlands, the average morbidity across affected sheep farms was observed to be 7.5 per cent (Range 0.9 per cent-14.2 per cent), and the case fatality rate in clinically-affected animals was 74.8 per cent (van den Brink *et al*, 2024). Farms that reported clinical cases of BT had mortality rates 15.1 times higher than those in unaffected flocks (Santman-Berends *et al*, 2024).

The clinical signs observed in cattle are typically less severe and include fever, lethargy, conjunctivitis, nasal discharge, erosion and crusting of the lips and nose, ulceration and erosions of the oral mucosa, oedema of the nose, inflammation of the coronary band, and superficial necrosis of the teats (van den Brink *et al*, 2024).

In the Netherlands, the mortality in BTV-3 infected suckler herds was found to be 2.62 times higher than in herds in unaffected areas between September and December 2023 (van den Brink *et al*, 2025). In dairy herds, mortality in cows over two years old in infected herds was 1.71 times higher during this period, with the risk of death increasing in the

Figure 2: Oedema and crusting of the muzzle and nose in a cow.

90 days post calving, and increases in youngstock deaths, premature calvings, and abortions were also identified (van den Brink *et al*, 2025).

In farms that reported clinical cases of BTV-3, milk production fell by an average of 1kg per cow from the time of reporting and for the following nine weeks in comparison to the previous year (Royal GD, 2024).

The impact of BTV-3 following infection of cows during pregnancy has also been recognised. A recent report from the East of England described reduced fertility, abortion, stillbirth, and the birth of 'dummy' calves with congenital brain lesions in January 2025 on three suckler farms associated with transplacental BTV-3 infection (Swinson *et al*, 2025). Between five and 17 per cent of calves born were affected, and on one farm 20 per cent of the breeding animals were found to be barren.

In addition to clinical disease, infected cattle may harbour high levels of virus in their blood for a prolonged period, potentially acting as an important reservoir of infection for the *Culicoides* midge (van den Brink *et al*, 2024).

Symptomatic treatment of clinically-affected animals has been attempted and is focused on alleviating pain and inflammation and treatment of secondary infections, in addition to supportive nursing care. However, during the outbreak in the Netherlands, the poor long-term prognosis for severely-affected sheep and severe sequelae of disease, meant that early euthanasia was increasingly practiced on welfare grounds (Lovatt *et al*, 2024).

Disease transmission and the *Culicoides* vector

The spread of BTV requires the presence of a competent *Culicoides* vector (see Figure 3), although virus can also, less commonly, be transferred from animal to animal via needles, semen, and embryos, and some serotypes can also undergo vertical transmission from dam to foetus, further complicating control (Maclachlan *et al*, 2015).

Transmission of BTV typically occurs during the warmer months, between May and October, when these midges are most active. In mild climatic zones such as Ireland, insect numbers will increase in late spring and early summer, peak in late summer or early autumn, and fall dramatically as temperatures drop. During this seasonal vector low period, the risk of disease transmission is low.

The virus can overwinter in a number of ways, including the survival of small numbers of infected *Culicoides* midges, prolonged viraemia within a ruminant host, and as a result of transplacental transmission and the birth of infected lambs or calves.

A minimum temperature of 11-13°C is required for replication of the virus within the *Culicoides* midge (Carpenter *et al*, 2011) and the rate of replication increases at higher temperatures, shortening the extrinsic incubation period. This means that the risk of infection increases as temperatures rise.

Adult biting midges are short-lived and only a few individuals survive longer than 10 to 20 days. During this time, females will feed on hosts multiple times, and once infected with BTV, will remain infected for life. A single bite from an infected midge can be enough to spread disease.

BTV can be spread by infected *Culicoides* over both short

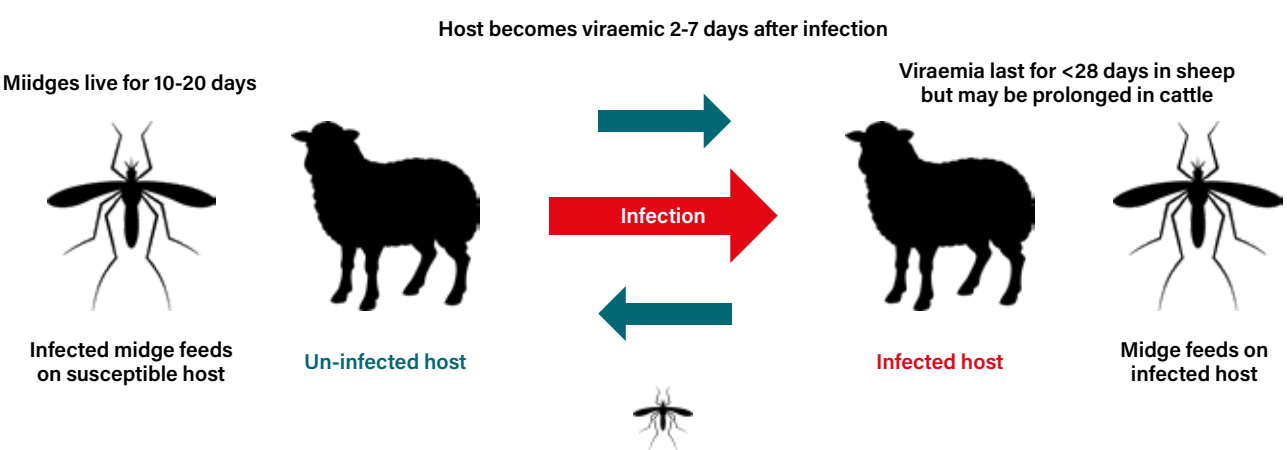

Figure 3: Transmission of BTV-3 by the Culicoides midge vector.

and long distances. At wind speeds of less than 2 metres per second (m/s), and at low altitude, midges can fly unaided at speeds of around 0.5m/s in all directions (Elbers *et al*, 2015). Individuals can travel distances of up to 5km in just a few days. The presence of livestock may influence the speed and extent of their dispersal, driving local spread of infection (Elbers *et al*, 2015).

Long-range dispersal of *Culicoides* occurs at high altitudes when midges are carried on the wind (Elbers *et al*, 2015). Further distances can be achieved over water due to reduced air turbulence and there are many reported cases of BTV being spread long-distance (>100km) in this way, including the incursion of BTV-8 into the UK from Belgium in 2007 (Elbers *et al*, 2015). There is also potential for transport of infected *Culicoides* during the movement of livestock and other goods.

Climate change is thought to be playing an important role in increasing the risk of BT outbreaks in Northern Europe. For example, the range of *Culicoides* imicola, the major vector of BTV in Africa and the Mediterranean basin, is expanding northwards and may come to overlap with the range of Palearctic species of *Culicoides*, creating new disease dynamics (Hudson *et al* 2023). In addition to this, it is probable that increasing temperatures will lengthen the seasonal activity period of the *Culicoides*, leading to an increased risk of BTV overwintering, accelerated larval development, and increased virus replication rates within the midge vector (Elbers *et al*, 2015).

Surveillance

Vector surveillance plays an important role in assessing the risk of BTV transmission during an outbreak. Using traps to collect *Culicoides* at sentinel sites allows vector abundance to be monitored. This information is also used to determine the onset and end of the seasonal vector low period, when the risk of transmission of arboviral infections, such as BTV and Schmallenberg Virus (SBV) is reduced (Carpenter *et al*, 2009). Although Ireland has remained free of BTV to date, studies to assess abundance and species composition have demonstrated the presence of *Culicoides* species, such as *C. obsoletus*, that are the putative vectors of BTV, as well as other viruses of veterinary importance (Collins *et al,* 2018). Targeted active surveillance of livestock for infection or exposure to BTV provides a means of demonstrating freedom from BTV, but should also provide early detection of disease incursions.

Control strategies

Effective control strategies are essential to prevent ongoing spread of the virus and mitigate the financial costs associated with an outbreak of BTV. Movement restrictions, enhanced surveillance, and vaccination are identified as key actions in controlling the spread of disease.

Vaccination plays a significant role in the control of BTV by reducing infection and disease in naïve hosts and, in doing so, reducing onward transmission and curtailing the spread of the virus.

Vaccination has proven to be a valuable tool in controlling, and in some instances eradicating, BTV (Savini *et al*, 2021). Following the emergence of BTV-8 in the UK in 2007, it had spread to 125 holdings by early 2008. But, in May 2008, a voluntary vaccination programme was launched using inactivated BTV-8 vaccine, and no further cases of transmission within the UK was recorded that year. Statistical modelling to assess the factors that had contributed to this successful outcome indicated that case numbers would have increased significantly in 2008 in the absence of vaccination (Szmaragd *et al*, 2010). The model showed that achieving a high level of vaccination (>80 per cent of farms) in previously-affected areas is most important for controlling the spread of BTV, but that vaccination beyond these areas, to create a buffer zone and prevent escape, is also key. The study also highlighted the importance of vaccinating early to ensure immunity is established ahead of disease challenge.

Inactivated vaccines are predominantly used in the control of BTV infections due to their improved safety profile in comparison to live attenuated vaccines, which have been shown to have potential for reversion to virulence and to cross the placenta (Maclachlan *et al*, 2015). In time, novel vaccine technologies may provide opportunities for improved control. (Savini *et al*, 2021).

Vaccination or natural exposure to BTV induces high levels of neutralising antibodies against the VP2 outer capsid protein, which confer protection against (re)infection. However, these antibodies are serotype-specific, and do not cross-protect against other serotypes (Mayo *et al*, 2017).

In response to the emergence of this highly pathogenic strain of BTV-3, vaccines were rapidly developed and, in 2024, three inactivated BTV-3 vaccines were made available under the emergency use provisions and were used widely across Europe.

Like other control strategies, vaccination carries a cost, but this should be evaluated in the context of the significant level of mortality, morbidity, and production loss documented during outbreaks of BTV-3 (van den Brink *et al*, 2024), and specific farm-level risk factors.

Conclusions

The outbreak of BTV-3 highlights the risk that unexpected incursions of emerging diseases can pose to the livestock industry. Although Ireland has no history of BTV incursion, its proximity to Northern France and the UK where infection has become widespread, together with the changing epidemiology of the disease itself, means the risk should not be overlooked. Vets and farmers play an important part in monitoring for disease and should be aware of, and vigilant for, the clinical signs of BTV and report any suspected cases.

**Photographs courtesy of Mark van der Heijden.*

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READER QUESTIONS AND ANSWERS

1. WHICH OF THE FOLLOWING ARE NOT CLINICAL SIGNS TYPICALLY ASSOCIATED WITH BTV-3 INFECTION?

A. Ulceration of the lips and palate
B. Neurologic signs and ataxia
C. Coronitis and lameness
D. Conjunctivitis

2. WHAT WAS THE FATALITY RATE REPORTED IN SHEEP CLINICALLY-AFFECTED BY BTV-3 INFECTION IN THE NETHERLANDS?

A. 22.7 per cent
B. 54.3 per cent
C. 74.8 per cent
D. 97.6 per cent

3. CLINICALLY AFFECTED FARMS IN THE NETHERLANDS REPORTED AN AVERAGE REDUCTION IN MILK YIELD OF 1KG/COW/DAY. HOW LONG WAS THIS REDUCTION SUSTAINED FOR?

A. One week
B. Two weeks
C. Five weeks
D. Nine weeks

4. WHAT BTV CAPSID PROTEIN INDUCES A SEROTYPE-SPECIFIC NEUTRALISING ANTIBODY RESPONSE IN AN INFECTED ANIMAL?

A. VP2
B. VP3
C. VP5
D. VP7

5. WHAT IS THE MINIMUM TEMPERATURE RANGE REQUIRED FOR REPLICATION OF THE VIRUS WITHIN THE CULICOIDES MIDGE?

A. 0-4° C
B. 11-13° C
C. 21-23° C
D. 27-30° C

ANSWERS: 1B; 2C; 3D; 4A; 5B.