Compaction and particle size distribution of maize as affected by dry matter, chop length and intensity of kernel processing
Structure

• Introduction and objective

• Material and methods

• Results and diskussion

• Conclusion
Introduction

Factors affecting losses associated with the aerobic stability of silage (Pahlow and Muck, 2009)

Thermographic image obtained after 5 days of open surface (60L bucket with insulation) (based on Jungbluth et al. 2016)
Objective of the tests

Determine the effect of Chop length (3-29mm) on Crop compaction

Dry matter (29-43%) on Particle length distribution

Kernel processing different processors (US HD, Scherer) and differential speed

CSPS, silage quality and aerobic stability
Test Location & Field

- Futterkamp:
  - State owned test facility in northern Germany
  - 35 ha of corn
  - Dairy facility with 180 cows

Test field:
- Approx. 14 ha of corn variety (LG 30211, SZ210)
- Yield: 55 to 60 t/ha
- Harvest at 4 stages of maturity 9/15/2016-10/5/2016
- DM at first harvest 29-30%, and at last harvest 39-43%
**Methods**

**Testdesign**

<table>
<thead>
<tr>
<th></th>
<th>15&lt;sup&gt;th&lt;/sup&gt; September</th>
<th>Harvest time</th>
<th>5&lt;sup&gt;th&lt;/sup&gt; October</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>KP 40% d. speed, gap 1mm US HD, Scherer</td>
<td>chop length</td>
<td>KP 40% d. speed, gap 1mm US HD, Scherer</td>
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<tr>
<td></td>
<td>3/5/ 8/11/14/17/ 20/23/26/29 mm</td>
<td></td>
<td>3/5/ 8/11/14/17/ 20/23/26/29 mm</td>
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<tr>
<td>B</td>
<td>KP 40% d. speed, gap 1mm US HD, Scherer</td>
<td>chop length</td>
<td>KP 40% d. speed, gap 1mm US HD, Scherer</td>
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<tr>
<td>C</td>
<td>KP 40% d. speed, gap 1mm US HD, Scherer</td>
<td>chop length</td>
<td>KP 40% d. speed, gap 1mm US HD, Scherer</td>
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<td></td>
<td>3/5/ 8/11/14/17/ 20/23/26/29 mm</td>
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<tr>
<td>D</td>
<td>KP 40% d. speed, gap 1mm US HD, Scherer</td>
<td>chop length</td>
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+ test at 50% d. speed with both kernel processors
Procedure of crop handling in the test (every test variant)

Maize maturity A-D

6 skips of 60l are filled by the chopper

transport

compacted in buckets

samples are stored in vacuum bags and 1,5l glasses
Test to estimate the crop compaction under constant conditions (n=3)

- Compaction in 120l bucket (pressure 0,25 mpa)
- Filling in 4 layers of 10 kg crop mass
- Measuring of crop volume
Estimation of mass percent in 7 size ranges (n=3)

Filling of 100 g dried silage crop

5 cycles of 3 sec. sieving

Weighing of all fractions

Electric sieve machine (mod. Leurs 2006)

Round hole sieves in Polypropylen frame

Particle fractions  (<3/ <6/<10/<15/<20/<25/>25 mm)
Results

DM of maize silage crop in the test variants at four stages of maturity (A-D)

Chop length and kernel processor

<table>
<thead>
<tr>
<th>Point of Harvest</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chop length &amp; Kernel processor</td>
<td>HD 8</td>
<td>SC 8</td>
<td>HD 17</td>
<td>SC 17</td>
</tr>
<tr>
<td>HD 23</td>
<td>SC 23</td>
<td>HD 29</td>
<td>SC 29</td>
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</table>

DM in %

20 days
DM density at four stages of maturity and chop length from 3 up to 29mm (n=6)
DM density versus chop length and crop DM (n=6)

target value according to Honig

DM density in kg/m³

DM in %

3mm
8mm
14mm
20mm
26mm

A
B
C
D
Particle length distribution according to chop length (5-29mm) kernel processor (N= reversed sawtooth, S= reversed sawtooth with spiral groove) at differential speed of 40% and 50% (point of harvest C 34-36% DM)
Diskussion

Gas flow through a sample of maize dependent on crop density
(35 % TM Δ P 0,3 Pa mod. HONIG, 1987)

- Rising density
- Decrease of gas flow
Compaction of maize (sketched model)

uncompacted crop  300 bis 350 kg FM m$^{-3}$
porosity 70-75%

Crop compaction works by shifting particles against each other and plastic deformation of leaf and stem pieces in order to fill most of the por volume
Conclusion

• Crop compaction was clearly affected by the adjusted chop length.
• Density decreased from 5mm to 17mm c.l. about 12%.
• Later stages of maturity with higher crop DM lead to a rising DM density.
  But the increase was lower than the rising target values.
• Longer chop length increased the mass percent of bigger leaf and stem particles.
• The processing of kernel was only little affected.
• High DM affected higher proportion of small particles <6 and <3 mm.
• Effects of different kernel processors on frey out of the stem and leaf pieces could not be found by the sieving tests.
Thank You for Your attention!