DLG Test Report 7406

John Deere GmbH & Co. KG

Forage harvester 9800

Functionality and quality of work in silage maize

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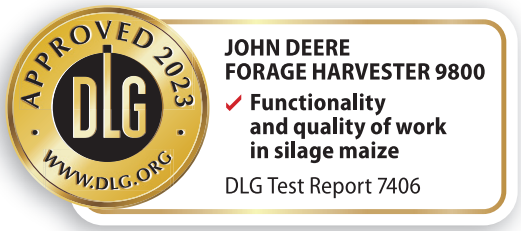
Overview



The DLG APPROVED quality mark for single, value-determining criteria is awarded to technical products that have passed a less comprehensive DLG usability test which is carried out and evaluated to independent and approved criteria. The purpose of the test is to highlight a product's special innovative and key features. The test may include criteria that are laid down in the DLG test framework on Full Tests or may focus on further product features and properties that confer a specific value to the product. A DLG panel of experts defines the minimum standards to be applied to the product and describes the test conditions and procedures as well as the criteria by which the test results are to be evaluated. These parameters reflect the acknowledged state of the art as well as scientific findings and agricultural insights and requirements. After a product has passed the test, a test report is produced and published and the quality mark is awarded to the product and will retain its validity for five years from the date of award.

The John Deere 9800 forage harvester was submitted to the DLG partial test on Functionality and quality of work in silage maize. This test involved a number of field tests during which the work rates and corresponding fuel consumption rates were measured. These measurements were used to compute throughputs [t FM/h] and specific consumption rates [l/t FM] of the machine. Further on, the tests included measurements of the technical chopping quality. All test parameters were measured with the machine set to three different lengths of cut (LOC): 4 mm, 7 mm, 12 mm. In each of these three test versions samples were taken from the crop flow and analysed for dry matter contents, chop length distribution and the level of kernel processing to the Corn Silage Processing Score index (CSPS).

The tests on throughput and specific fuel consumption were carried out in a high-yielding region in northern Italy, whereas the tests on the technical chop quality were conducted on a trial site in northern Germany.

Other criteria were not tested.

Assessment in brief

Harvesting in high-yielding fields in northern Italy, the tested JD 9800 forage harvester achieved relatively high throughputs of up to 328 t FM/h (at a nominal LOC of 12 mm), demonstrating its high performance in these test conditions. As anticipated, throughputs dropped when the nominal LOC was reduced. By comparison, the fuel rates per operating hour never really changed when the chopping lengths were altered. Yet the specific consumption rates did drop when throughput increased. On the whole, specific consumption is very low, hovering around 0.5 litres per tonne of harvested material. It was indeed particularly low at 4 mm LOC.

The test shows that the selected chop length has a significant effect on the particle size distribution in the sample so that the percentage distribution changes just as desired. Some test versions produced a relatively large amount of fine (< 3 mm) and very fine particles (< 1.18 mm). This was partly attributed to the fact that prior to the test runs the crop had been damaged by frost temperatures which increased fragmentation.

It was also found that kernel processing was very good in low dry matter crops and good in high dry matter crops. This result applies to all chop length settings.

Based on these good test results, the John Deere 9800 forage harvester is awarded the DLG APPROVED quality mark on the individual test criterium "Functionality and quality of work in silage maize".

Table 1:
Overview of results

DLG QUALITY PROFILE	Evaluation*
Functionality and quality of work in silage maize	✓

* Evaluation range:
requirements fulfilled (✓) / requirements not fulfilled (✗)

The Product

Figure 2:
The 870hp John Deere 9800 forage harvester

Manufacturer and applicant

John Deere GmbH & Co. KG, John Deere Werk Zweibrücken, Homburger Straße 117-125, 66482 Zweibrücken, Germany

Product

John Deere 9800 forage harvester

Description and specifications

The John Deere 9800 specifications are listed in Table 2. The test machine had the 12-row, 9 m work width Kemper 490plus maize header with six large drums.

Table 2:
*John Deere 9800 forage harvester specifications**

Engine	Liebherr V12
kW/hp	640 kW/870 hp
Displacement	24 l
Engine speed (harvesting)	1,400-1,600 rpm
No. of pre-compression rollers	4
No. of knives on the tested chopping drum	64
LOC band (64 knives)	3-14 mm
Kernel processor gap	2 mm

* Manufacturer information

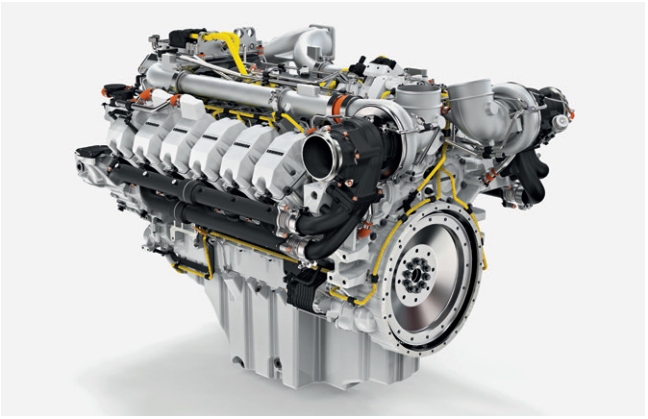


Figure 3:
The 24-litre Liebherr D9512 engine

The Method

The DLG partial test scheme 'Functional test in silage maize' applies to self-propelled forage harvesters which are tested in the field. The field tests consist of running the machine on at least two sites yielding crops in at least two different dry matter bands (27 %-32 % DM and 37 %-43 % DM). The stands selected should be as homogeneous as possible. Here, the machine is run at typical forward speeds in three different test versions, i.e. at three different but typical chopping lengths (4 mm, 7 mm, 12 mm). The base settings on the forager are made on the site to suit the prevailing conditions. The focus of all tests is on the overall efficiency of the machine. This is determined by measuring its throughput (t/h) and specific fuel consumption (l/t). In addition, samples are taken from the chopped material to describe the technical quality of chop.

Measuring the throughput

The throughput rates are determined separately by dry matter band and length of cut. In each test run, the forager fills a representative number of trailers with the filling time being recorded. Then the trailer content is weighed and the throughput [t FM/h] in the prevailing test conditions is determined.

Measuring the fuel consumption

The fuel rates [l/h] are measured by means of the mobile DLG equipment while the forager is filling the trailers. The test equipment measures the fuel flow in the forager's supply and return lines.

Specific fuel consumption per tonne of harvested material

The throughputs [t FM/h] and fuel rates [l/h] measured in each test version are used to compute the specific fuel rates per tonne of harvested crop [l/t FM].

Measuring the technical quality of chop

The technical quality of chop is determined by sampling the crop as it flows from the spout. This is done by means of the DLG sampler (Figure 4) in each test version. These samples are then used to obtain representative sub-samples for determining the dry matter content, the particle size distribution and the level of kernel processing.

Dry matter content

To determine the dry matter content (DM) of the harvested material the sub-samples are weighed on the site and then deep-frozen and stored until the field trials are completed. Then DM is determined by the oven-drying method.

Particle size distribution

The particle size distribution is determined with the help of the DLG cascade sieve system which is made up of multiple screens with 33 mm, 19 mm, 13 mm, 8 mm, 5 mm and 3 mm meshes (round holes) plus one screen for particles smaller than 3 mm.

If the weight of the particles collecting in the < 3 mm sieve (fine chops) is more than 5 % of the total sample weight, this fraction will be sieved by another 1.18 mm screen which determines the percentage of 'very fine' particles (< 1.18 mm). These very fine particles should not account for more than 3 % of the total sample.

Kernel processing

The level of kernel processing is assessed by analysing sub-samples that are taken during each test version. The analysis is carried out at the lab and assessed to the so-called CSPS index (Corn Silage Processing Score to USDA Forage Research Center).

Table 3:
Processing level to MERTENS (2005) and LUFA NRW

Processing level	very good	good	poor
CSPS	> 70 %	50 % to 70 %	< 50 %

Figure 4:
The DLG silage maize sampling unit is used for assessing the technical quality of chopping

Detailed account of the test results

Throughput and fuel economy

The throughput and fuel economy tests were carried out in the Lauden region in northern Italy in August 2017. The region is very fertile and crop yields are very high. The reason for choosing this region for the tests was because it offered the best conditions for utilising the forage harvester to its full potential. The individual test runs were carried out in various silage maize fields.

The dry matter content of the standing crop was measured by a NIR sensor that was integrated on the spout of the forager, the readings of which ranged between 31.4 % and 37.6 %. Growth heights in the test fields ranged between 2.90 m and 3.70 m. The readings are listed in Table 4.

The throughputs were relatively high and amounted to up to 328 tonnes of fresh mass (FM) per operating hour (at a nominal chop length of 12 mm) and reflect the high performance potential of the JD 9800 in these high-yielding fields and test conditions.

As anticipated, the actual throughput of fresh mass increased when the nominal length of cut increased. The specific throughput [t FM/kWh] also increases when the nominal length of cut increases (Figures 5 and 6). Fuel consumption was about 150 litres per engine hour. This rate was more or less maintained across all chop length settings. Therefore, when throughput increased the specific fuel rates dropped to about 0.5 litres per tonne of harvested fresh mass – a very low rate. These fuel measurements reveal that the John Deere 9800 does not respond sensitively to altering the chop length (see figure 7).

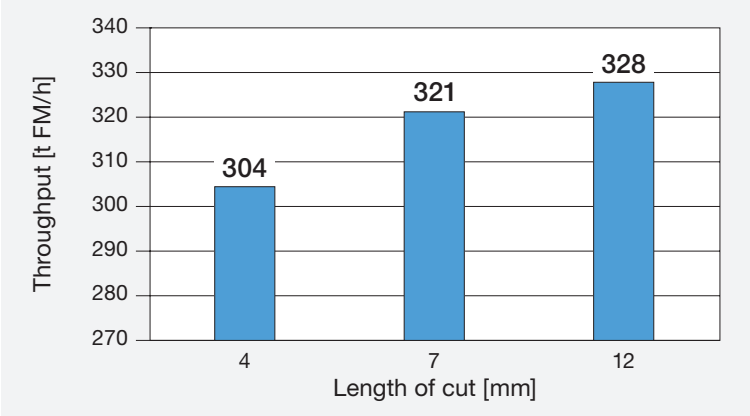


Figure 5:
Throughput in t FM/h

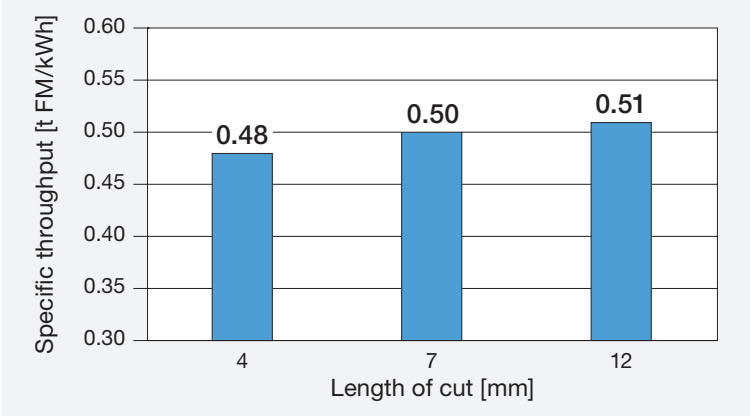


Figure 6:
Specific throughput in t FM/kWh

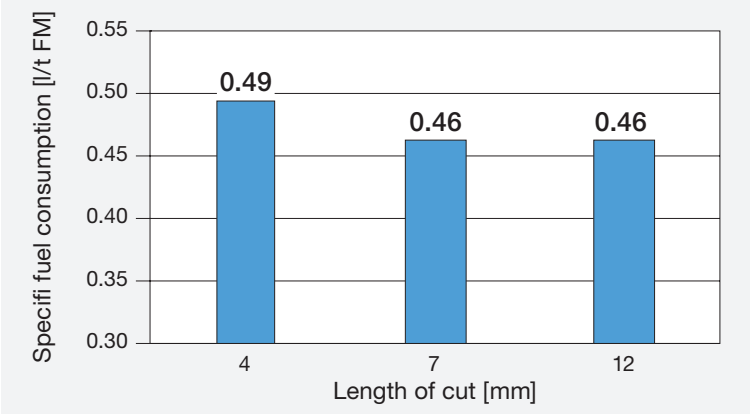


Figure 7:
Specific fuel consumption in l/t FM

Table 4:
Throughput and fuel economy

Nominal length of cut [mm]	Throughput [t FM/h]	Fuel consumption [l/h]	Specific fuel consumption [l/t FM]	Specific throughput [t FM/kWh]
4	304	150	0.49	0.48
7	321	149	0.46	0.50
12	328	152	0.46	0.51

Technical quality of chop

The measurements of the technical quality of chop were carried out in a separate series of tests in silage maize fields in northern Germany (Rendsburg region) in October 2017. The dry matter content levels in the selected stands ranged between 29.7 % and 32.9 % (low DM band) and between 37.0 % and 49.3 % (high DM band). Some of the harvested material had been damaged by night frost.

Particle size distribution

The results of the particle size distribution test are shown in figures 8 and 9.

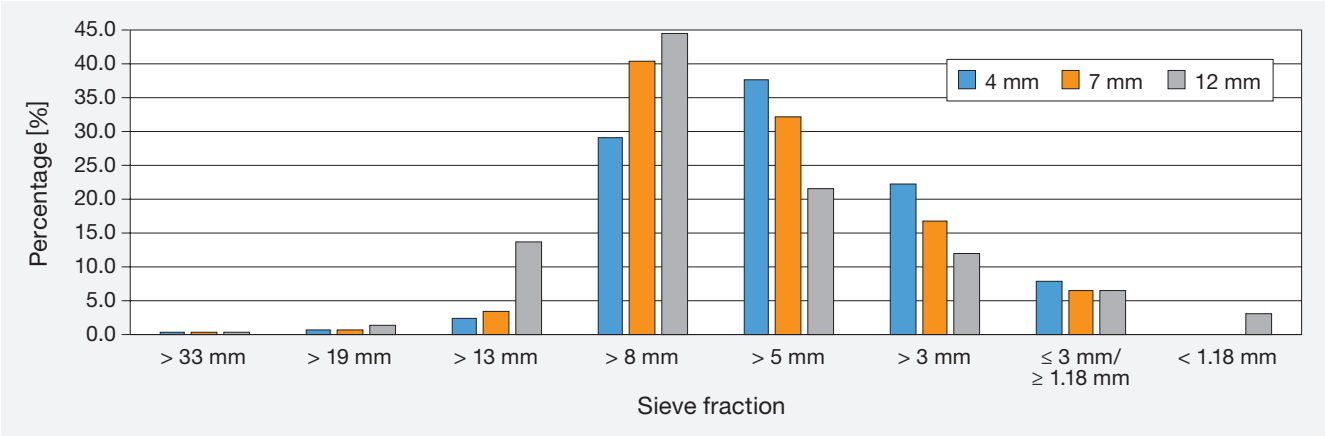


Figure 8:
Particle size distribution in the low-DM band

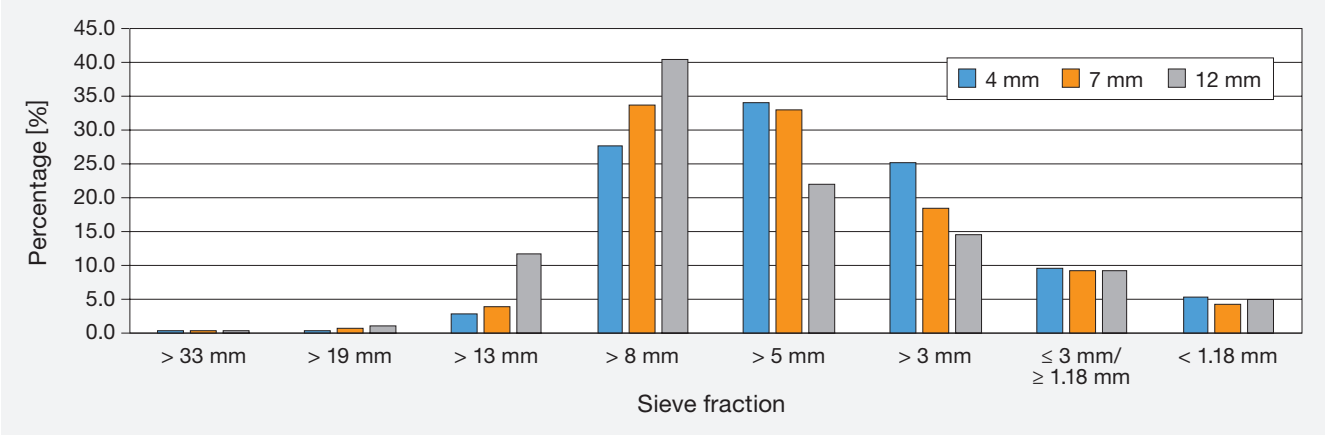


Figure 9:
Particle size distribution in the high-DM band

The graphs show that the set chop length has a clear effect on the distribution of the various particle sizes in the sieves. Changing the settings effectively shifts the distribution in the desired direction.

A nominal chop length of 4 mm results in nearly 60 % of all sample particles collecting in the > 3 mm and > 5 mm sieves. When the LOC increases, the number of particles in these two sieve fractions decreases as desired. For example, this fraction is reduced to 50 % when the nominal chop length is changed to 7 mm. At the same time, the > 5 mm and > 8 mm fractions together increase to 70 %, representing the highest percentage. This shows that the LOC settings have a significant effect on the distribution of the particle sizes. This effect is less pronounced but yet still very clear in the 7 mm and 12 mm LOC settings which lead to a clear 8 % and 10 % increase especially in the > 13 mm fraction. But at the same time the > 8 mm fraction remained the largest fraction containing 45 % and 41 %
of all particles.

The percentages in the > 19 mm and > 33 mm fractions were always small (0.1 % and 1.2 %) and were not affected by the dry matter content. By comparison, changing the settings has a much more significant effect

on the > 13 mm fraction which also increases when the nominal chop length is 12 mm. The percentage weights in the < 3 mm fraction (fine chops) were relatively high. This applies to both DM bands and may be attributed to the freezing temperatures prior to the tests which damaged the crop and increased the risk of fragmentation. In the lower DM bands, the percentage of fine particles (7 % of the total weight) was smaller than in the higher DM bands where fine particles accounted for 10 % of the total weight. In the latter DM band, the percentage of the smallest < 1.18 mm particles was higher than 3 % which is the ceiling set by the GfE German society for feed physiology.

Corn Silage Processing Score (CSPS)

The effects of kernel processing are assessed at the lab by scoring the samples to the CSPS index. In this test the kernels from the low DM band sample achieved higher CSPS scores (figure 10). The CSPS score decreases when the selected chop length increases. According to MERTENS (2005) and LUFA NRW, kernel processing was very good in low DM crops (more than and nearly 70 % score) and good in high DM crops (about 60 % score) and this applies to all chop length settings.

Yet from the information gathered in the test, we are unable to explain why the CSPS score decreases in higher DM maize. Starch contents in the dryer crops were also about 5 % less than in the low DM band and vice versa the amount of fibre percentages increased (NDF, ADF, ADL). This might be down to the frost damage the stand suffered before harvest, which affected the starch levels and fibre percentages and hence the CSPS score.

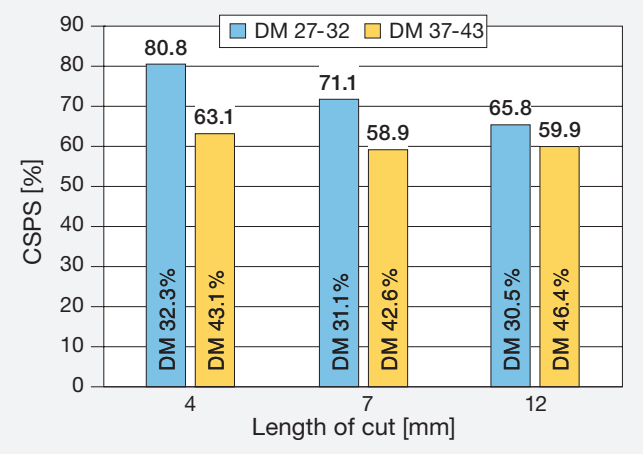


Figure 10:
CSPS values (intensity of kernel processing)

Summary

The tested JD 9800 forage harvester achieves relatively high throughputs that reflect a high machine performance in the specific test conditions. With chop length set to a nominal 12 mm, the machine harvested 328 tonnes of fresh mass per hour; at a nominal 4 mm chop length, the amount of fresh mass per hour still stood at more than 300 tonnes.
At the same time, the specific fuel consumption (litres per tonne) per harvested fresh mass was between 0.46 l/t (12 mm) and 0.49 l/t (4 mm). This is a very low rate and applies to all settings. John Deere argues that this high efficiency is certainly attributed to the relatively frugal LIEBHERR engine along with the low-speed concept which involved an update of the entire powertrain and all crop flow components tailoring them to the lower engine speeds.

The test shows that changing the chop length has a clear effect on the particle size distribution. In some test versions, the testers recorded relatively high percentages of fine particles (< 3 mm) and very fine particles (< 1.18 mm). This was partly attributed to frost damage of the crop.

According to MERTENS (2005) and LUFA NRW, kernel processing was very good and good in all chop length settings.

Based on these test results, the self-propelled John Deere 9800 forage harvester (in test specification) is awarded the DLG APPROVED quality mark on the individual test criterium of “Functionality and quality of work in silage maize”.

More information

Testing agency

DLG TestService GmbH,
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The tests are conducted on behalf of DLG e.V.

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Agriculture

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Dr. Ulrich Rubenschuh

Test engineer(s)

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Photos und graphics

DLG and John Deere

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DLG – the open network and professional voice

Founded in 1885 by the German engineer Max Eyth, DLG (Deutsche Landwirtschafts-Gesellschaft – German Agricultural Society) is an expert organisation in the fields of agriculture, agribusiness and the food sector. Its mission is to promote progress through the transfer of knowledge, quality standards and technology. As such, DLG is an open network and acts as the professional voice of the agricultural, agribusiness and food sectors.

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The DLG Test Center Technology and Farm Inputs and its test methods, test profiles and quality seals hold a leading position in testing and certifying equipment and inputs for the agricultural industry. Our test methods and test profiles are developed by an independent and impartial commission to simulate in-field applications of the products. All tests are carried out using state-of-the-art measuring and test methods applying also international standards.

The forage harvester John Deere 9800 already received the DLG-ANERKANNT test mark in 2018 for the test module „Functionality and quality of work in silage maize". The results presented in the report are based on DLG Test Report 7406. According to the manufacturer, the forage harvester John Deere 9800 is produced unchanged in the tested version.

Internal test code DLG: 2302-0003

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