Chopping quality.
What really matters.

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Contents

Quality counts.

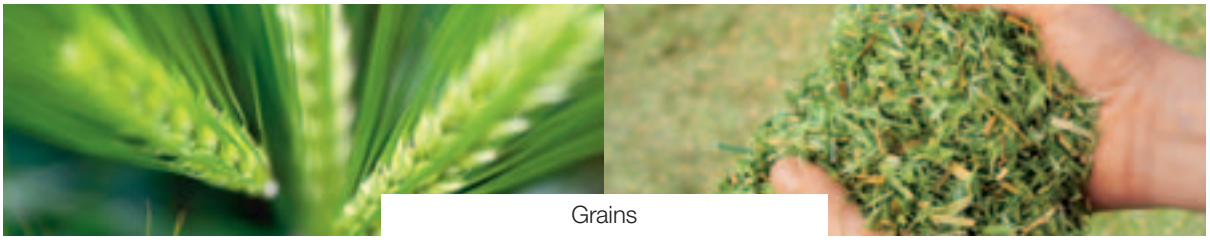
The development of the biogas sector over recent years has been accompanied by a continuous increase in the requirements placed on the substrate or co-substrates used in the facilities. While attention focused initially on extremely short chop lengths, there is currently a clear trend towards chopped material with a large surface area. But there are also calls for a move to longer chop lengths for forage for dairy and beef cattle.

On the one hand, the chop length establishes a good forage structure. On the other hand, the surface of the chopped material is increased, thereby altering the area available for micro-organisms to work on. The greater the extent to which the crop is cracked open, the faster and more effectively it can be transformed into biogas or into milk/meat via cattle feed. In both cases, there is an increase in the cost-efficient energy obtained from the base product.

Wide variety of crops.

A huge variety of biomass products for energy generation are available today. Although the picture is dominated by classic maize silage on account of its high energy yield per hectare, many alternative crops are now being cultivated successfully and are growing in importance. As well as loosening up crop sequences, these new biomass crops now offer very good biogas yields, too.

Crop examples:



Grains

Maize

Sorghum

Ground ear maize

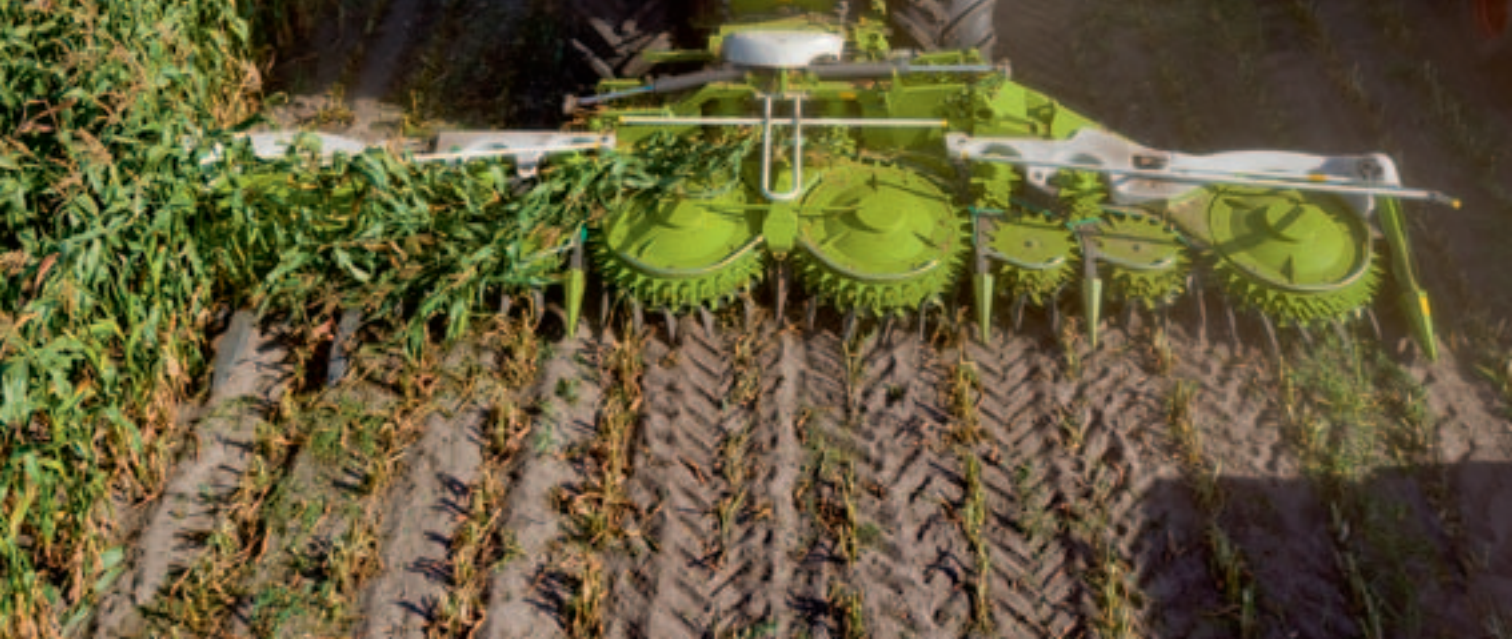
Work and harvest quality: both are important.

Work quality is the result of the entire harvesting process in the field.

Chopping quality is the quality of the harvested crop.

Factors influencing chopping quality.

Crop take-up by the front attachment, precompression of the crop, cutting of the plants, cracking and processing of the kernels as well as grinding of the stalk fibres and shredding of the cob pieces – these are the fundamental functions of the forage harvester. It is here that the work quality – and, above all, the chopping quality – are determined.



Speed adjustment for different crop types and chop lengths

Finger extensions, attachable points and feeding drums for different operating conditions

Front attachment – crop take-up.

The front attachment shares the responsibility for the quality of the chopped crop. It can be adjusted in various ways to allow it to be optimised for the different operating conditions encountered around the world.

Factors influencing performance:

- Working height
  (clean crop take-up, consistent stubble)
- Speed of conveying elements
- Roller scraper settings
- Condition of wear elements
- Adjustment of speed of front attachment to deliver even crop flow and uniform chop length
- Additional equipment to optimise performance for applications such as whole plant harvesting or laid maize

Precompression rollers – precompression of the crop.

The precompression and transport rollers play an important role with regard to chopping quality. It is at this stage that the crop is compressed by the required amount prior to chopping. The interplay of the intake speed and the number of knives on the drum determines the chop length.

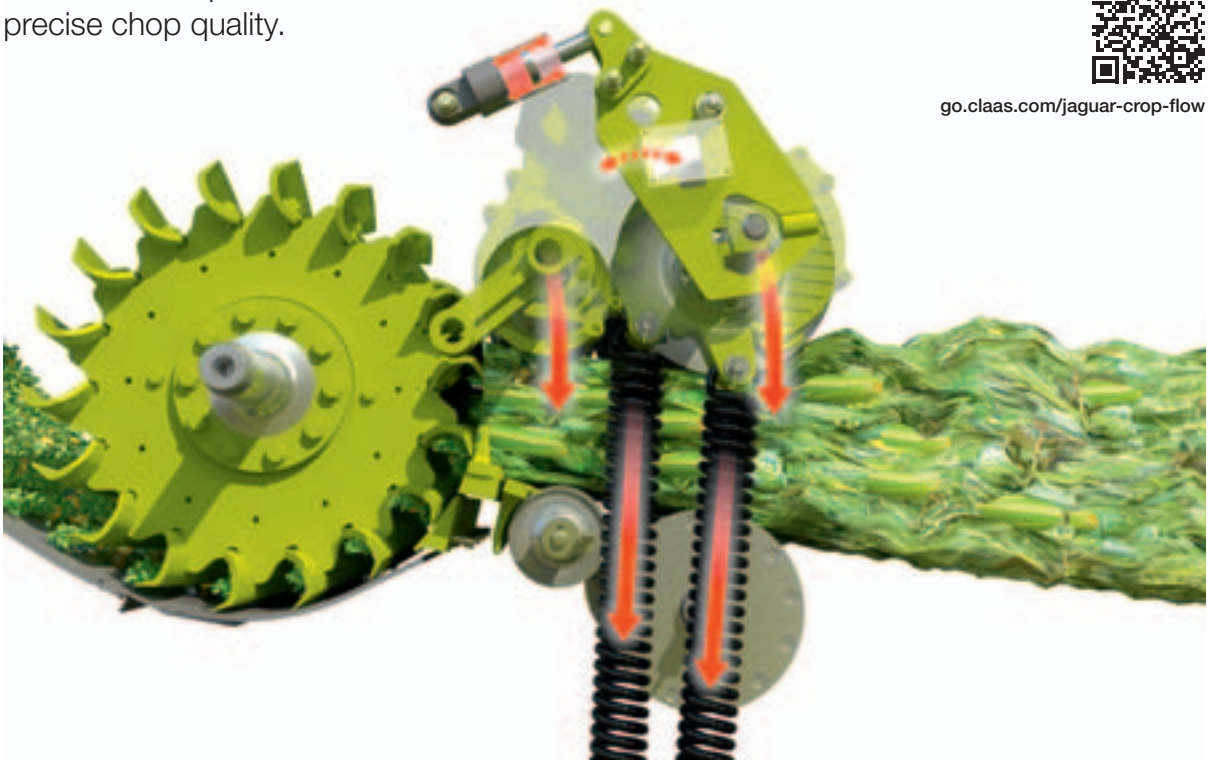
For optimal precompression, it is important for the tension springs of the precompression rollers to be fully tensioned. This results in consistent and precise chopping quality.

Factors influencing performance:

- Intake rollers with aggressive wear bars
- Correct pretensioning of the tension springs
- Stripper bar positioned precisely with regard to drum roller
- Make sure full capacity is used when working

Maximum compression for precise chop quality.

go.claas.com/jaguar-crop-flow

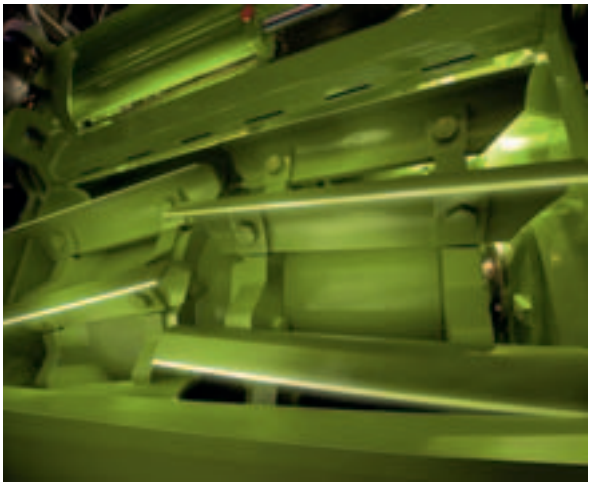


Knife drum – precise chopping and discharging.

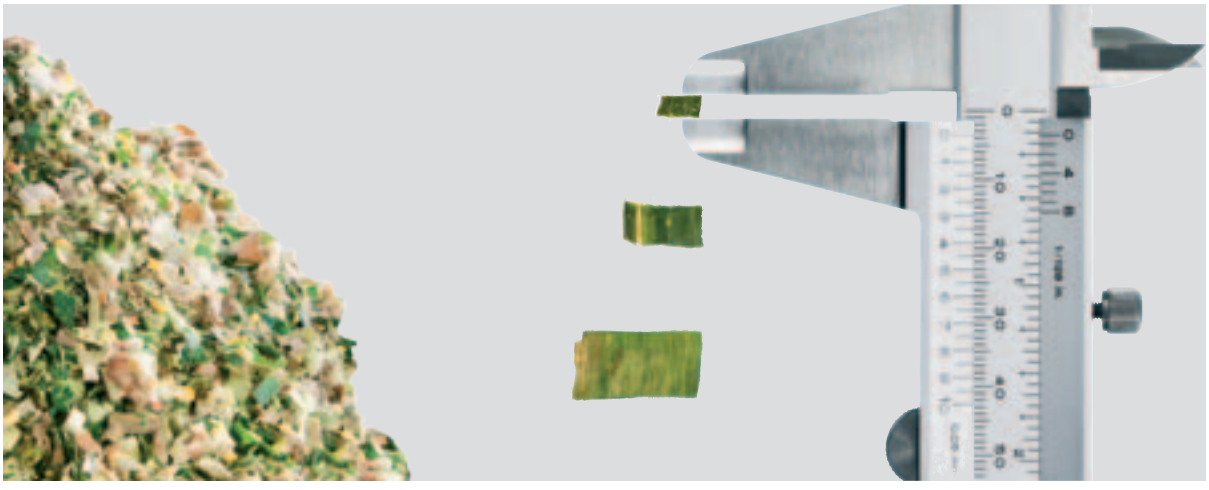
The shear bar and the knives are responsible for cutting the plants precisely while a consistent crop flow speed, courtesy of the precompression rollers, ensures a uniform chop length. A continuous and power-saving crop flow is made possible by the smallest possible distance between knives and drum base.

Factors influencing performance:

- The knife drum with 36 / 28 / 24 / 20 knives for the required chop-length range
- Shear bar (universal/maize) with sharp knife edge for precise chopping
- Narrow gap between shear bar and knives to minimise power requirement and provide clean chopping quality
- Frequent sharpening intervals with few sharpening cycles for economical fuel consumption and consistent chop quality
- Narrow gap between knives and drum concave for power-saving crop flow



Well sharpened knives for clean chopping



Precision of chopping is measurable.

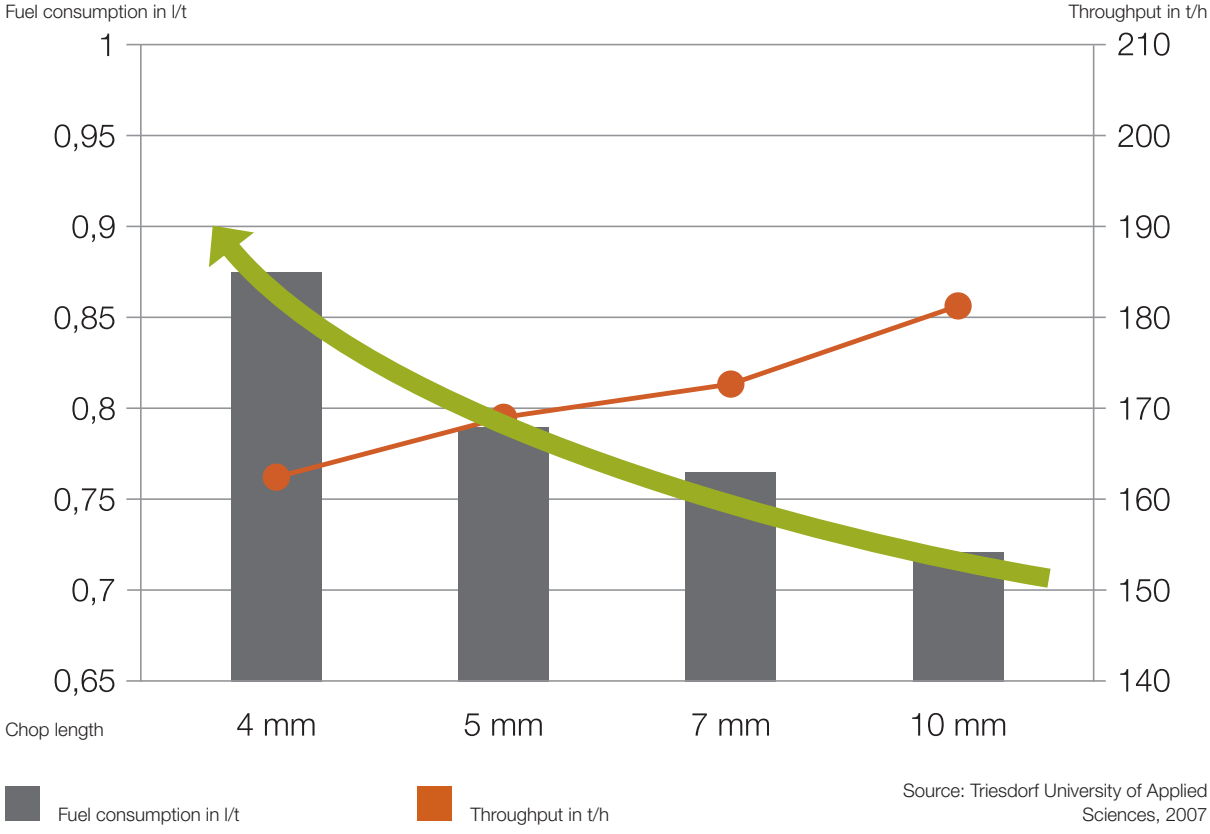
Throughput and power requirement with different chop lengths.

The energy required to reduce plants and grains is always related to the throughput.

The Weihenstephan-Triesdorf University of Applied Sciences carried out an investigation into the topics of cutting, cracking and processing (16 test variants with 4 repetitions). Chop lengths of 4 / 5 / 7 / 10 mm were investigated with regard to throughput and the amount of power required.

As chop lengths become shorter, fuel consumption increases drastically. From 10 mm to 4 mm, it was possible to measure an overall increase in fuel consumption of 20.8%. Particularly striking was the 10.1% increase between 5 mm and 4 mm. The "last" millimetre requires a great deal of energy.

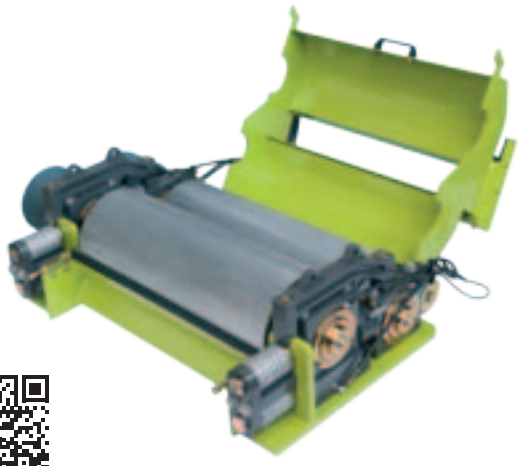
Chopping. Only as short as necessary.



Source: Triesdorf University of Applied Sciences, 2007

Corn Cracker – processing the crop.

The Corn Cracker influences the structure of the chopped crop – and therefore its quality – to a very large degree. The task of the cracker rollers is to open up the kernels, grind the stalk fibres and shred the cob pieces.



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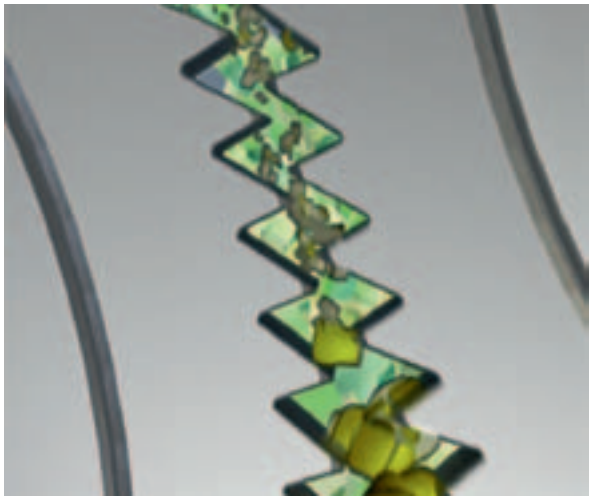
Factors influencing performance:

- Hard-chrome plated roller sleeves with different numbers of teeth offer a high degree of flexibility for handling different crops
- The sharp saw-tooth roller profile makes for optimal crop processing and a perfect crop flow
- The roller spacing setting affects the frictional performance, the kernels and cob parts being processed particularly intensively
- The speed difference between the cracker rollers causes the plant matter fibres to be separated

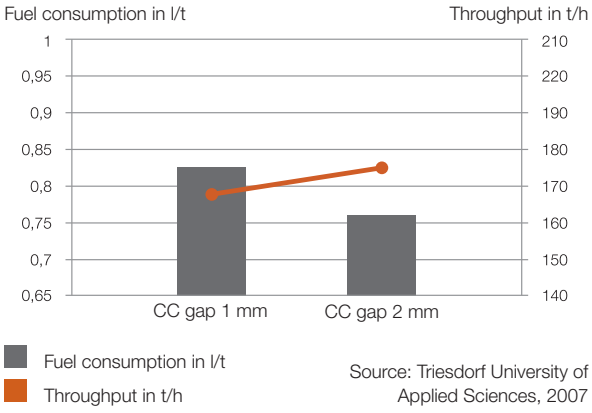
Functional principle of a high-performance cracker with saw-tooth profile



Throughput and power requirement can be measured.

High demands are placed on the Corn Cracker when huge crop volumes have to be processed with the cracker roller spacing set to a narrow setting in order to deliver the required chopping quality. As power can be wasted easily, the degree of processing selected should only be as intensive as necessary. Power consumption varies very noticeably in accordance with the roller spacing setting.

Processing in the Corn Cracker. Only as intensive as necessary.

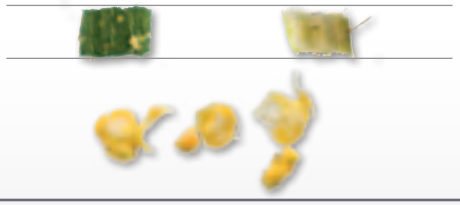


Source: Triesdorf University of Applied Sciences, 2007

Difference in kernel cracking performance between cracker roller gap of 1 mm and 2.5 mm (speed differential 40%).

Corn Cracker roller spacing

1 mm



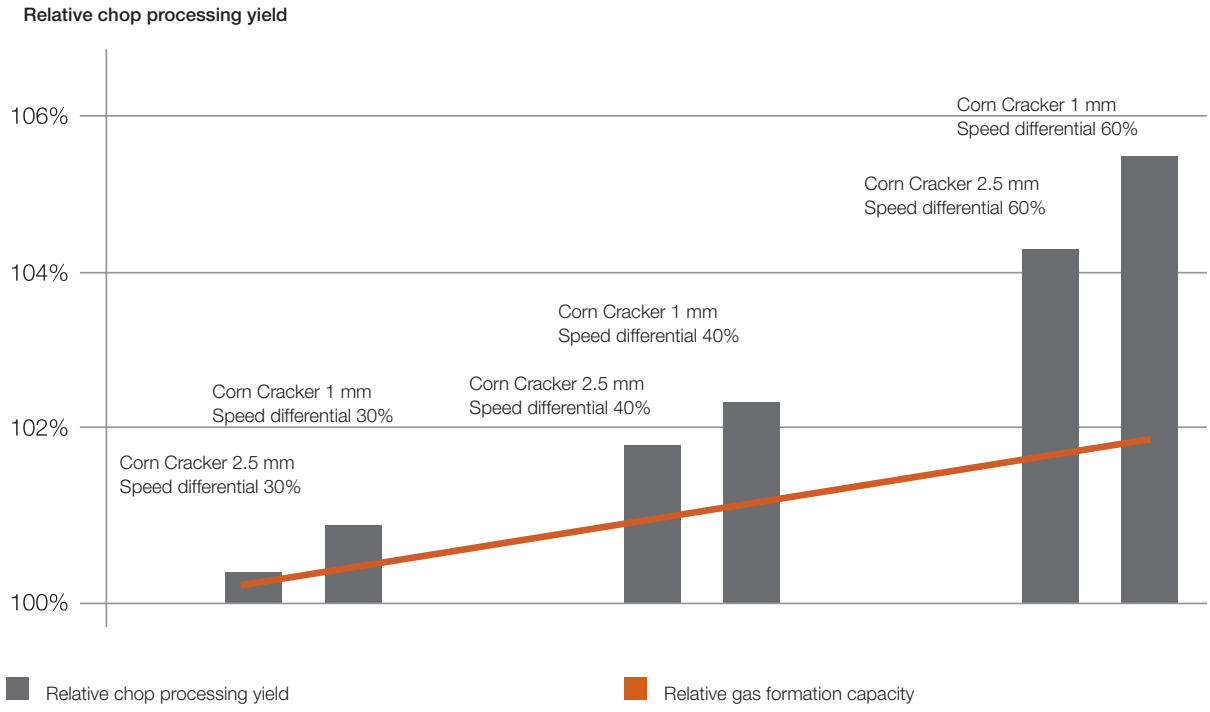
2.5 mm

According to measurements by the Triesdorf University of Applied Sciences, the difference between a Corn Cracker roller spacing of 1 mm and 2 mm in terms of the energy requirement is only 3.6%. The difference in throughput for the different gaps was significantly higher at 7.9%.

Economical processing of chopped material as demonstrated by the gas yield of biogas facilities.

Ultimately, the question of how much processing the crop and kernels require can only be answered by the farmer or biogas facility operator. In order to make the energy in the kernels of the maize or alternative crops accessible, they have to be cracked open. Only in this way can the microorganisms in an animal's stomach or in the fermenter reach the starch inside. The intensity of the crop processing required depends on the crop variety and the extent of maturation/dry matter content.

Chop length: uniform.
MULTI CROP CRACKER: 125 teeth

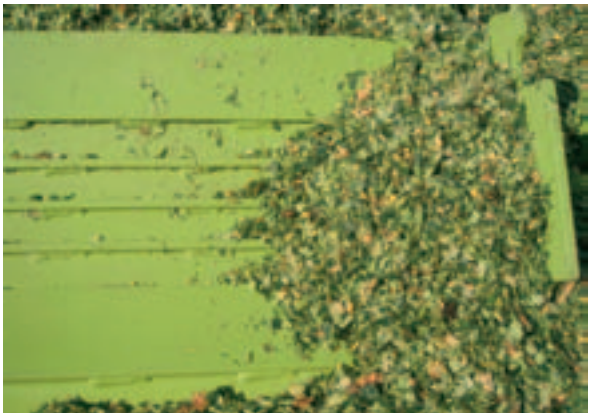


The more intensive processing which results from reducing the Corn Cracker roller gap from 2.5 mm to 1 mm can be increased further still by increasing the roller speed differential from 30% to 40% and as high as 60%.

Friction concave plate – alternative chop processing.

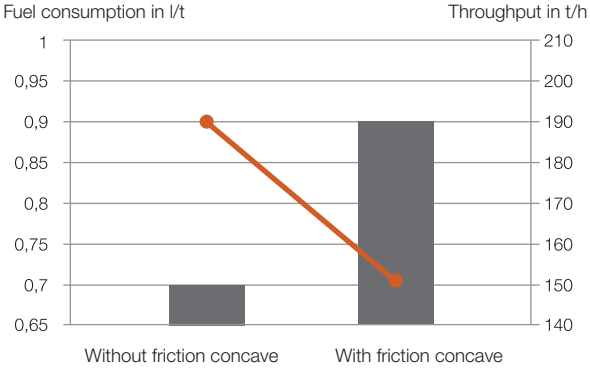
When chopping whole crops, especially in regions with stony soil, the friction concave plate is used as an alternative. The fibres of the cereal stalks and nodes are broken down extremely effectively in this way.

A special measure taken when harvesting ground ear maize is the use of the friction concave plate in addition to the Corn Cracker in order to literally grind the kernels along with the cobs.



The friction concave plate: it can be fitted under the knife drum as an alternative method of processing the chopped material

With and without friction concave.



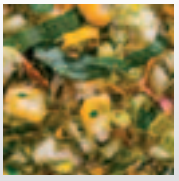
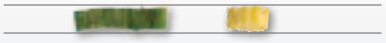
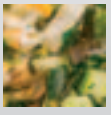
Source: Triesdorf University of Applied Sciences, 2007

On the basis of the comprehensive studies conducted by the Triesdorf University of Applied Sciences, it was possible to measure an extremely high fuel requirement (+25%) as well as a huge drop in throughput (-25%) for forage harvesters using a friction concave plate.

Fuel consumption in l/t

Throughput in t/h

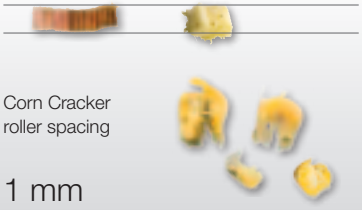
Chopped material processing. Roller cracker with high flexibility.

	Speed differential Corn Cracker 30%
Chop length 3.5 mm	  Corn Cracker roller spacing 1 mm 
Chop length 7 mm	  Corn Cracker roller spacing 1 mm 
	 2.5 mm 
Chop length 11 mm	  Corn Cracker roller spacing 1 mm 

Speed differential

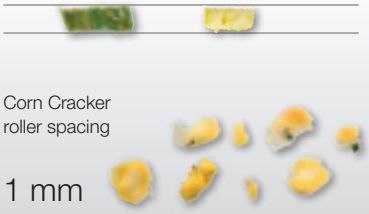
Corn Cracker

40%



Corn Cracker
roller spacing

1 mm

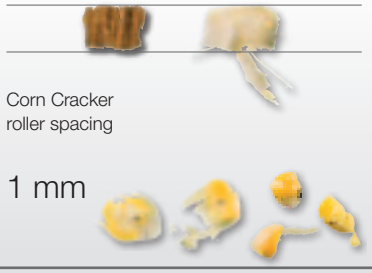


Corn Cracker
roller spacing

1 mm

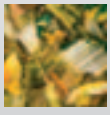
Corn Cracker
roller spacing

1 mm

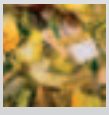


Corn Cracker
roller spacing

1 mm



2.5 mm



2.5 mm

Corn Cracker
roller spacing

1 mm

Corn Cracker
roller spacing

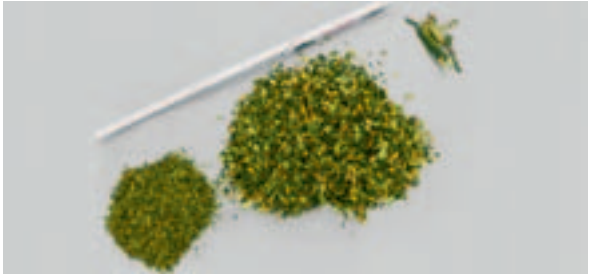
1 mm

Chopping quality is measurable.

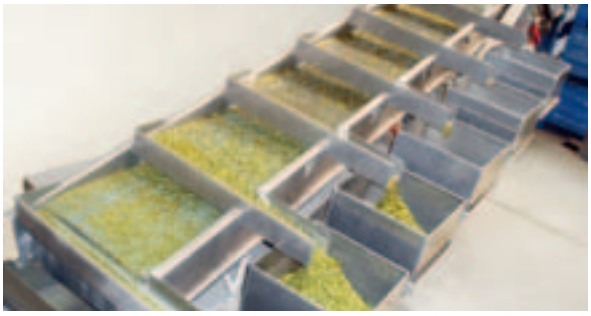
A widely used method for checking the proportion of different chop lengths is the shaker box which has proven itself in practical use. The various sieve fractions of the different chop lengths can be weighed to estimate their respective proportions.
The three fractions are of a relatively simple design, with two sieve hole sizes: 20 mm for overlengths and 9 mm for the set chop length ranges. This means that the content which reaches the lower fraction comprises everything with a chop length of less than 9 mm along with the fine fraction. Depending on the set chop length, the target is a fraction of at least 45% in the lower container or at least 45% in the middle sieve. If the chop length is reduced, the fine fraction in the lower container increases significantly.

Fixed cascades of sieves, which are used for scientific experiments, have a finer graduation of hole sizes and are therefore able to provide a more precise picture of the different sieve fractions.

The percentages of the different sieve fractions change in accordance with the chop length set on the forage harvester. When checking the chop length spread, it is important to remember that this is always a theoretical chop length. Even when crops are chopped precisely, there is always a spread across the sieve fractions in accordance with the normal distribution curve.



Shaker box results



Cascade of sieves

Shaker box

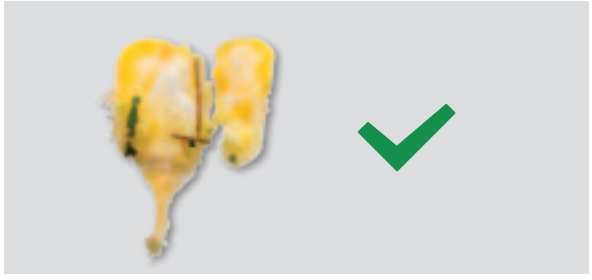
Chopping quality is "countable".

In the US, counting kernels by filling a standardised measuring cup is a widely used method of assessing chopping quality. The contents of the cup are inspected to establish the number of kernels which have not been cracked open. Furthermore, it is possible to count very obvious overlengths. This simple method provides an extremely good overview of how well the Corn Cracker is performing. The forage harvester settings can be adjusted quickly once a measurement has been performed.

How the test works:

- The measuring cup (32 oz, ~0.95 l) may not contain more than two kernels which have not been cracked open
- Kernels which are only cracked do not count as being cracked open
- It is recommended that the test be repeated every two hours

Performance assessment:



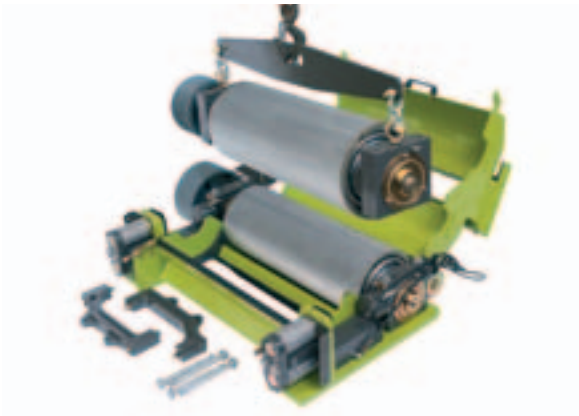
Maize kernel is cracked open correctly.

Maize kernel is only cracked and counts as inadequately processed.

Maximum, flexible processing.

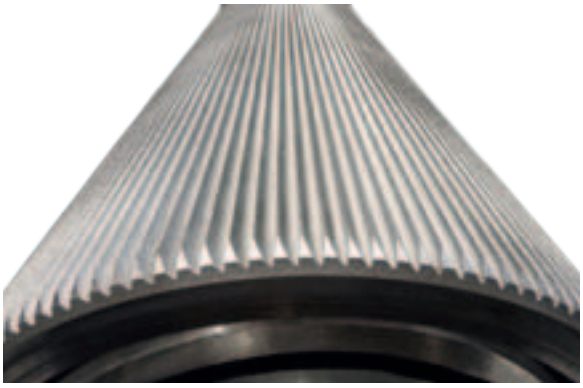
The MULTI CROP CRACKER.

- Very rugged construction and new housing design
- Outstanding functional reliability due to the large bearing units
- Very high throughput while providing optimum chop processing
- High standard of build quality and seal to maintenance compartment ensure that plant fluids remain in the harvested material
- High degree of flexibility through fast replacement of CRACKER rollers
- Can be adjusted quickly to different crops and stages of crop maturity
- Maintenance-free hydraulic belt tensioning for consistent, maximum power transmission



At a glance:

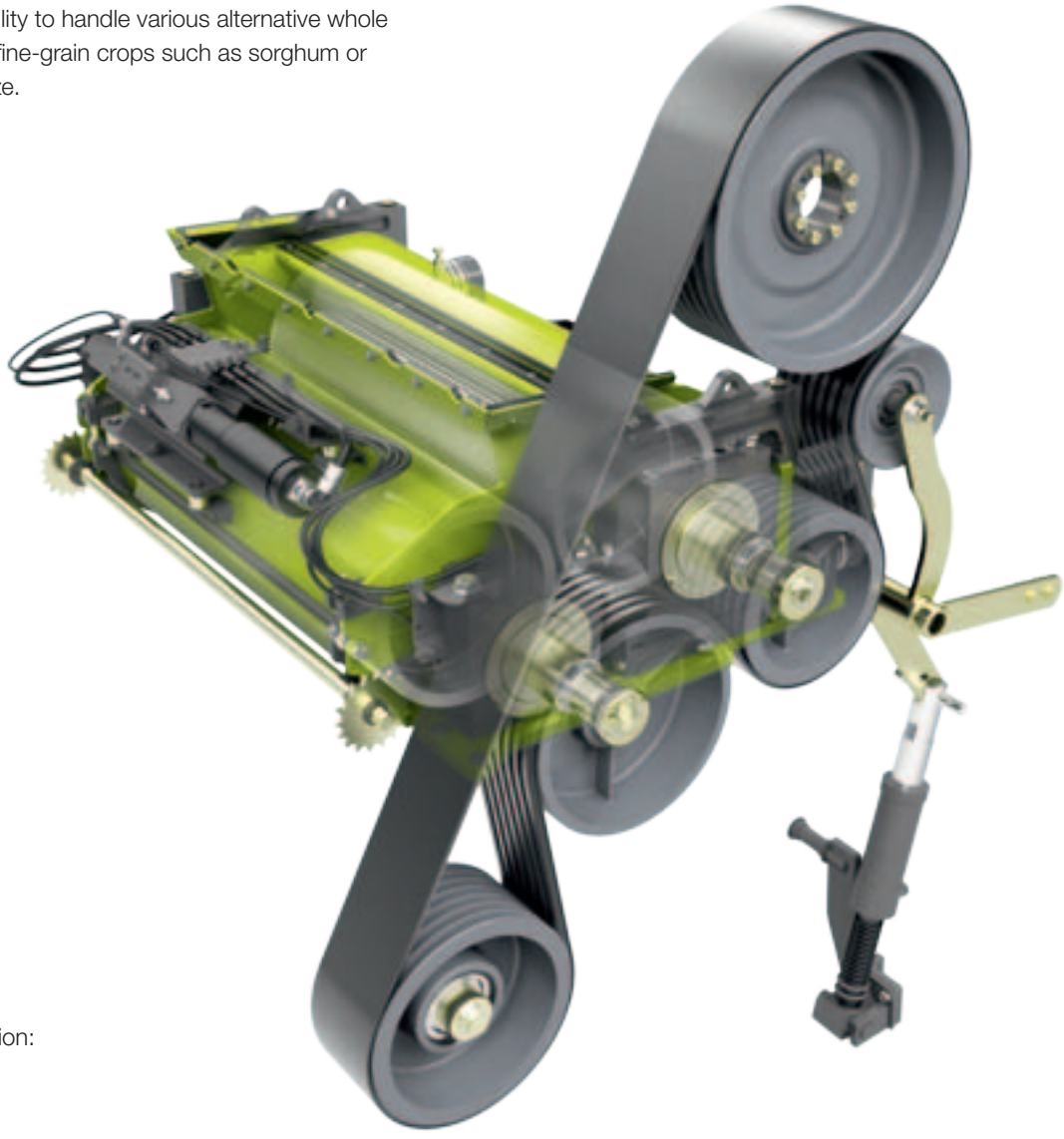
- Dead weight: 450 kg
- Roller diameter: 250 mm
- Roller spacing 1 – 4 mm
- Roller width: 665 mm
- Sawtooth roller profile
- Roller wear protection: hard-chrome plating
- No. of teeth on roller circumference: 100, 125, 150
- Possible speed differentials: 30%, 40%, 60%



MULTI CROP CRACKER.

In the 900-series JAGUAR models, the MULTI CROP CRACKER ensures high-quality, flexible crop processing.

The extremely rugged design makes for perfect crop processing, even at very high throughput rates. An outstanding characteristic of the flexible Corn Cracker System is its ability to handle various alternative whole crop cereals or fine-grain crops such as sorghum or ground ear maize.



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