Factors affecting bag silo densities and losses

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Introduction Bag silos (polyethylene tubes, 30 to 90 m length, 2.4 to 3.7 m diameter, 0.22 mm thick) are used on approximately one-third of the dairy farms in the U.S.A. for making silage, and the level of adoption is increasing rapidly. Unfortunately, almost no research data have been published on these types of silos. Our objective was to measure densities and losses in bag silos at three farms, looking for causes of variation in both.

Materials and methods Bag silos made on three research farms over the course of two years were monitored at filling and emptying. These consisted largely of lucerne and whole-crop maize silages. All loads of forage entering the bags were weighed and sampled. Average density was calculated based on bag length and nominal bag diameter. At emptying, the weight of all silage removed from a bag was recorded. Any spoiled silage not fed was weighed, sampled and specifically identified on the emptying log. A grab sample from the face of each silo was taken periodically, one per filling load. Factors influencing density and losses were determined through data analysis using a combination of the CORR, GLM, and STEPWISE procedures in SAS®.

Results Over two years, 47 bag silos were made at the three farms, 23 of lucerne, 23 of whole-crop maize and 1 of red clover. Density ranged from 160 to 280 kg dry matter (DM)/m^3. Density increased as DM content increased (Figure 1). The operator and how the bagging machine was set were important factors affecting density. The same bagging machine (Kelly-Ryan, KR) was used at the Arlington (Arl) and West Madison (WM) farms, and Arl consistently got higher densities. The Prairie du Sac (PDS) farm had higher densities the second year after training from a manufacturer's representative. Density declined with longer particle size (Fig. 2). Kernel processing in maize reduced density at PDS where there was a planned comparison.

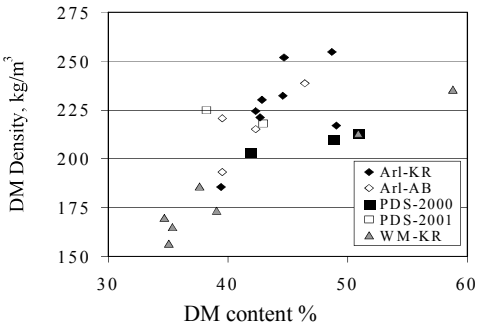

Figure 1 Dry matter density in hay crop bag silos as affected by dry matter content, farm (Arl, PDS, WM), and bagging machine (Ag-Bag, AB; KR)

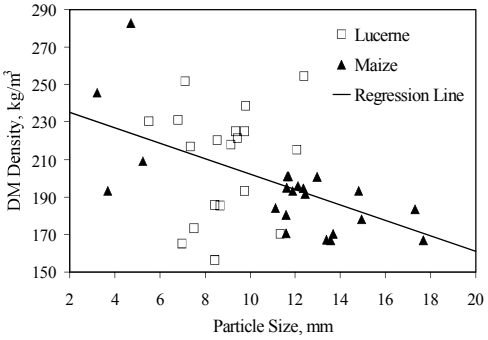

Figure 2 Dry matter density in bag silos as affected by average particle size at ensiling

Dry matter losses were measured on 39 of the bag silos and ranged from 0 to 40%. Average DM losses were 9.2% invisible plus uncollected losses and 5.4% spoilage losses for a total loss of 14.6%. Six silos had excessive spoilage losses (>15%) due to damaged plastic or overly dry silage (>40% DM) being fed out in warm weather. In contrast, 11 silos had no spoiled silage, and 15 bags had less than 5% spoilage loss, representing bags with spoilage largely at the ends. Invisible losses were reduced in high porosity silages (where spoilage losses were exacerbated), greater in warm weather, and affected by emptying procedures (reduced at WM where bag silos were emptied in 2 to 3 one-day periods as opposed to daily removal for cattle at PDS and Arl). Spoilage losses in bags without damaged plastic were greater in dry, porous silages, from emptying silos in warm weather, and at lower feed out rates. Both invisible and spoilage losses were not affected by crop or bagging machine.

Conclusions These results indicate that low DM losses (<10%) are regularly achievable in bag silos. However, deviations from good management (harvesting between 30 and 40% DM, operating the bagging machine to get a smooth bag of high density, monitoring routinely for and patching holes, and feeding out at a minimum of 300 mm/d) can result in substantial (>25%) losses. Because higher losses occur during warm weather, silage from the best preserved bags should be reserved for summer use.