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

XVIII ISC 2018

XVIII International Silage Conference
24-26 July 2018 Bonn, Germany

Landwirtschafts-kammer Schleswig-Holstein
Johannes Thaysen

Landwirtschaftskammer Nordrhein-Westfalen
Heinz-Günter Gerighausen

LKS LABOR
Wolfram Richardt

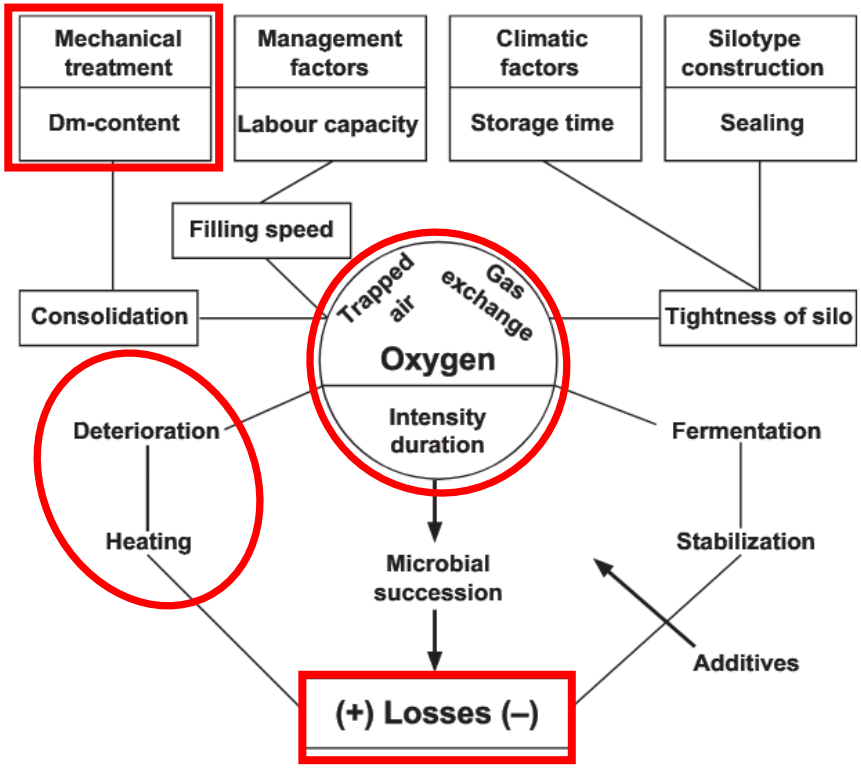
JOHN DEERE
Klaus Kellner,
Alexander Even

Christian Maack
Institute of Agricultural Engineering
University of Bonn

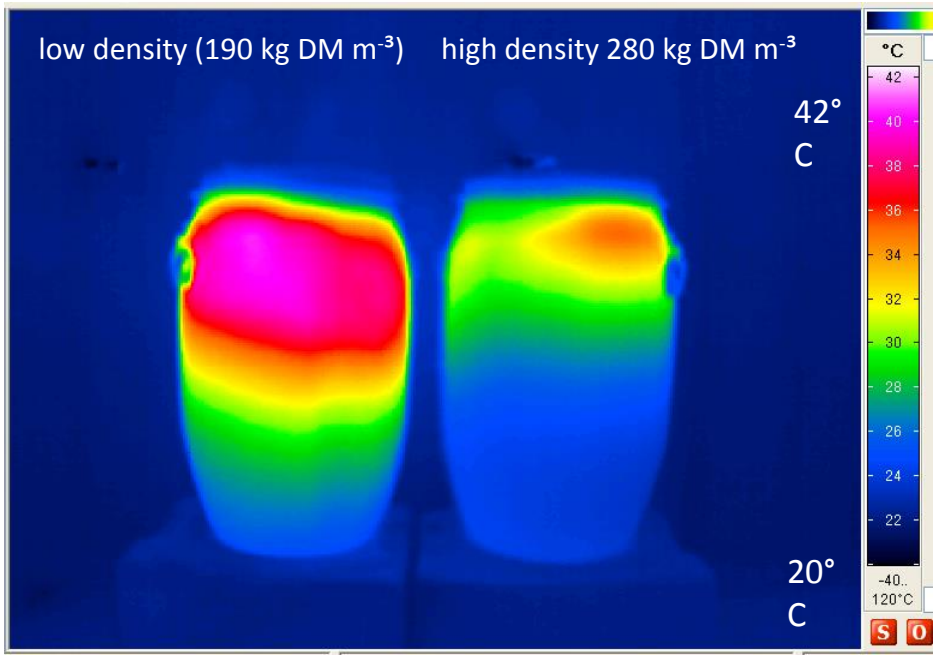
Structure

- **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)

Dry matter (29-43%)

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

on

Crop compaction

Particle length distribution

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

15th September — Harvest time — 5th October

A	B	C	D
KP 40% d. speed, gap 1mm US HD, Scherer	KP 40% d. speed, gap 1mm US HD, Scherer	KP 40% d. speed, gap 1mm US HD, Scherer	KP 40% d. speed, gap 1mm US HD, Scherer
chop length 3/5/ 8/11/14/17/ 20/23/26/29 mm	chop length 3/5/ 8/11/14/17/ 20/23/26/29 mm	chop length 3/5/ 8/11/14/17/ 20/23/26/29 mm + test at 50% d. speed with both kernel processors	chop length 3/5/ 8/11/14/17/ 20/23/26/29 mm

Procedure of crop handling in the test (every test variant)

Maize maturity A-D

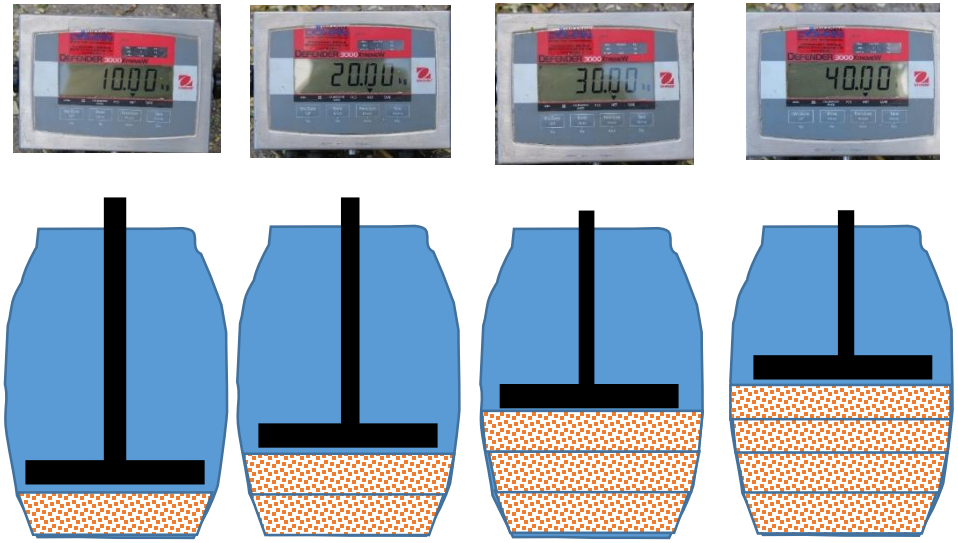
6 skips of 60l are filled by the chopper

transport

compacted in buckets

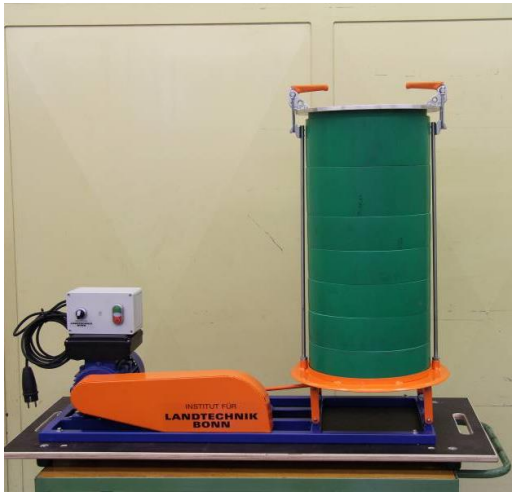
samples are stored in vacuum bags and 1,5l glasses

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)



Electric sieve machine (mod. Leurs 2006)

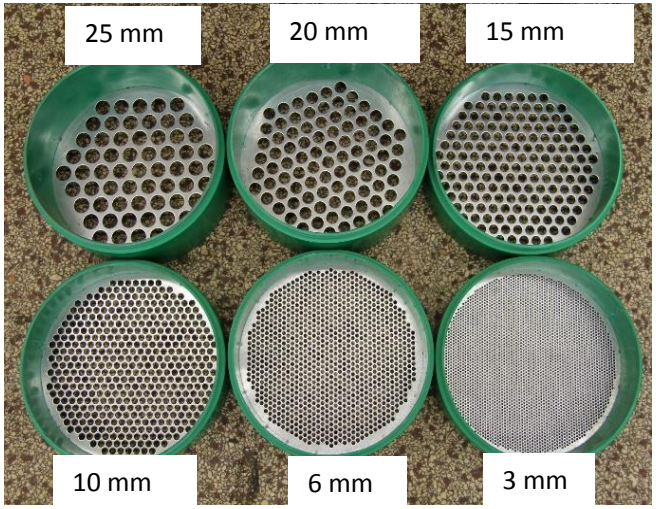
Filling of 100 g dried silage crop

▼

5 cycles of 3 sec. sieving

▼

Weighing of all fractions

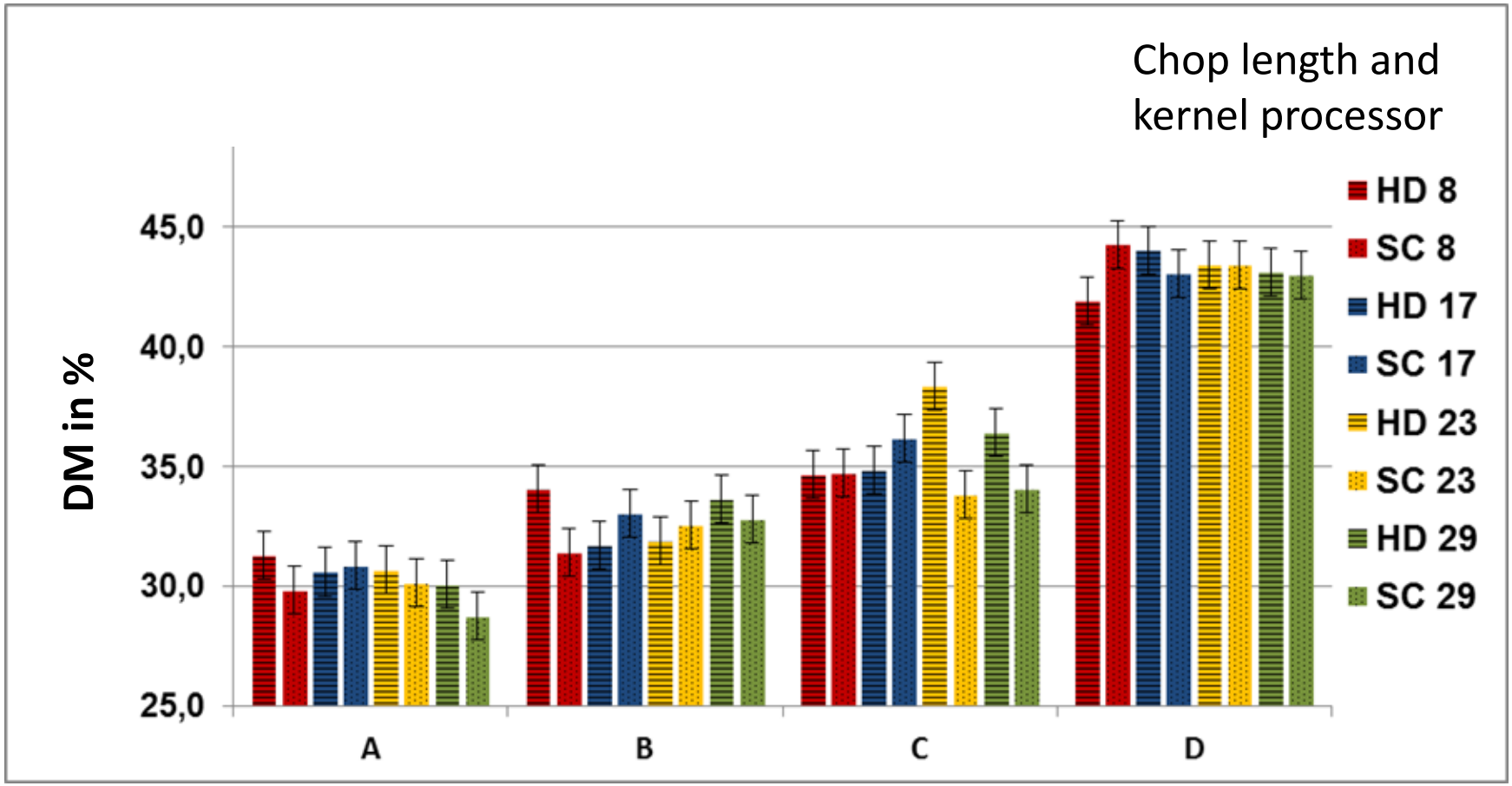


Round hole sieves in Polypropylen frame

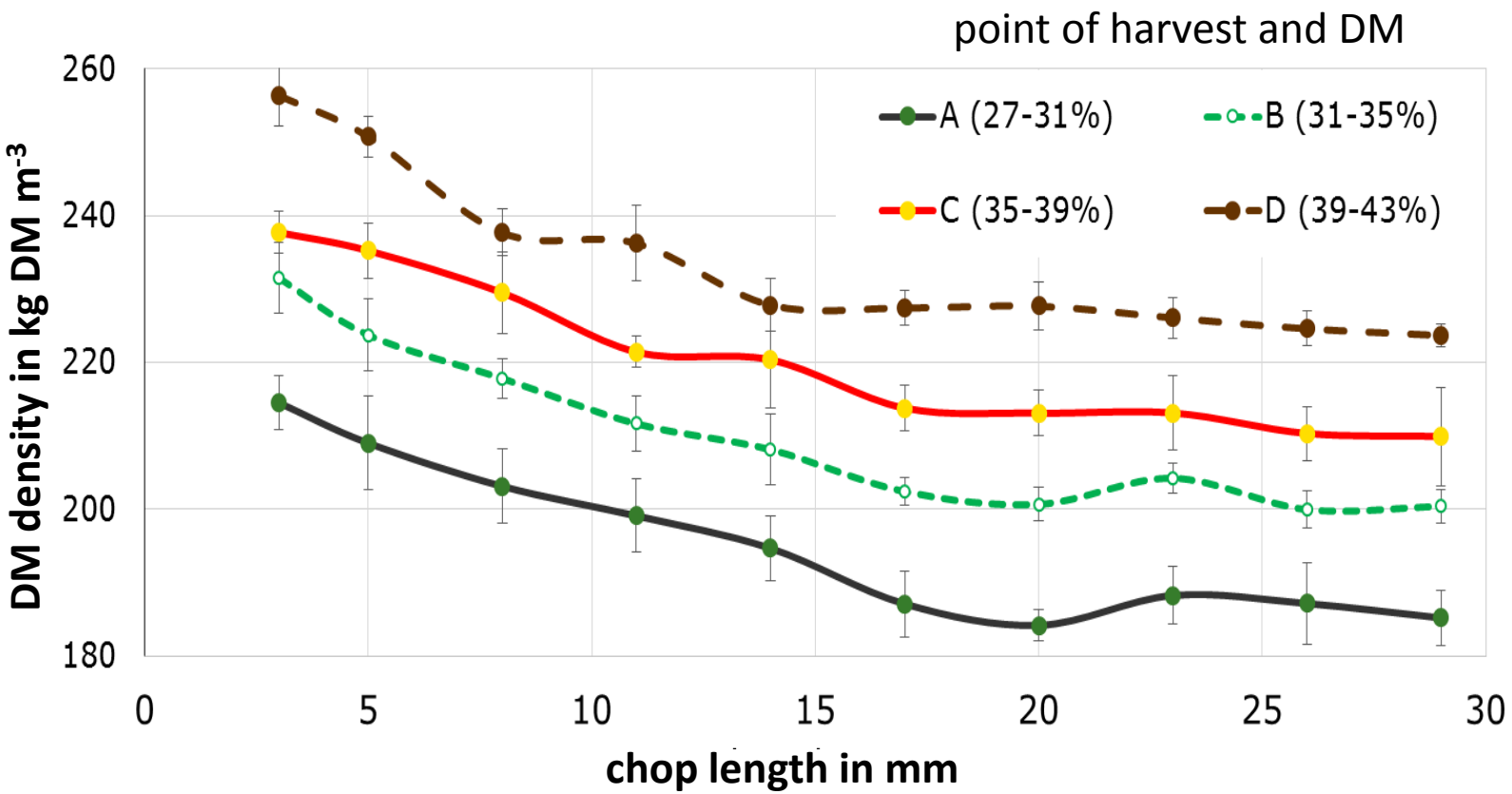
Particle fractions (<3/ <6/<10/<15/<20/<25/>25 mm)

Results

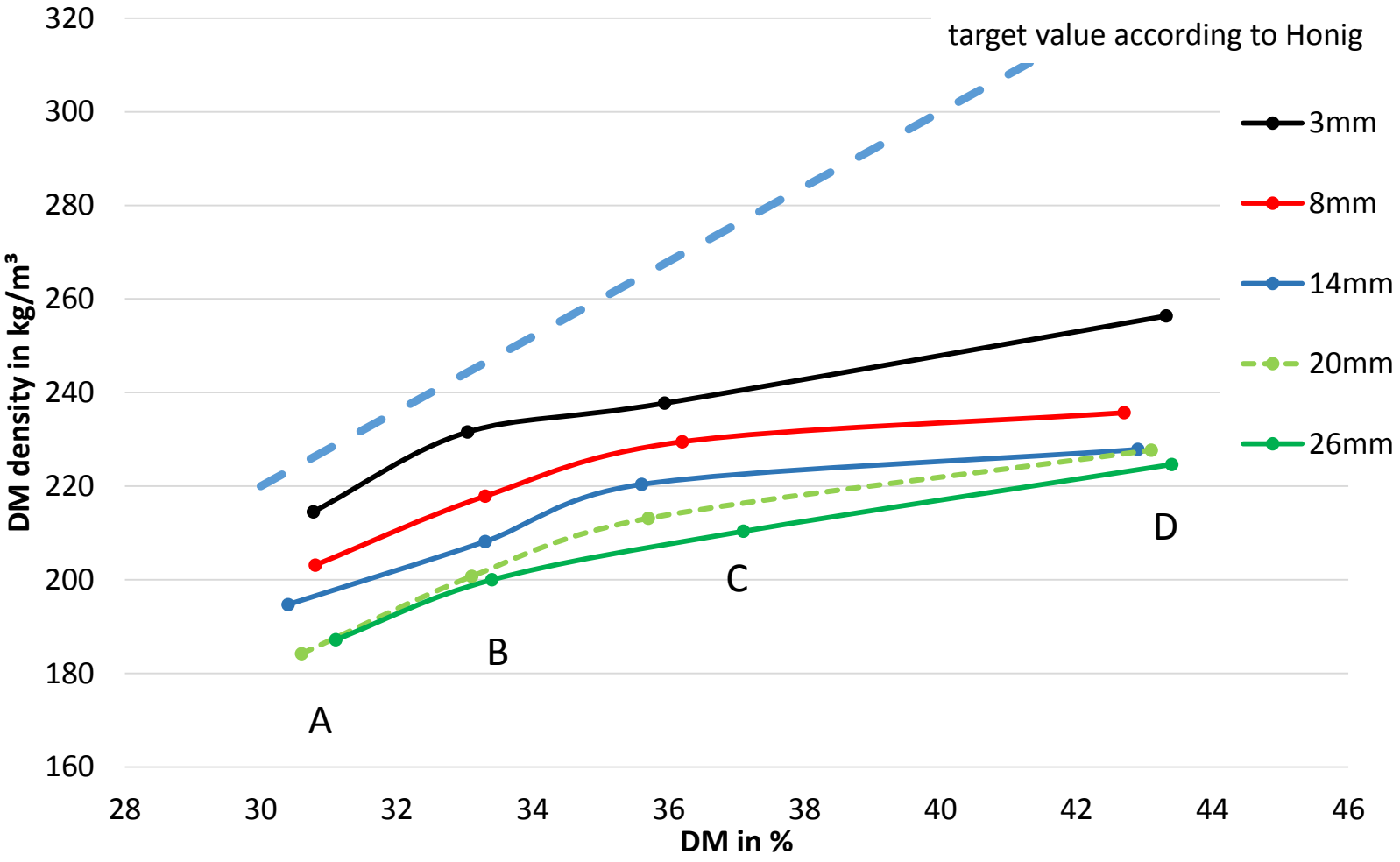
DM of maize silage crop in the test variants at four stages of maturity (A-D)



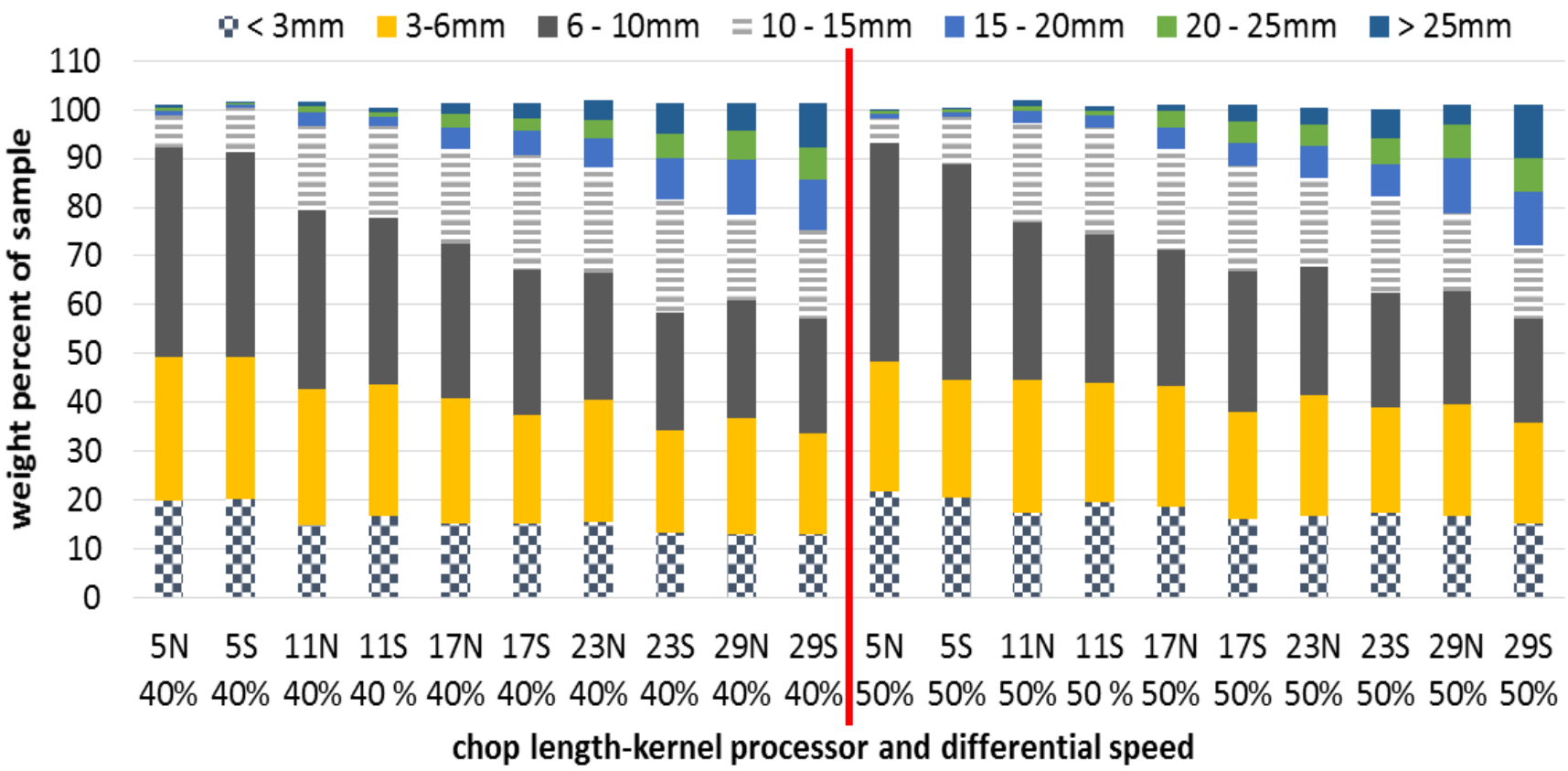
DM density at four stages of maturity and chop length from 3 up to 29mm (n=6)



DM density versus chop length and crop DM (n=6)

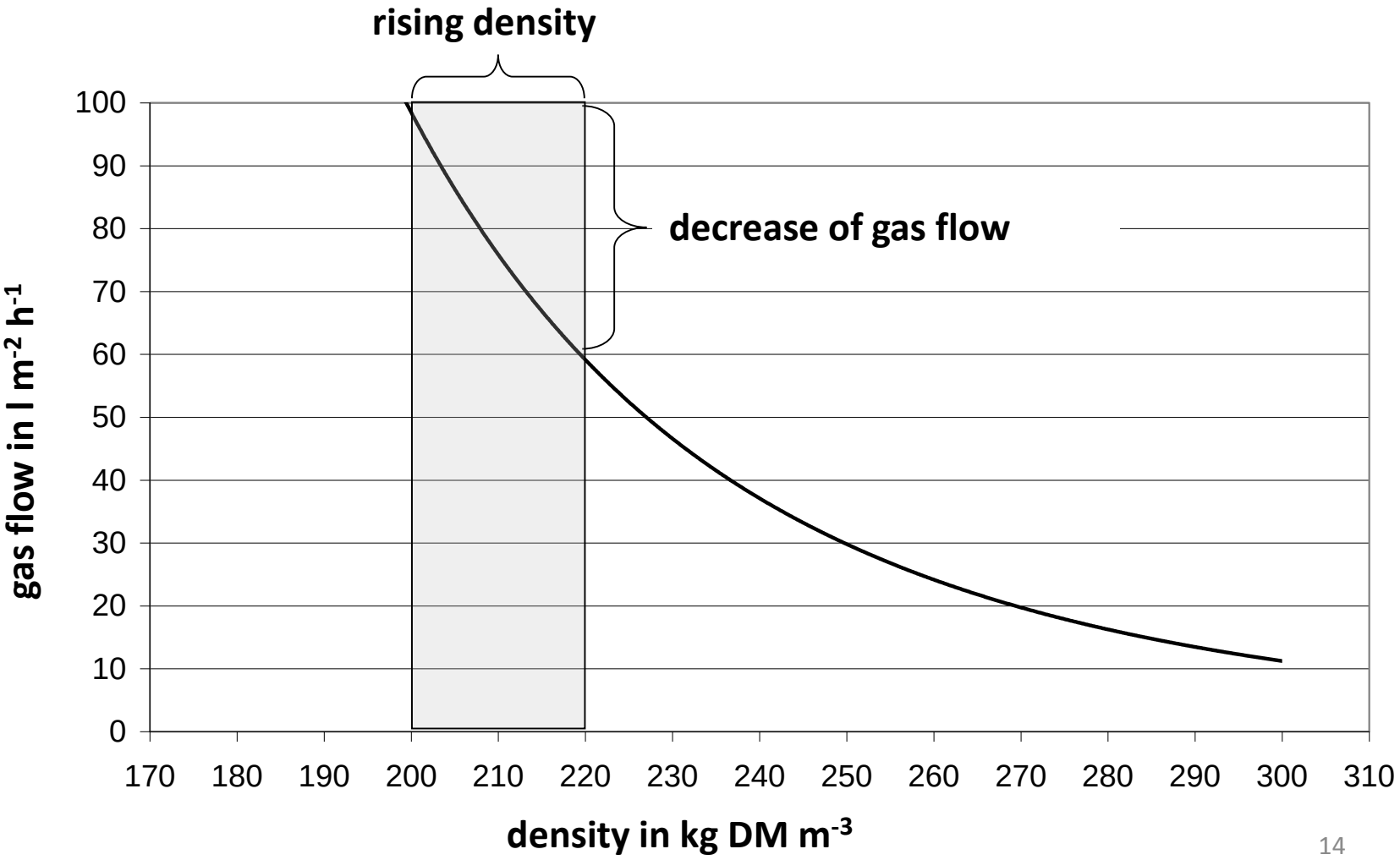


Particle length distribution according to chop length (5-29mm) kernel processor (N= reversed sawtooth, S= reversed sawtooth with spiral groove) at differential speed of 40% and 50% (point of harvest C 34-36% DM)



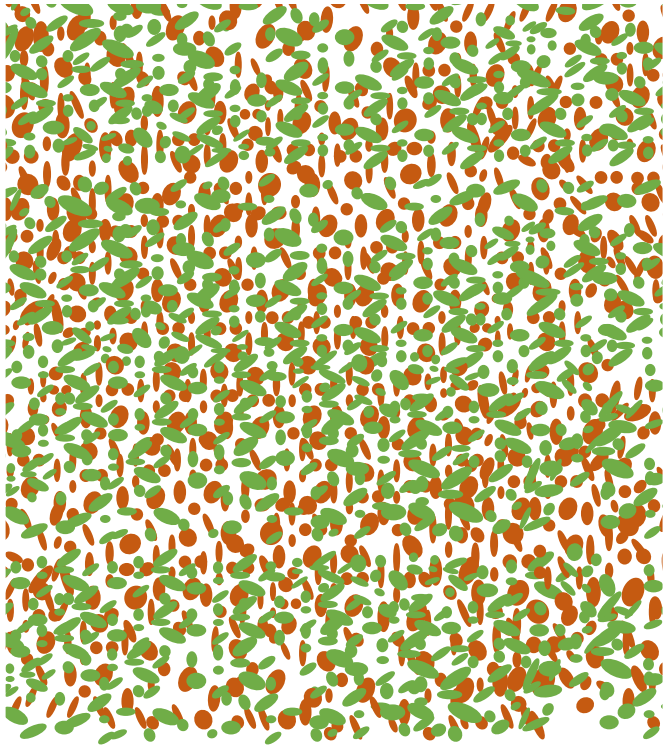
Diskussion

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



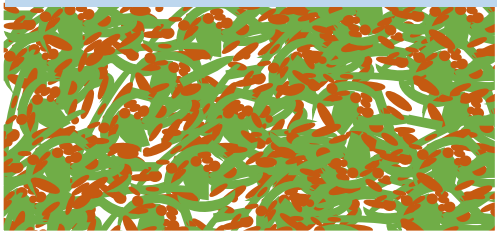
Compaction of maize (sketched model)

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



reduction of Volume 60-70%

compacted in the clamp Silo: 750 bis 950kg kg FM m^{-3}

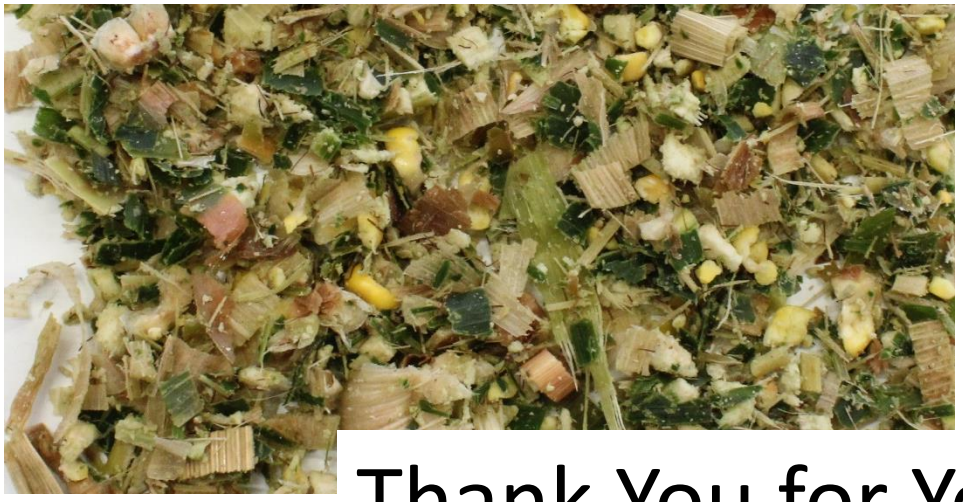


Crop compaction works by shifting particles against each other and plastic deformation of leaf and stem peaces in order to fill most of the por volume

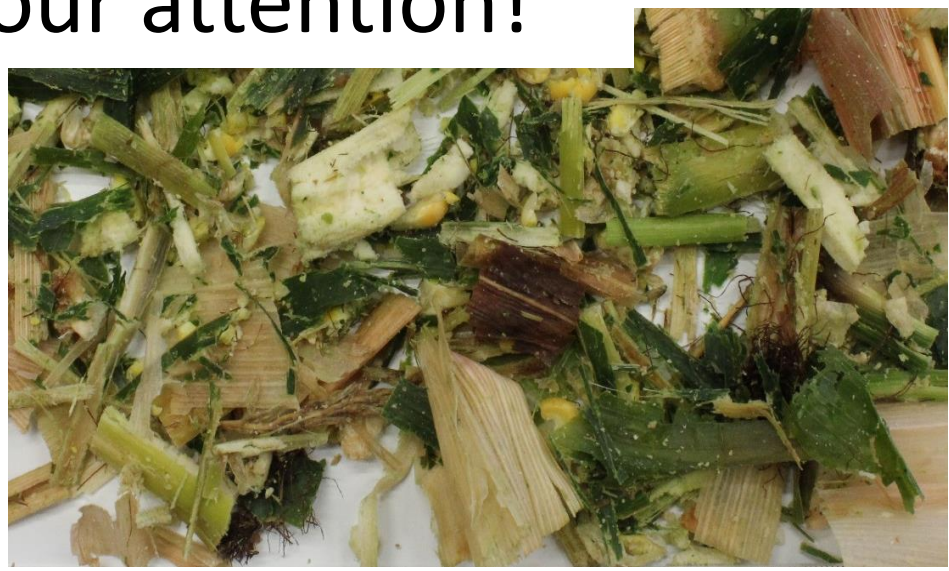
Conclusion

- 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 peaces could not be found by the sieving tests.




Thank You for Your attention!

Landwirtschafts-kammer Schleswig-Holstein
Johannes Thaysen

Landwirtschaftskammer Nordrhein-Westfalen
Heinz-Günter Gerighausen

LKS LABOR
Wolfram Richardt

JOHN DEERE
Klaus Kellner,
Alexander Even

Christian Maack
Institute of Agricultural Engineering
University of Bonn