DLG Test Report 7338

John Deere GmbH & Co. KG

Forage harvester 8600i

Functionality and quality of work
in silage maize

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Overview

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A test mark „DLG-APPROVED for individual criteria“ is awarded for agricultural products which have successfully fulfilled a scope-reduced usability testing conducted by DLG according to independent and recognised evaluation criteria. The test is intended to highlight particular innovations and key criteria of the test object. The test may contain criteria from the DLG test scope for overall tests, or focus on other value-determining characteristics and properties of the test subject. The minimum requirements, test conditions and procedures as well as the evaluation bases of the test results will be specified in consultation with an expert group of DLG. They correspond to the recognised rules of technology, as well as scientific and agricultural knowledge and requirements. The successful testing is concluded with the publication of a test report, as well as the awarding of the test mark which is valid for five years from the date of awarding.

The John Deere 8600i 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. The tests also 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 particle size distribution and the level of kernel processing to the Corn Silage Processing Score index (CSPS). The test was carried out in northern Germany.

Other criteria were not tested.

Assessment in brief

The 8600i forage harvester (model year 2023) in the tested specification achieved throughputs of up to 239 tonnes of fresh mass per hour (at nominal 12 mm LOC), demonstrating that it was able to deliver its potential in the prevailing test conditions. As anticipated, the throughputs dropped when the nominal LOC was reduced. The fuel rates per operating hour did not change significantly when the LOC settings were changed. The specific consumption rates dropped when throughput increased. All measurements show low rates of 0.47 to 0.55 litres per tonne of harvested material.

The test shows clearly that preselecting a different length of cut on the forager has a clear effect on the particle sizes and their relative percentages in the harvested material. Regardless of the dry matter contents of the material from two different plots, overlengths (> 33 mm and > 19 mm) accounted for only a small portion. The < 3 mm fraction (fine particles) always accounted for a relatively high percentage weight, i.e., in both stands with different dry matter contents. In the two DM stands, the fraction of the smallest < 1.18 mm particles never exceeded 3 %, which is the ceiling set by the German GfE society for feed physiology.

According to MERTENS (2005) and LUFA NRW, kernel processing was very good, producing 4 mm and 7 mm chop lengths, and good at 12 mm lengths.

Based on these good test results, the John Deere 8600i 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

Manufacturer and applicant

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

Product:
John Deere 8600 i forage harvester

Description und technical data

The John Deere 8600 i specifications are listed in Table 2. The tested machine was equipped with the Kemper 475plus header with 10 rows (7.5m working width) and four large and two small gathering rotors.

Table 2:
*Specifications of the tested forager John Deere 8600 i (model year 2023)**

Engine	John Deere Powersystems
kW/hp	460 kW/625 hp
Displacement	13.5 l
Engine speed (harvesting)	1,600 - 1,700 rpm
No. of pre-compression rollers	4
Feeder house	Standard 660 mm wide version
No. of knives on the tested chopping drum	64
LOC band (from 64 knives)	3 - 15 mm
Kernel processor	John Deere Premium 110/144 with 40 % speed difference
Selected kernel processor gap	2 mm

* Manufacturer information

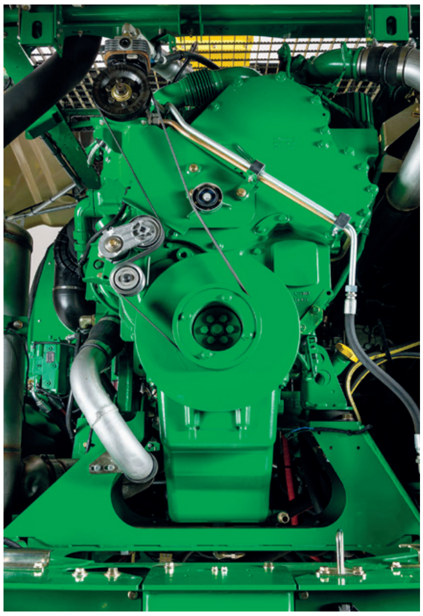

Figure 3:
John Deere 13.5 l PowerTech with 13.5 l displacement

Figure 2:
John Deere 8600 i with 625 hp engine

Figure 4:
John Deere Premium 110/144 kernel processor

The method

The DLG partial test scheme "Functional test in silage maize" applies to self-propelled forage harvesters that are put to a comprehensive field test. 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 had to be as homogeneous as possible. Here, the machine is run at typical forward speeds in three different test versions, i.e., at three different yet typical chopping lengths (4 mm, 7 mm, 12 mm). The base settings on the forager are made on the site and to prevailing conditions. The tests focus on the overall machine efficiency. 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.

Throughput

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

Fuel consumption

Fuel consumption [l/h] is measured as the forager is filling the trailer running alongside, using suitable and calibrated meters from a third party or by reading out the CAN-Bus data. If the latter is applied, the accuracy of the CAN-Bus data is verified before the test by carrying out reference measurements using suitable third-party instruments.

Table 3:
Kernel processing results to MERTENS (2005) and LUFA NRW

Kernel processing level	very good	good	poor
CSPS	> 70 %	50 % to 70 %	< 50 %

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].

Technical quality of chop

The technical quality of chop is determined by sampling the material as it flows from the spout. This is done by means of the DLG sampler (Figure 5) in each of the test versions. 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

The dry matter content is determined by weighing the material into smaller samples, deep freezing and storing these until the field trials are completed. Then dry matter is determined by the oven-drying method. Another quick method for determining DM contents in the field are NIRS sensors, the accuracy of which was verified and found to be sufficient by DLG engineers before these tests.

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 that collects particles smaller than

Figure 5:
The silage stream from the spout is sampled. The sample is analysed for the technical quality of chop.

3 mm. If the weight of the particles collecting in the < 3 mm sieve (fine particles) 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 % in the total sample.

Measuring 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).

Detailed account of the test results

Throughput and fuel economy

The test was carried out in northern Germany in September 2022. The dry matter content of the standing crop was measured by the integral NIR sensor which produced readings between 27.2 % and 44.2 %. Growth heights in the test fields ranged between 2.90 m and 3.50 m (Amaveritas variety from Agromais).

The results are illustrated in Figure s 6, 7, 8 and listed in table 4..

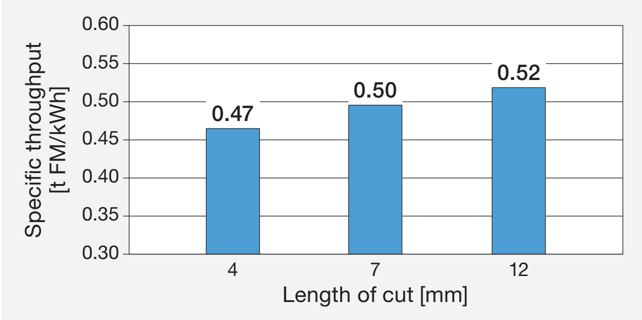

Figure 7:
Specific throughput in t FM/kWh

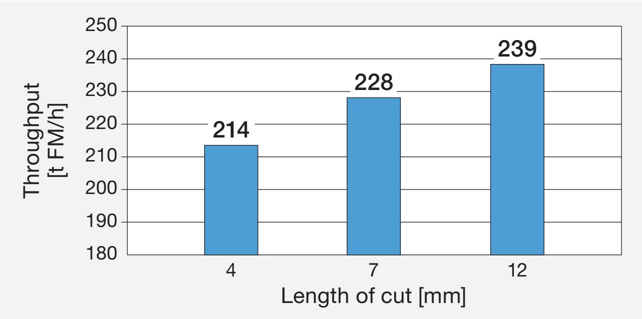

Figure 6:
Throughput in t FM/h

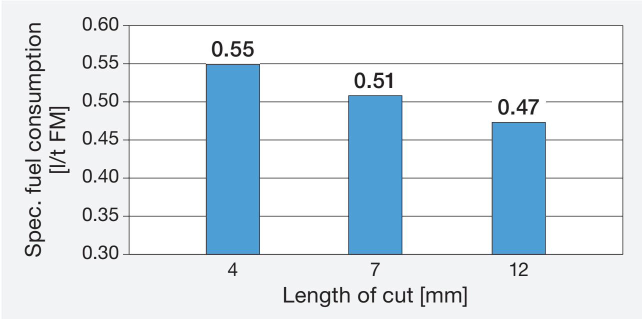

Figure 8:
Specific fuel consumption in l/t FM

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	214	117	0.55	0.47
7	228	116	0.51	0.50
12	239	113	0.47	0.52

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 6 and 7). The fuel consumption rates per operating hour ranged between 113 and 117 litres and did not vary much when the LOC were altered. Therefore, the specific fuel consumption drops when throughput increases. The specific fuel consumption rates per tonne of harvested fresh mass ranged between 0.47 and 0.55 litres – which is low on the on the whole (Figure 8).

Technical quality of chop

All test runs for determining the technical quality of chop were carried out in the same field. The dry matter contents in the patches with lower DM levels ranged between 27.9 % and 31.8 % (the low-DM band) and in the patches with higher DM rates between 37.0 % and 43.2 % (the high-DM band).

Particle size distribution

The results of the particle size distribution test are shown in Figures 9 and 10.

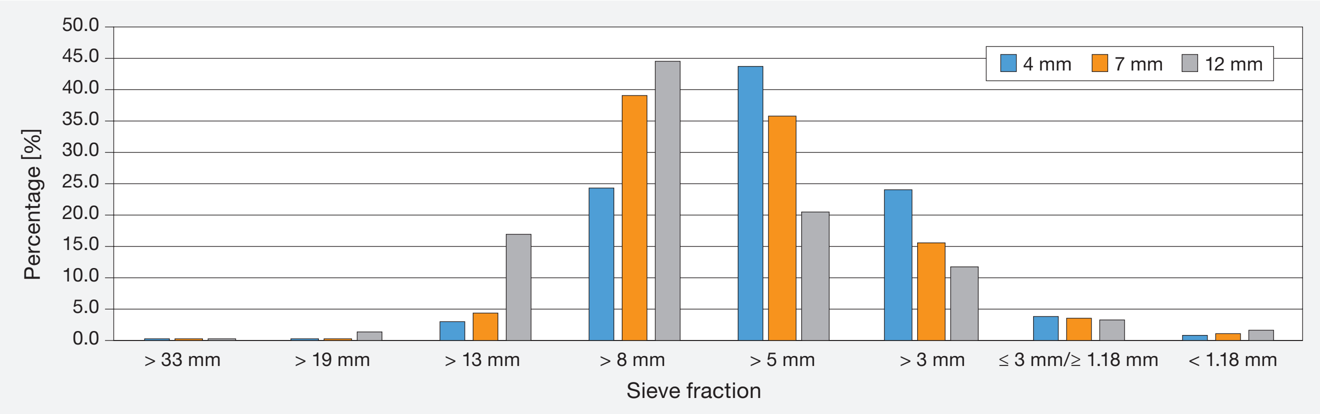

Figure 9:
Particle size distribution in the low-DM band using the 110/144 kernel processor (40 % speed difference).

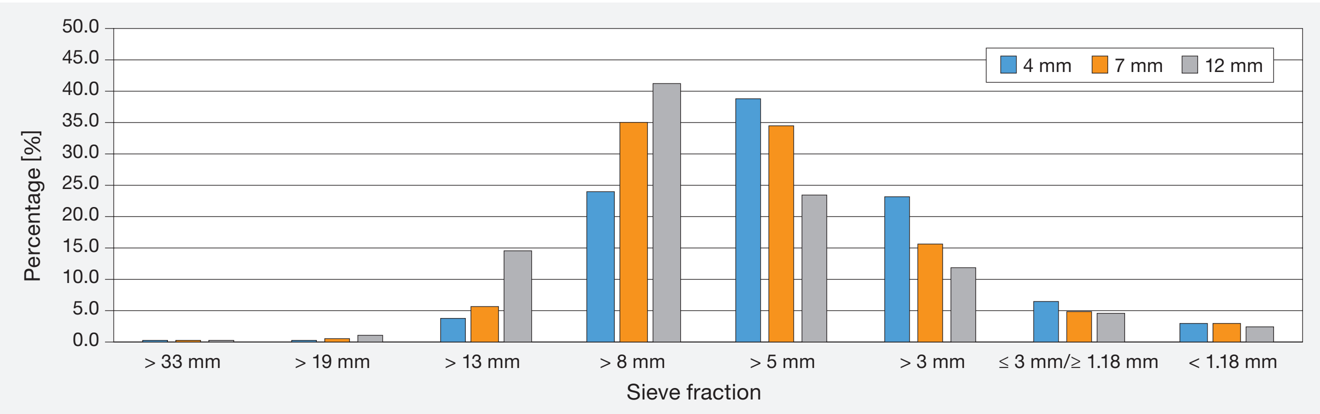

Figure 10:
Particle size distribution in the high-DM band using the 110/144 kernel processor (40 % speed difference)

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

A nominal chop length of 4 mm results in nearly 65 % of all sampled particles collecting in the > 3 mm and > 5 mm screens. When the LOC increased, the number of particles in these two fractions decreased as desired. For example, with LOC set to 7 mm, this percentage drops to 50 % and the accumulated > 5 mm and > 8 mm fractions increased to about 70 %, representing the highest percentage. This shows that the LOC settings have a significant effect on the particle size distribution. This effect is less pronounced yet still very clear when the LOC was set to 7 mm and 12 mm. With LOC at 12 mm, especially the > 13 mm fraction increased clearly by 13 % and 9 % in the comparison. At the same time though, the > 8 mm fraction remained the largest fraction containing 45 % and 41 % of all particles.

The percentages collected in the > 19 mm and > 33 mm fractions were always small (0.0 % and 1.3 %). These results were unaffected by the DM band. By comparison, changing the settings has a much more significant effect on the > 13 mm fraction which also increases more when the nominal chop length is set to 12 mm. The < 3 mm fraction (fine chops) accounted for relatively high percentage weights. This applied to both DM patches. In the lower DM bands, the percentage of fine particles (4.7 % of the total weight) was smaller than in the higher DM bands where fine particles accounted for 8 % of the total weight.

In both DM bands, the percentage of the smallest < 1.18 mm particles was not higher than 3 % which is the ceiling set by the German GfE society for feed physiology.

Corn Silage Processing Score (CSPS)

The efficacy of kernel processing was assessed at the lab by scoring the samples to the CSPS index (Figure 11). The CSPS score decreases when the chop length increases. According to MERTENS (2005), kernel processing was very good when chop length was set to 4 mm and 7 mm. At these chop lengths, the score is significantly and slightly higher than 70 %. When the LOC were set to 12 mm, the scores were 69 % and 65 %, which is good.

In this test, the kernels from the low-DM band sample achieved higher CSPS scores. This is possibly attributed to the fact that the DM content of these cobs was between 48 % and 51 %. By comparison, DM contents in the cobs from the higher-DM band were relatively low and between 40 % and 47 %. The kernels from the higher-DM cobs (harvested from the low-DM patch) were damaged more effectively in the processor.

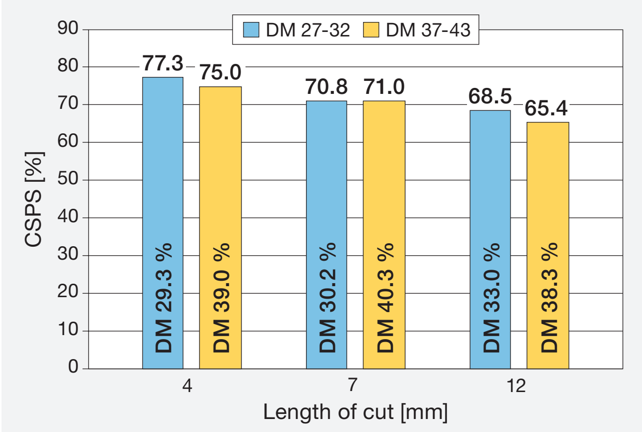

Figure 11:
CSPS values (intensity of kernel processing)

Summary

The 8600i forage harvester (model year 2023) in the tested specification achieved throughputs of up to 239 tonnes of fresh mass per hour (at a nominal 12 mm LOC) and 214 tonnes at a nominal LOC of 4 mm. At the same time, the specific fuel consumption (litres per tonne) per harvested fresh mass was between 0.47 l/t (12 mm) and 0.55 l/t (4 mm). This is a low rate and applies to all settings.

The test shows that changing the chop length has a clear effect on the particle size distribution so that the percentage distribution changes just as desired. Regardless of dry matter content levels, overlengths (> 33 mm and > 19 mm) accounted for only a small portion. The < 3 mm fraction (fine particles) accounted for a relatively high percentage weight – in both stands of different dry matter contents. In the two DM stands, the percentage of the smallest < 1.18 mm particles never exceeded 3 %, which is the ceiling set by the German GfE society for feed physiology.

According to MERTENS (2005) and LUFA NRW, kernel processing was very good when the LOC was set to 4 mm and 7 mm and good when the LOC was 12 mm.

Based on these test results, the self-propelled John Deere 8600i 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”.

Further information

Testing agency

DLG TestService GmbH,
Gross-Umstadt location, Germany

The tests are conducted on behalf of DLG e.V.

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Agriculture

Division head

Dr Ulrich Rubenschuh

Test engineer(s)

Dipl.-Ing. agr. Georg Horst Schuchmann *

Photos and graphics

DLG and John Deere

* Author

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.

As one of the leading organisations in the agricultural and food market, DLG organises international trade fairs and events in the specialist areas of crop production, animal husbandry, machinery and equipment for farming and forestry work as well as energy supply and food technology. DLG's quality tests for food, agricultural equipment and farm inputs are highly acclaimed around the world.

For more than 130 years, our mission has also been to promote dialogue between academia, farmers and the general public across disciplines and national borders. As an open and independent organisation, our network of experts collaborate with farmers, academics, consultants, policymakers and specialists in administration in the development of future-proof solutions for the challenges facing the agriculture and the food industry.

Leaders in the testing of agricultural equipment and input products

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.

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