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Preliminary survey on the impact of Schmallenberg virus on sheep flocks in south of Belgium

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Summary

Between late February and May 2012, a preliminary anonym survey was conducted among sheep farmers in south of Belgium in order to contribute to future estimations of the economic losses caused by Schmallenberg virus (SBV). Based on clinical signs consistent with SBV infection, this survey involved 13 meat sheep flocks considered as positive flocks with subsequent SBV detection by RT-qPCR (PF; total of 961 animals) and 13 meat sheep flocks considered as negative flocks (NF; total of 331 animals). These preliminary results indicated several significant characteristics that were more present in PF than in NF. These include an increased rate of abortions (6.7% in PF *vs.* 3.2% in NF), of lambs born at term but presenting malformations (10.1% in PF *vs.* 2.0% in NF) and of dystocia (10.1% in PF *vs.* 3.4% in NF). Lamb mortality during the first week of life was reported more frequently in PF (8 of 13 PF, 61.5%) than in NF (1 of 13 NF, 7.7%). In PF, the observed prolificacy rate was two-fold lower (93%) than expected (186%).

The implementation of a survey at larger scale, including a high number of breeders, is necessary to allow a more detailed analysis of the SBV impact in the sheep sector.

Keywords: Schmallenberg virus; Sheep; Epidemiology; Survey; Livestock impacts; Economic impacts.

Running title: Impact of Schmallenberg virus on sheep flocks

Introduction

A new virus of the family *Bunyaviridae*, genus *Orthobunyavirus* has recently emerged in Europe. It has been provisionally named Schmallenberg virus (SBV), following the location of its first identification in Germany (Hoffmann et al. 2012). SBV was initially diagnosed by RTqPCR, while serological tests have been developed more recently. The SBV is not a reportable disease to the World Organization for Animal Health (*Office International des Epizooties* - OIE). Under-reporting and under-detection are prejudicial to an accurate estimation of the impact of the disease caused by SBV on livestock industry (Martinelle et al., 2012). Therefore gathering farmers' estimations in matters of apparent reproductive and clinical consequences of SBV infection could help to more accurately delineate the effects of the disease on sheep flocks.

Materials and methods

In 2010, a total of 1,223 sheep flocks (with professional incomes) were registered in Walloon Region (South of Belgium), including 48,000 animals (DGARNE, 2012).

Five hundred Walloon breeders are identified as members of the inter-professional federation of goats and sheep in the south of Belgium (*Fédération Interprofessionnelle Caprine et Ovine Wallonne*, FICOW). Among these, 367 members hold meat sheep flocks.

A solicitation to participate to an anonymous survey was sent by the Journal "*Filière ovine et caprine*" to all members of the FICOW (Vandiest, 2012). The purpose of this survey was to gather first field clinical observations, including any disorders encountered during the lambing period.

This survey took place in south of Belgium between late February and May 2012. The time period of the reported lesions corresponds to the period from May 2011 until February 2012.

A SBV-positive flock (PF) was defined as a flock for which at least one suspected animal with clinical signs consistent with SBV infection was submitted to the laboratory with subsequent positive RT-qPCR result (USDA, 2012). A SBV-negative flock (NF) was defined as a flock for which no clinical signs consistent with SBV infection were observed. Attempts of SBV detection were performed using the brain stem and cerebellum of the foetuses (Cay et al., 2012). Recommendations issued in the note accompanying the survey explicitly specified that all flocks could participate, regardless of their SBV status (PF or NF).

The comparison of prolificacy rates and the comparison of the number of breeding females in PF and NF was realized using a paired non-parametric Wilcoxon signed-rank test and a non-parametric Mann–Whitney test, respectively (the hypothesis of normality of the distributions could not be verified). The frequency of clinical signs has been assessed with Pearson's chi-squared test or a Fisher's exact test depending of conditions of use (Petrie and Watson, 2006).

Results and discussion

Responding farmers were divided in two groups, depending on the detection of SBV (confirmed by RT-qPCR) in their herds: 13 SBV positive meat sheep flocks (PF; total of 961 animals) and 13 SBV negative meat sheep flocks (NF; total of 331 animals). In total, it represents a sample of 5% (*i.e.* 26/500) of all members of the FICOW or 7% (*i.e.* 26/367) of meat sheep breeders that are members of the FICOW. This rate represents the lower limit of what is expected for this type of investigation (Dufour, 1994). The farmers who participated in the survey are from all provinces of the Walloon Region (south of Belgium) (**Figure 1**). In addition, farmers who responded reported variable levels of losses in their flocks (with first report at January, 2012). In this condition the presence of bias (*i.e.* over representation of severely affected flocks) had probably a limited impact.

The numbers and characteristics of sheep considered in this survey are listed in **Table 1**. Different sheep breeds used for meat production were represented with a predominance of Texel.

The observed and the expected prolificacy rates for each flock was estimated considering the breed and aggregated by group (PF and NF) (Babo, 2000; Laignel et Benoit, 2005). No difference occurred in NF between the observed and the expected values (Wilcoxon signed-rank test; $P = 0.12$) but for PF, the aggregated observed prolificacy rate was significantly

lower (93%) than the aggregated expected prolificacy rate (186%) (Wilcoxon signed-rank test; P = 0.01). This represents a two-fold reduction of the expected prolificacy. No significant difference was observed between PF and NF in term of the starting date and duration of the first lambing period. However, it appears that the number of breeding females was significantly higher in PF (average of 41, median of 23, minimum of 5 and maximum of 154) compared to NF (average of 11, median of 8, minimum of 2 and maximum of 26) (Mann-Whitney test; P = 0.01) (**Figure 2**). This finding should be in accordance with the hypothesis of a wide exposition of flocks to the SBV and a higher probability to detect SBV in flock with an increased number of breeding females.

Clinical signs encountered in the two groups were compared. It appeared that the observation frequency of stiff joints was significantly higher in PF (11/13) compared to NF (2/13) (Fisher's exact test, P = 0.045). The abortion rate (Chi 2 test, P = 0.04) and the number of stillborn or lambs dying right after being born (Chi 2 test, P <0.001) were significantly higher in PF compared to NF (**Table 2**). Reported Schmallenberg virus-associated lesions were similar to those attributed to SBV in previous reports (Herder et al., 2012; van Maanen et al., 2012).

The flock dystocia rate was significantly higher (mean 18.5%, median 13%, minimum 0% and maximum 66.7%) in PF compared to NF (mean 6.4%, median 0%, minimum 0% and maximum 83% in only one flock of small size) (Fisher's exact test, P <0.001). In addition, lamb mortality during the first week of life was reported more frequently by farmers in PF (8 of 13 PF, 61.5%) than in NF (1 of 13 NF, 7.7%) (Fisher's exact test, P = 0.01).

A symptomatic treatment (antibiotics and / or anti-inflammatory) was administered occasionally after dystocia in 10 out of 13 PF. The average duration of treatment was 3.5 days (minimum 2 and maximum 6 days). The mean percentage of treated animals per flock was 18.5% (minimum 0% and maximum 67%). The cost of treatment per animal averaged € 50.4 (median 50, minimum 8 and maximum € 124.5).

The number of lambs born at term but deformed was significantly different between PF and NF (Chi 2 = 16.4; P < 0.001) and reached 10% in PF compared to 2% in NF. This percentage is not significantly different from that observed in France and obtained with a greater number of PF, *i.e*. 11.7% (Chi 2 = 1.33, P = 0.25) (Dominguez et al., 2012).

Schmallenberg virus affection does not figure among reportable diseases list (Royal Order, 20.11.2009); therefore, it is hard to achieve a representative view of the real situation because of the risk of underreporting (Martinelle et al., 2012). Moreover, the detection by RTqPCR is also limited by the short length of the viraemia, ranging from 2 to 5 days in experimentally infected adult cattle (Hoffmann et al., 2012). In addition, organ distribution of SBV-RNA in malformed newborns, especially in lambs, is an important component to take into account to allow an increase of the sensitivity of the diagnostic strategy as demonstrated by Bilk and collaborators (2012). Furthermore in a recent study, Hahn et al. (2012) found that only 12 % of RT-qPCR positive calves were also positive by *in situ* hybridization, most likely because of a lower sensitivity of the latter technique, unsuitable to detect SBV mRNA in tissues with low SBV mRNA copy number and/or reduced viral load. In addition, in another study, Maanen et al. (2012) reported that only 42 % ELISA positive fetuses were also positive by RT-qPCR. This percentage was even lower for animals without malformations and provides support to the superiority of ELISA as a reliable and sensitive diagnostic test. Therefore it is likely that some negative flocks may have been misestimated. Consequently, the zootechnical impact of SBV infection might be slightly different than these preliminary results suggest.

In contrast to bluetongue disease, the emerging disease caused by SBV was characterized by a very large and fast geographic spreading (Beer et al., 2012). In sheep, in acute phase of the disease, no particular alteration was observed in adults. This fact participates to the silent spreading of the disease. This is supported by a recent EFSA report, which highlights the underreporting of SBV cases (European Food Safety Authority, 2012). Retrospective epidemiologic studies would bring to light useful data to clarify more accurately spatio-temporal circumstances of SBV emergence in Belgium.

This preliminary survey allowed a better characterization of SBV-related economic losses in meat sheep flocks and will allow refining questionnaires for a larger scale use.

Conclusion

Measuring the extent of the episode of SBV on livestock and zootechnical performances requires further research efforts. As these results are preliminary and exploratory, an implementation of the survey on a larger scale, including a larger number of farmers is needed to allow a more detailed analysis of the impact of SBV in the sheep sector.

Acknowledgments

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204 **Tables and Figures caption**

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206 **Table 1.** Characteristics of sheep being monitored by the participating sheep farmers

Sheep category	Number of animals present in sheep flocks with		Total
	PF	NF	
Meat sheep less than one year	422	153	575
Meat sheep over one year	496	167	663
Breeding rams	43	11	54
Total	961	331	1292

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208 Legend: PF, SBV positive flocks; NF, SBV negative flocks. Status of the flocks was assigned
209 based on RT-qPCR results.

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215 **Table 2.** Comparison of reproductive and clinical parameters

Variable	PF (N = 13)	NF (N = 13)
Number of pregnant primiparous ewes	22	26
Number pregnant multiparous ewes	505	119
Number of abortions	35 (6.7%)	8 (3.2%)
Number of clinically healthy	366 (70.0%)	216 (85.4%)
Number of stillborn or died at birth lambs	69 (13.2%)	24 (9.5%)
Number of lambs born at term but malformed	53 (10.1%)	5 (2.0%)

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217 Legend: PF, SBV positive flocks; NF, SBV negative flocks. Status of the flocks was assigned
218 based on RT-qPCR results.
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221 **Figure 1.** Localization of the flocks originating from the south of Belgium included in the
222 survey in relation to their SBV status

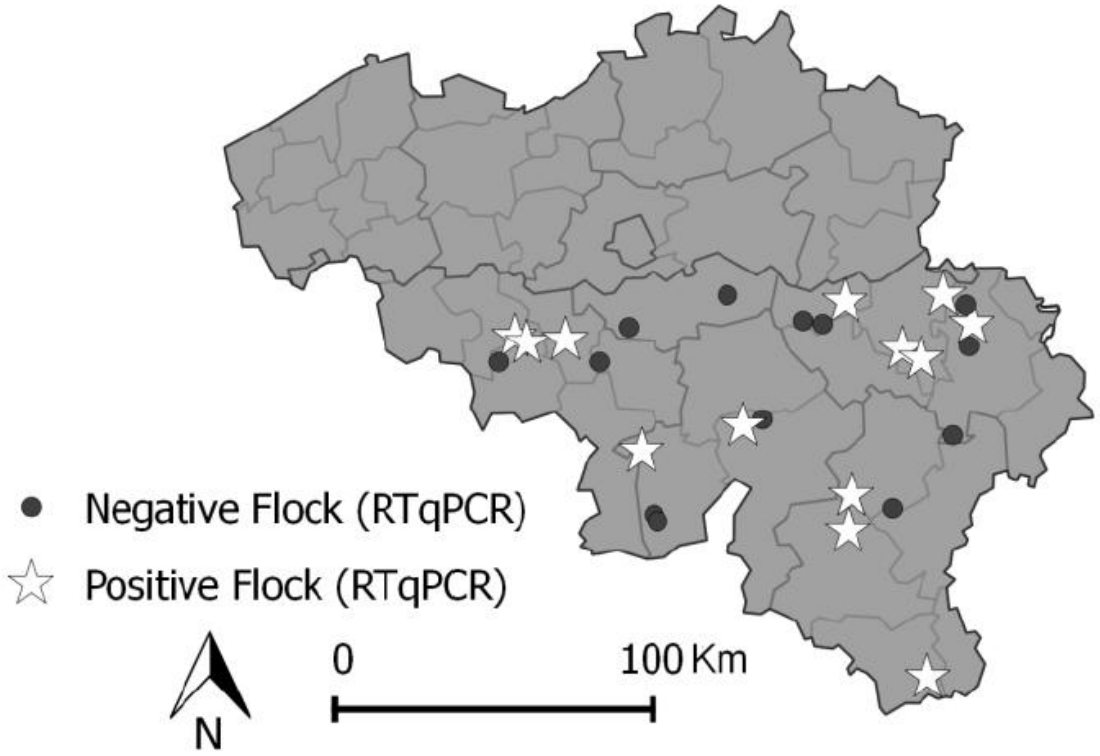

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Figure 2. Number of breeding females in function of SBV flock status

Legend: PF, SBV positive flocks; NF, SBV negative flocks. Status of the flocks was assessed based on RTqPCR results.