Effect of an oxygen barrier film on composition and losses from the upper layers of grass/clover crops ensiled in farm-scale bunker silos

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Introduction. The upper layer of silage in bunker silos covered with conventional polyethylene film can deteriorate if oxygen ingress occurs by permeation through the top polyethylene film during the storage period. Borreani et al. (2007) found, with untreated maize silage stored in a split single farm-scale bunker silo under either oxygen barrier (OB) film or under conventional film (C), that loss of DM from bags buried in the upper 40 cm layer was 37% to 10% for OB and C, respectively (P=0.04). The reduction in loss of DM was attributed to a reduction in mould count and was also associated with a reduction in butyric acid spore count (Borreani and Tabacco, 2008). The two studies described here were undertaken with grass/clover crops ensiled in farm-scale bunker silos to compare the effect on silage preservation of a silo sealing system based on OB film compared to a conventional sealing system based on polyethylene film.

Materials and methods. Wilted crops of mixed grass and red clover were harvested with inoculation and ensiled in farm-scale bunker silos. One half of the top surface of each silo was covered lengthways with OB film ("Silostop", S), 45μm thickness, on which was placed a woven polypropylene net. The other half was covered with a single layer of conventional white-on-black plastic film (150μm, C). The conventional film was protected by car tyres. Divisions between sheets and the edges of the silo were weighed down with 20 kg bags of woven polypropylene containing gravel. After 120-day storage periods, four samples of the silage were taken at random to a depth of 30 cm from the top surface of both halves of each silo for analysis. Single pooled sub-samples per treatment were subjected to microbial analysis. In Experiment 1, four gauze cloth bags were filled with the crop during the silo filling period and placed within the top 30 cm of each side of the silo to calculate DM loss. In Experiment 2, losses were calculated by weighing the harvested crop as it was ensiled and by weighing all the material removed from the silo during the feed-out period.

Results and discussion. In both experiments pH and concentrations of NH_3-N and butyric acid were lower, whilst concentrations of lactic and acetic acids were higher for silage stored under S than for silage under C ($P<0.05$, Table 1). The higher lactic acid in silage stored under S probably reflected restricted development during the storage period of *Clostridium tyrobutyricum* Table 2). Losses of DM from bags buried in the top 30 cm of the silo in Experiment 1 averaged 5.0% and 2.5% for C and S, respectively. The total quantity of silage fresh weight discarded in Experiment 2 from the top 30 cm layer because it was judged to be inedible by livestock was 1.7 tonnes (0.1%) and 100 tonnes (5.9% of the total 1700 tonnes fresh weight ensiled) for S and C, respectively. The high mould count found in the crop at harvest in Experiment 2 (Table 2) may have been a contributory factor to the poor fermentation quality of the material stored under C. Counts of yeasts, moulds and clostridial spores were numerically lower in both experiments for silages stored under S than under C, in agreement with Borreani and Tabacco (2008). These

results illustrate the importance of placing an effective protective layer on top of conventional polyethylene film to restrict oxygen permeation as Bernades et al. (2009) also found, or alternatively to use an oxygen barrier film.

References

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Table 1 Composition of the upper 30cm layers of silages covered with either conventional polyethylene (C) or oxygen barrier film (S).

	Experiment 1			***Experiment 2***		
Type of covering	C	S	s.e.d.	C	S	s.e.d.
DM (g/kg fresh weight)	310	294	8.86	207	221	9.93
pH	4.5	4.2	0.08	8.5	3.7	1.00
Crude protein (g/kg DM	151	156	2.25	110	142	5.68
NH_3-N (g/kg total N)	59	48	3.40	145	69	3.57
Lactic acid (g/kg DM)	44.0	94.0	5.75	0.60	17.1	6.30
Acetic acid (g/kg DM)	17.5	19.5	0.89	3.10	12.6	1.72
Butyric acid (g/kg DM)	6.20	0.45	0.51	6.10	0.0	0.54

Table 2 Microbiological characteristics (cfu/g) of the crops at harvest upper layer of the upper 30 cm layers of silages covered with either conventional polyethylene (C) or oxygen barrier film (S).

	Experiment 1			**Experiment 2**		
	Crop at harvest	Silage		Crop at harvest	Silage	
Type of covering		C	S		C	S
Yeasts	4.5×10^4	1.3×10^4	6.8×10^2	4×10^4	2.2×10^7	2×10^5
Moulds	6.3×10^5	6.2×10^3	4.4×10^2	8.85×10^8	8×10^4	4×10^2
C.tyrobutyricum vegetative cells	-	-	-	ND	1.95×10^6	ND
C. tyrobutyricum spores	ND	1.8×10^4	6.8×10^2	ND	1×10^2	ND

ND = Not detected