Effect of silo management factors on aerobic stability and extent of spoilage in farm maize silages

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The aerobic deterioration of silages

- DM losses (various authors since 1964; McDonald et al., 1991)
- Reduction in animal performance (Withlock et al., 2000)
- Risk for animal health due to mycotoxins and biogenic amines (Woolford, 1990; Wilkinson, 1999)
- *Listeria* and other pathogens (Fenlon and Wilson, 1991)
- Clostridia spore outgrowth (Vissers et al., 2007; Tabacco et al., 2009)
- *Bacillus* and *Paenibacillus* spores (Te Giffel et al., 2002)
What is the health status of the silage during consumption?

Visible
- Spoiled with visible mould

Invisible
- Spoiled with yeast or *Acetobacter* spp. development
- Increase in silage temperature
- Well conserved silage
- High feeding value
Aim to identify the extent of aerobic deterioration in farm silos.

- Invisible spoiled areas
- Visible moulded areas
- Well conserved silage
- Line of increased temperature due to microbial activity
Yeast count and silage temperature at the silo face

Yeast count

Visible moulded areas

Temperature
Aims

• to quantify the extent of aerobic deterioration of maize silages on commercial farms in Northern Italy
• to define good management practices that should be applied as the basis for safe silage production
Materials and Methods

- six years (2005-2010) of data collection in 107 farms breeding Italian Friesian cows
- winter and summer maize silage sampling
- representative samples from silage core, peripheral areas and visible moulded spots (if present)
- silage analyses for pH, lactic acid, VFA, yeast and mould
Materials and Methods

- measure of linear feed-out rate of the working face
- measure of temperatures at various depths into the working face
- measure of the extension of the visible moulded areas on the silo feed-out face
Extent of mouldy spoilage in farm maize silages in Northern Italy

Winter season
- More 10%: 29%
- 2-10% spoiled: 42%

Summer season
- More 10%: 46%
- 2-10% spoiled: 10%
- Less 2% spoiled: 44%
DM losses and mould count in maize silage at farm level

![Graph showing the relationship between DM losses (%) and mould count (log CFU/g silage). The graph includes a trend line with an R² value of 0.8629.](image-url)
Removal rates from bunkers and piles

Measured in meters per week ranged from 0.32 to 2.69 m in summer from 0.24 to 3.15 m in winter
Silo face visibly moulded in relation with feed-out rate:

WINTER CONSUMPTION

Mouldy areas below 2%

Weekly feed-out rate from the silo face (m) vs. Silo face visibly moulded (%) graph.
Silo face visibly moulded in relation with feed-out rate:

**SUMMER CONSUMPTION**

Mouldy areas below 2%

Weekly feed-out rate from the silo face (m)
Some further considerations

Weekly removal rate from the silo face (m)

Silo face visibly moulded (%)

- Minimum feed-out rate
- Good silo management practices!

- Summer consumption
- Winter consumption
Strategies to prevent aerobic deterioration at farm level

- Packing down fresh forage when filling the silo
- Oxygen barrier films to cover silage
- Weigh down shoulder and top sheets
- Additives and inoculum types
Type of plastic cover: Oxygen barrier films
(temperature profile)

Barrier film (120 μm)
PE film (150 μm)

Maize silage: summer consumption
18 cm/day = 1.26 m/wk

See Poster no. 66 (Borreani and Tabacco)
Weigh down shoulder and top sheets

Gravel (150 kg/m$^2$)  Tyres (30 kg/m$^2$)

Maize silage:
Summer consumption
15 cm/day = 1.05 m/wk
Silo wall and packing density effect

Maize silage: summer consumption

17 cm/day = 1.19 m/wk
## Seasonal recommended feed-out rates (m/week) in dairy areas around the world

<table>
<thead>
<tr>
<th>Location</th>
<th>Latitude</th>
<th>Winter</th>
<th>Summer</th>
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<td>Israel</td>
<td>31°N</td>
<td>1.40</td>
<td>2.10</td>
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</tbody>
</table>

*Sources: Visset et al., 2007; Schroeder, 2004; Muck and Pitt, 1993; Berger and Bolsen, 2006; Weinberg, 2003.*
Recommended silage feed-out rates in relation with environmental temperatures

![Graph showing recommended feed-out rates vs seasonal mean temperature]

- Present survey
- International data

**Equation:**

\[ R^2 = 0.84 \]
In conclusion

• This study on maize silages, underlines the importance of coupling high feed-out rates with careful silo management in order to control aerobic deterioration

• Defining the correct size of silos at farm level is the main factor that could prevent aerobic spoilage

• The environmental temperature seems to be the driving factor in sizing silos for different areas and seasons
Thank you for your attention!