Silo sealing strategies preventing dry matter and quality losses

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Introduction Silage is the product of the fermentation of agricultural crops, under anaerobic conditions. The silage aims to conserve the maximum amount of dry mass, nutrients and energy of the culture, to feed the animals (Kung, 2013). As the fermentation process results in losses of dry mass and also nutritional quality, silage must be made in the best way to minimize such losses (Muck, 1988), and ensure efficiency and professionalization of the forage conservation process (Reis et al., 2014). The control of anaerobiosis is essential, however the contact of the mass with the oxygen is inevitable during some phases that comprise the silage process (ensiling, storage and removal), triggering the proliferation of undesirable microorganisms that develop using energy reserves present in the forage (Amaral, 2011). Thus, the objective of this work was to evaluate different strategies of silo sealing in order to reduce the losses of dry mass and quality of the silage.

Material and Methods The study was conducted in the city of Castro, Paraná, Brazil. Three treatments were evaluated: black and white plastic sheets (BW), transparent polyvinyl film under the BW (PFBW) and cover with soil over the BW sheet (SBW). The experimental design was a randomized block with eight replicates. It was used 24 boxes with a capacity of 48 liters each, 30 kg of forage and density of 620 kg FM m^{-3}. Corn plants were harvested, chopped and compacted in the boxes, that were settled at the top layer of a commercial silo and then covered according to the treatment. At the time of silage, a sample of each box was collected for analysis of initial dry matter (DM). After 146 days the silo was opened and the boxes were taken for the evaluations. A sample of each box was collected for pH analysis through a potentiometer (Silva & Queiroz, 2006), dry matter (AOAC, 1998) and *in vitro* digestibility of dry matter - IVDMD (Tilley e Terry, 1963). The aerobic stability was evaluated by measuring the temperature of the boxes with skewer thermometer for seven days. The loss of fresh and dry mass was calculated by the weight difference between initial and final forage. The economic result was calculated by the difference between the treatments for dry matter losses and the costs of sealing method. Statistical analysis was performed with the SAS 9.4 program. When the F test was significant, the averages were compared by the Tukey test at the 5% probability level.

Results and Discussion Dry matter, dry mass loss, pH and IVDMD data are presented in Table 1. There was no statistical difference between these variables. The values of DM, dry matter losses, pH and IVDMD were 37.38%, 10.61%, 4.36 and 63.24%, respectively. PFBW coverage reduced losses by 0.77% and the SBW in 3.76% when compared to just BW. The breakdown of aerobic stability occurred with 18 hours for the BW, 26 hours for PFBW and 28 hours for SBW (Figure 1). The best economic result was verified in the SBW with a balance R$ 0.46 m^{-2}, whereas the PFBW coverage resulted in a balance of R$ -0.29 m^{-2} in relation to the cover with BW. The polyvinyl film used in this work was not totally oxygen barrier, but it is the most used by farmers of that region due the price being cheaper compared to the polyamide film.

Conclusions Sealing strategies did not affected dry matter losses and quality parameters in corn silage. Better Aerobic stability was found with the combined use of Black/White sheet plus polyvinyl plastic sheet or soil coverage.

Table 1 Dry Matter (DM), dry mass losses, pH and IVDMD according to silo coverage strategies.

Treatment	Final DM (%)	Dry mass losses (%)	pH	IVDMD (%)
BW	37.82	12.13	4.41	63.00
PFBW	37.83	11.35	4.39	62.27
SBW	36.49	8.36	4.30	64.44
Mean	37.38	10.61	4.36	63.24
P value	0.3999	0.1545	0.1258	0.0757
CV (%)	5.9	4.30	2.50	2.79

Means do not differ by Tukey test at 5% probability.

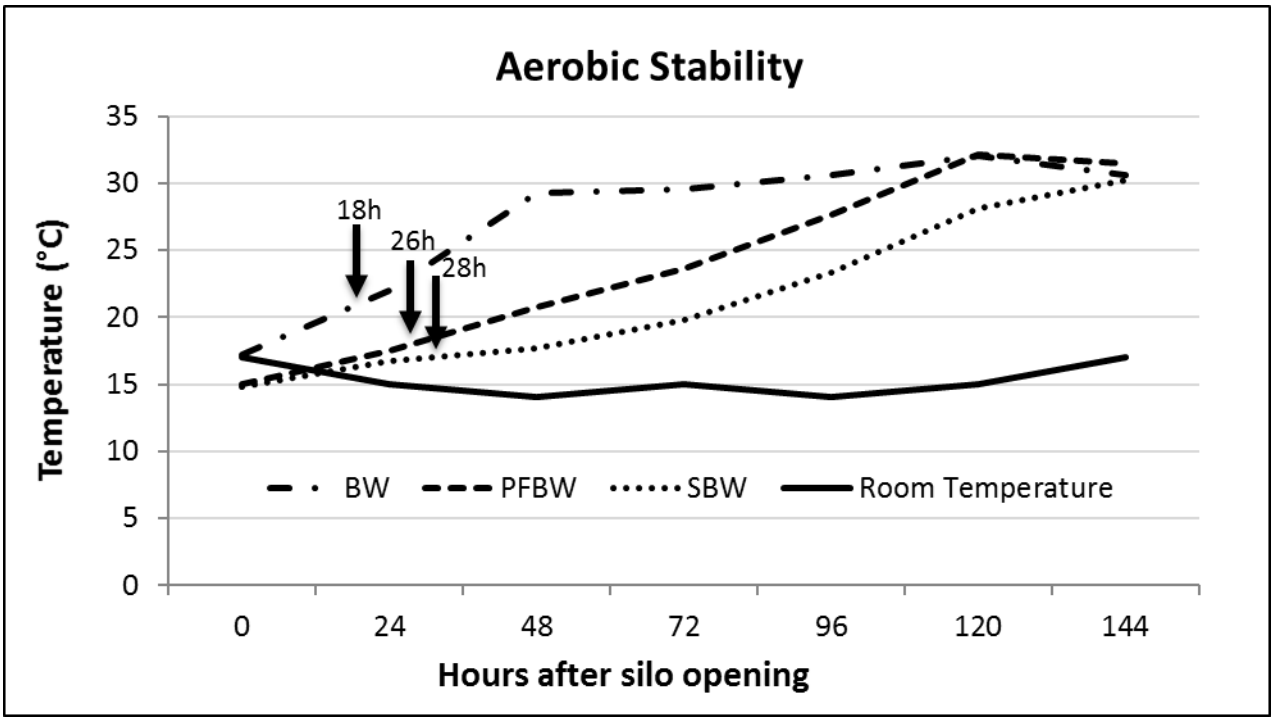

Figure 1 Aerobic stability according to silo sealing strategies.