DLG Test Report 7485

Balkrishna Industries Ltd. (BKT TIRES)

Agricultural tires for tractors

BKT AGRIMAXFACTOR

710/70 R 42 & 600/70 R 30

Soil preservation, fuel saving, traction

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BKT AGRIMAXFACTOR
710/70 R 42 & 600/70 R 30
- ✓ **Soil preservation**
- ✓ **Fuel saving**
- ✓ **Traction**

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www.DLG-Test.de

Overview

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.

This testing was carried out on the agricultural tractor tires BKT AGRIMAXFACTOR 600/70 R 30 and BKT AGRIMAXFACTOR 710/70 R 42. The tires were tested against 5 reference tires, one of which was from a premium manufacturer. All tires were tested according to the DLG test module “Resources Protection”. As part of these tests, the traction and the transmitted tractive forces, the effect of the tires on the ground and the fuel consumption under real-life conditions in the field and on the road were all measured. Other criteria were not tested.

Assessment in brief

The agricultural tractor tire combination BKT AGRIMAXFACTOR 710/70 R 42 and BKT AGRIMAXFACTOR 600/70 R 30 achieved convincing results in the DLG test. Based on the test results, the DLG-APPROVED test mark was awarded for the “Resources Protection” testing module.

With a measured wheel load of 2,960 kg on the rear axle, the contact area of the BKT AGRIMAXFACTOR tires at a soil-friendly tire inflation pressure of 0.6 bar is 5040 cm² (or 3,906 cm² at a pressure of 1.3 bar). At an inflation pressure of 0.6 bar, BKT AGRIMAXFACTOR tires have the second largest contact area of all tested tires and a correspondingly low tire contact area pressure of 0.43 kg/cm².

The ground pressures measured show a clear relation between the tire contact area and the depth of penetration. The BKT AGRIMAXFACTOR tires achieve the best values at all measured depths (10 cm, 20 cm and 40 cm); at a depth of 40 cm and an inflation pressure of 0.6 bar, the lowest ground pressure of 0.13 bar was measured.

The track depth of 6.5 cm measured at an inflation pressure of 0.6 bar is the second-lowest value.

The BKT AGRIMAXFACTOR tire achieve an area performance of 2.6 ha/h at a speed of 10 km/h and an average tractive force of 45 kN, putting it in the mid range of the tested tires.

Fuel consumption during the field test is 1.7 % below the average (17.4 l/ha). Fuel consumption during the transport test is 0.3 % lower than the average of all the reference tires.

Table 1:
Overview of results

DLG QUALITY PROFILE	Evaluation*
Soil protection	
Tire contact area	🟩🟩🟩🟩⬜
Ground pressure	🟩🟩🟩🟩🟩
Track depth	🟩🟩🟩🟩⬜
Fuel savings	
Field work	🟩🟩🟩🟩⬜
Transportation	🟩🟩🟩⬜⬜
Traction	
Area performance	🟩🟩🟩⬜⬜

* The DLG test framework provides the following options in its evaluation schemes:
🟩🟩🟩 or better = meets, exceeds or clearly exceeds the specified DLG standard, 🟨🟨 = meets the legal requirements for marketability, 🟥 = failed

The product

Manufacturer

Balkrishna Industries Ltd. (BKT), Mumbai – 400013, India

Product:
BKT AGRIMAXFACTOR 710/70 R 42 and 600/70 R 30

Description and technical data

The following tire combinations were tested for the front and rear axles

Rear axle R:
BKT AGRIMAXFACTOR
710/70 R 42

- tubeless radial tire
- tire width [mm]: 716
- total diameter: 2061
- recommended rim: DW 23 B
- alternative rim: DW 25 B

Front axle F:
BKT AGRIMAXFACTOR
600/70 R 30

- tubeless radial tire
- tire width [mm]: 611
- total diameter [mm]: 1602
- recommended rim: DW 20 B
- alternative rim:
  DW 18 L, W 18 L

Figure 2:
BKT AGRIMAXFACTOR

Table 2:
BKT AGRIMAXFACTOR technical specifications

	Tire pressure [bar]						
	0.6	0.8	1.0	1.2	1.4	1.6	2.0
Travelling speed [km/h]	**Front axle / Rear axle wheel load [kg]**						
10	3,515/2,250	4,040/2,615	4,635/2,985	5,235/3,350	5,835/3,720	6,430/4,085	7,030/–
30	3,515/2,250	4,040/2,615	4,635/2,985	5,235/3,350	5,835/3,720	6,430/4,085	7,030/–
40	3,340/2,135	3,835/2,480	4,405/2,830	4,970/3,180	5,540/3,530	6,110/3875	6,675/–
50	3,210/2,055	3,690/2,390	4,235/2,725	4,780/3,060	5,325/3,395	5,870/3,730	6,420/–
65	3,055/1,955	3,510/2,275	4,030/2,595	4,550/2,915	5,070/3,235	5,590/3,550	6,110/–

Additional technical information is available on the manufacturer's website:
https://www.bkt-tires.com/gb/en/agrimaxfactor

The method

DLG Test Module
"Resources Protection"

The aim of testing the agricultural tractor tires in the DLG test module "Resources Protection" is to examine the tires with regards to their effect on the soil and on fuel consumption. For this purpose, the tires are mounted on suitable tractors and tested in two parts.

Part 1 is a field test under real-life conditions and Part 2 is a test of transport tasks on the DLG chassis dynamometer.

Part 1 – Field Test

The test runs are carried out on suitable agricultural land under comparable conditions. The test area must be sufficiently large, homogeneous and flat and must be prepared for the tests. The soil type, texture, vegetation (if applicable), field history and test conditions (such as the weather, soil moisture and composition) are all documented. During the test, the moisture content of the soil is measured at depths of 0 to 30 cm.

The measurements are conducted with a vehicle combination consisting of 2 tractors. The first tractor is equipped with the tires to be tested and the rear tractor serves as a braking tractor. The tractors are connected by a sling with an integrated load cell (Figure 3). By this way, field operations are simulated and traction/slip curves are recorded at different inflation pressure values.

The set inflation pressure values are taken from the manufacturer-specific air pressure tables (Table 2). Attention is to be paid in order to not exceed maximum permissible wheel loads. Two pressures are chosen for the measurements:

- Minimum permitted tire pressure for 10 km/h (field work): 0.6 bar
- Average tire pressure for 50 km/h: 1.3 bar

To classify the measurement results, comparable tests were carried out on reference tires available on the market.

The following measurements were taken for the evaluation:

- Lead [%]
- Traction/slip curve [kN; %]
- Tire contact area [cm²]
- Ground pressure [bar]
- Track depth after passage [cm]
- Tractive power [kW]
- Area performance [ha/h]
- Fuel consumption [l/h]

The lead is calculated on the basis of the rolling circumference of the front and rear tires and the mechanical ratio of the tractor (front axle to rear axle) in all-wheel drive. There can be lead variations as to the manufacturer. The lead should be between 0.5 % and 5 %, optimally between 1.5 % and 3.5 %.

The contact area of each tire type can be made visible by dusting the tires. This way, the footprint area is measured (Figure 4). The depth of the imprint resulting from the tire pressure can also be measured.

In the test, the ground pressure generated during a passage is measured by means of Bolling probes.

Figure 3:
Vehicle combination

Figure 4:
Tire contact area

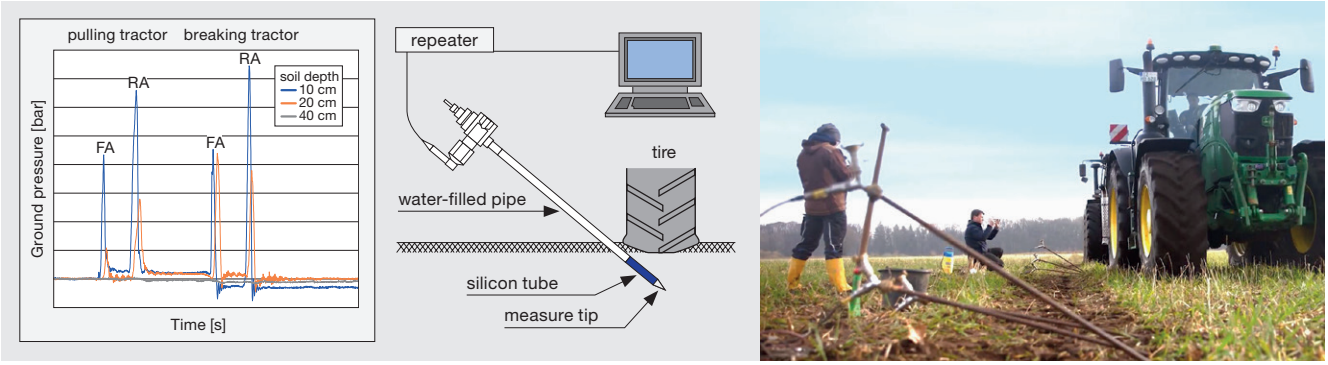

Figure 5:
Measuring the ground pressure with Bolling probes

The ground pressure is measured at depths of 10 cm, 20 cm and 40 cm (Figure 5). The ground pressure decreases as the depth increases (even when the wheel load remains the same) and it is mainly influenced by the tire contact area. The tire contact area changes as to the inflation pressure.

Part 2 –
Transport run on the DLG chassis dynamometer

To simulate transportation tasks, test runs are performed on the DLG chassis dynamometer. The testing process is based on the "DLG-PowerMix" test framework. The transport test consists of two different sections:

- Inclined section, which requires a high tractive force
- Flat section, which requires a relatively little tractive force

Slope levels have been previously defined according to real routes and added to the test programm.

The total towing weight (tractor and trailer) is simulated based on the performance class of the tractor and can range from 10 t to 40 t. For all tires, the pressure is set to 1.6 bar. During the comparison test, the position of the test vehicle on the chassis dynamometer is not changed. Accordingly, tire changes are done on the chassis dynamometer. Three test runs are performed; on the flat section at speeds of 40 km/h and 50 km/h considering the first run for conditioning.

During the runs the following measurements are recorded:

- Engine speed [1/min]
- Specific fuel consumption [g/kWh]
- AdBlue consumption [g/kWh]
- Speed and time required [km/h, s]

The essential and test-relevant vehicle specifications are recorded and documented.

Figure 6:
Transport run on the DLG chassis dynamometer

Detailed account of the test results

Figure 7:
Test field after the passage of the tractor

Table 3:
Axle and wheel loads

John Deere 6R 250			
	Axle load [kg]	**Distribution [%]**	**Wheel load [kg]**
Front axle	3,820	39	1,910
Rear axle	5,920	61	2,960
Total weight	**9,740**		

Test field

The tests were performed in March 2024 near Neumünster (Schleswig-Holstein) on a field planted with a catch crop (green rye). The type of soil is a sandy loam and the test field is largely homogeneous and even. The randomly measured moisture content during the testing period at soil depths from 0 to 30 cm is around 40 %. Therefore the test area is considered 'relatively wet'.

Axle and tire loads, rolling circumference, lead and tire inflation pressure

The tires to be tested are fitted on a John Deere 6R 250. A Claas Xerion is used as braking tractor. The axle and tire loads are determined afterwards.

The towing tractor's static weight distribution is 39 % on the front axle and 61 % on the rear axle.

Table 4 shows initial data and the measured lead values for the tested tires at 0.6 bar. All measured tires have a lead value between 0.5 % and 5 %. Reference tires B, C and E are in the optimal range from 1.5 % to 3.5 %. The BKT AGRIMAXFACTOR has the highest lead.

Traction/slip curve

The traction/slip curve at a tire inflation pressure of 0.6 bar shows that the tested tires transmit tractive forces of 46.8 kN to 55.1 kN with a slip of 20 %. The BKT AGRIMAXFACTOR tires achieve a tractive force of 48.5 kN.

Even higher tractive forces can be transmitted with higher slip values. From an energetic and

Table 4:
Rolling circumference and lead

	Rolling circumference and lead					
	BKT AGRIMAX FACTOR	**Reference tire A**	**Reference tire B**	**Reference tire C**	**Reference tire D**	**Reference tire E**
Front axle	600/70 R30	600/70 R30	600/70 R30	600/70 R30	600/70 R30	600/70 R30
Rolling circumference [mm]	4,765	4,781	4,749.80	4,791	4,774	4,809
Rear axle	710/70 R42	710/70 R42	710/70 R42	710/70 R 30	710/70 R42	710/70 R42
Rolling circumference [mm]	6,198	6,151	6,197.6	6,164	6,174	6,202
Lead with tire pressure of 0.6 bar [%]	4.56	0.84	1.68	2.55	3.91	2.71

agricultural point of view, however, operation with a higher slip makes little sense.

At a tire inflation pressure of 1.3 bar and either a low or high slip, the transmitted tractive forces are lower. With a slip of 20 %, the tested tires transmit tractive forces from 39.1 kN to 46.8 kN. The BKT AGRIMAX-FACTOR tires achieve a tractive force of 39.1 kN.

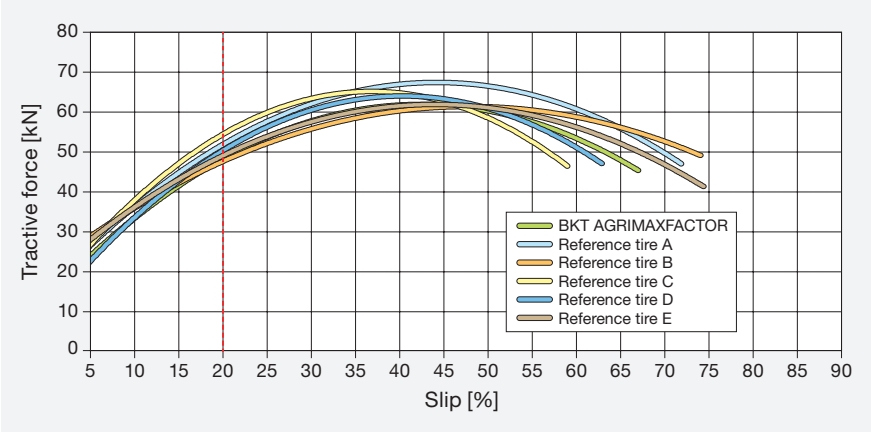

Figure 8:
Traction/slip curve at a tire inflation pressure of 0.6 bar

Tire contact area and track depth at 0.6 bar

A reduction of the tire inflation pressure from 1.3 bar to 0.6 bar increases the contact area of the tested tires by 7 % to reach 39 %. This results in a reduction of the contact area pressure in kg/cm² with the same wheel load.

In this case, the BKT AGRIMAX-FACTOR tires achieve the second-lowest contact area pressure of 0.43 kg/cm².

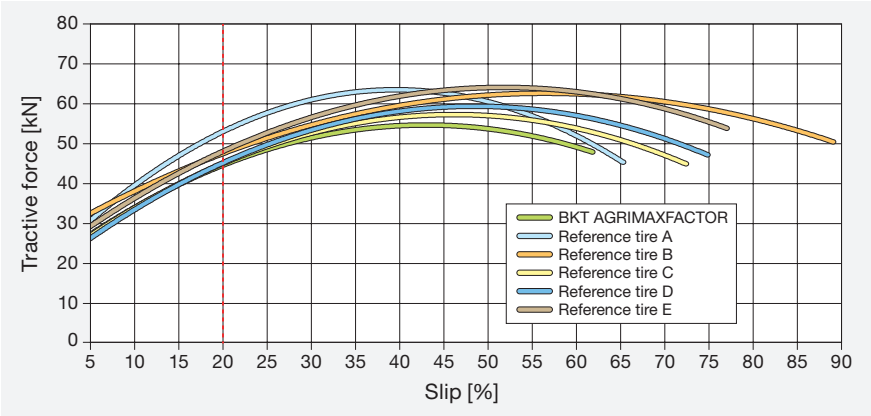

Figure 9:
Traction/slip curve at a tire inflation pressure of 1.3 bar

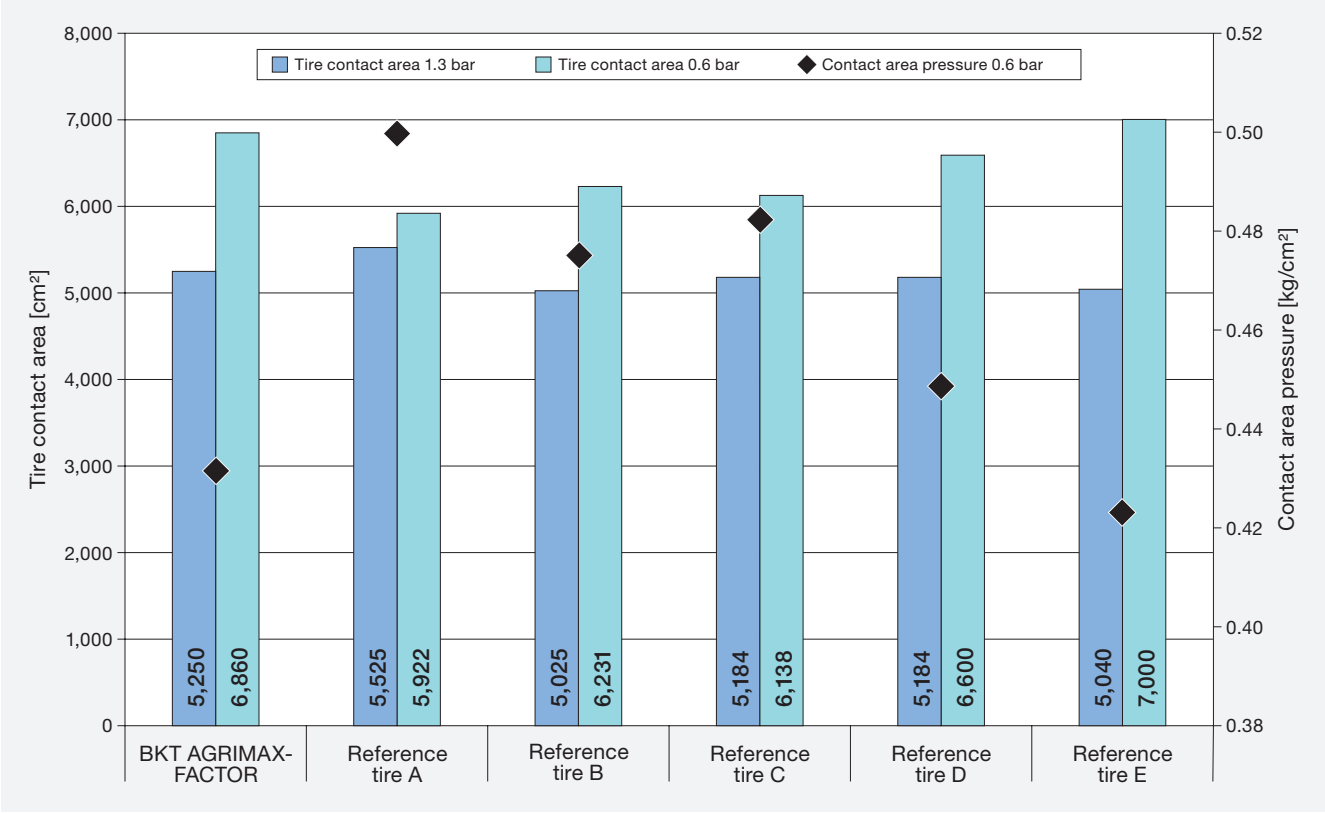

Figure 10:
Tire contact area

The lower contact area pressure has an impact on the measured track depth, which is of 7.1 cm on the average. Having a value of just 6.5 cm, the track depth produced by the BKT AGRIMAXFACTOR tires is 8 % less than the average of the reference tires, and 18% less than the last-positioned competitor.

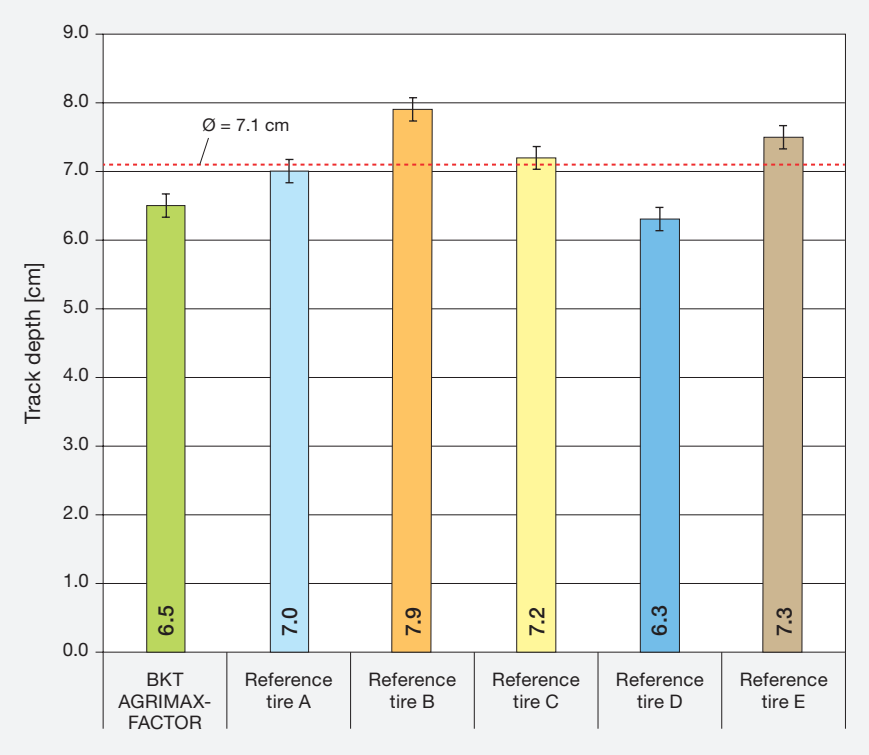

Figure 11:
Track depth in cm

Ground pressure

At an inflation pressure of 0.6 bar, the BKT AGRIMAXFACTOR tires have the lowest measured pressure values on the Bolling probes.

Overall, there is a close correlation between the measured pressure values at a depth of 10 cm and the set tire inflation pressure.

The ground pressure at a depth of 40 cm is primarily influenced by the size of the contact area (at a constant wheel load) In the case of the BKT AGRIMAXFACTOR tires, it is particularly evident that the value is significantly below the limit of 0.2 bar (-35 %) described in the literature.

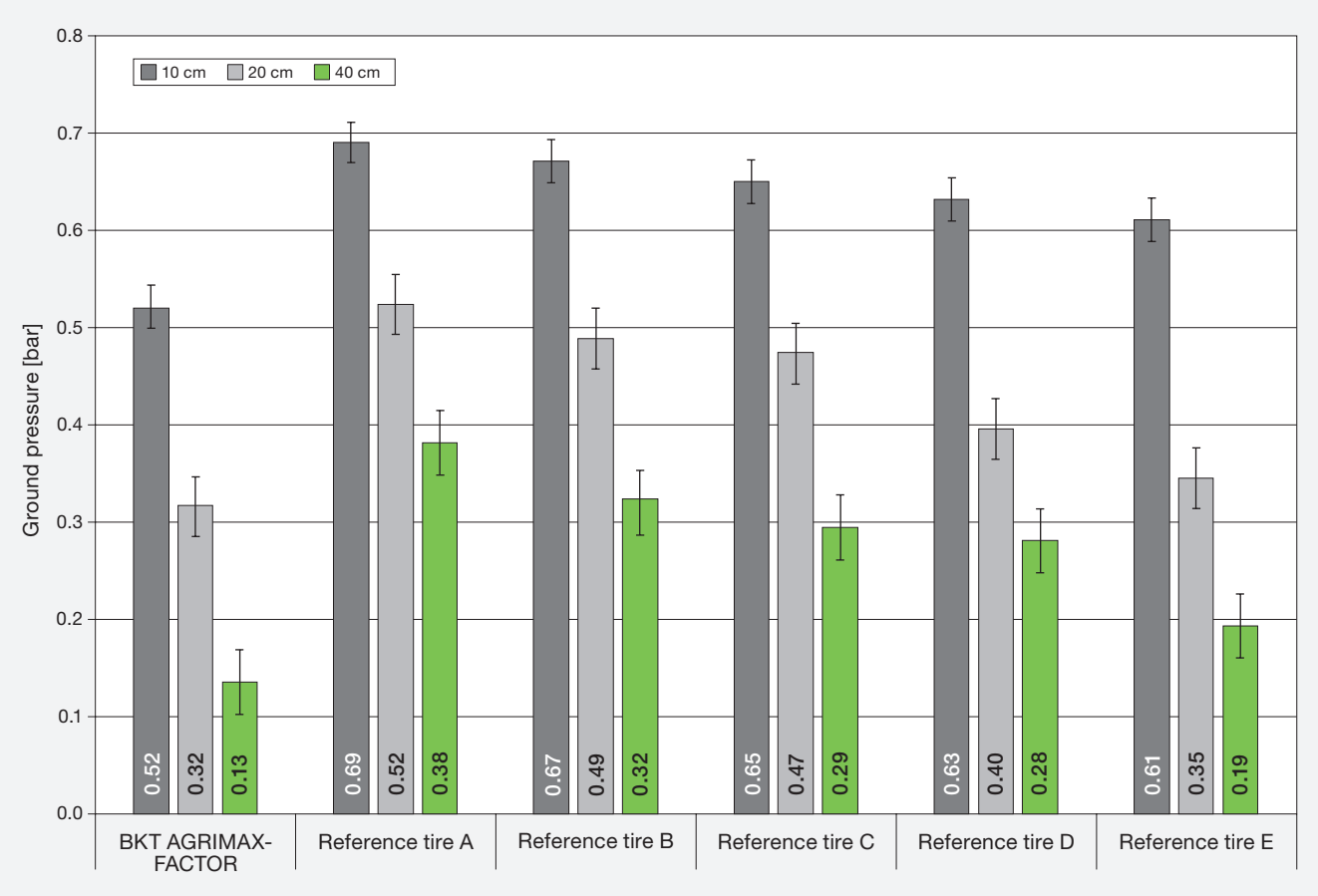

Figure 12:
Ground pressure at 0.6 bar at depths of 10 cm, 20 cm and 40 cm

Tractive power and area performance

The tractive power is calculated based on the tractive force and the travelling speed.

In this test, a tractive force of 45 kN was set to simulate a 3-m-wide soil cultivation implement. The tires can achieve different speed results depending on the traction (slip).

The average transmitted tractive power in the field test was 107.3 kW. In this case, the BKT AGRIMAXFACTOR tires correspond exactly to the average value of all tested tires here.

The area performance (ha/h) is calculated based on the width of the soil cultivation implement and the speed reached.

The average for all tested tires is 2.58 ha/h. Three of the tested tire sets are above average and two are below. The BKT AGRIMAXFACTOR tires achieve the third-highest area performance value of 2.60 ha/h.

Accordingly, the BKT AGRIMAXFACTOR tires are 0.8 % better than average and even 5.8 % better than the worst-performing competitor in the test.

Fuel consumption in the field test

High area perfomance tends to lead to low fuel consumption. The average consumption in the test at a tire inflation pressure of 0.6 bar and a braking force of 45 kN is 17.4 l/ha.

Therefore, the BKT AGRIMAXFACTOR are 1.7 % above average of all tested tires.

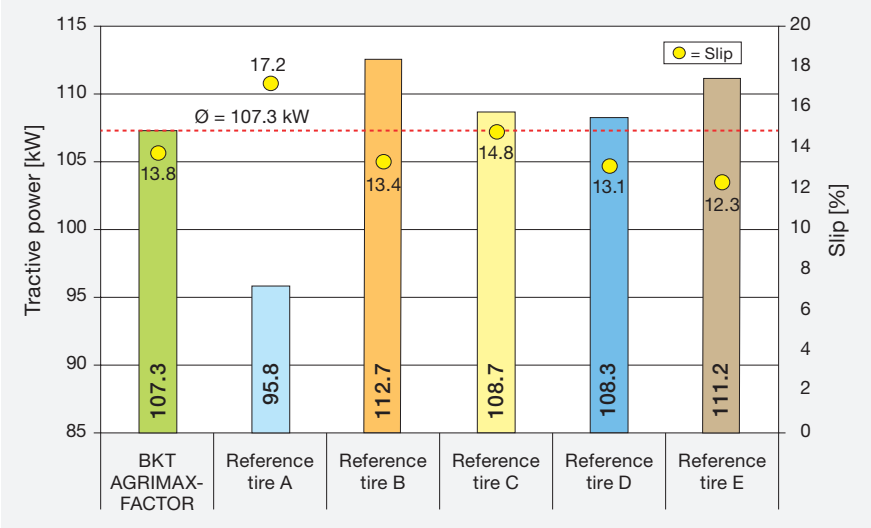

Figure 13:
Tractive power [kW] and slip [%] with an tire inflation pressure of 0.6 bar and a tractive force of 45 kN

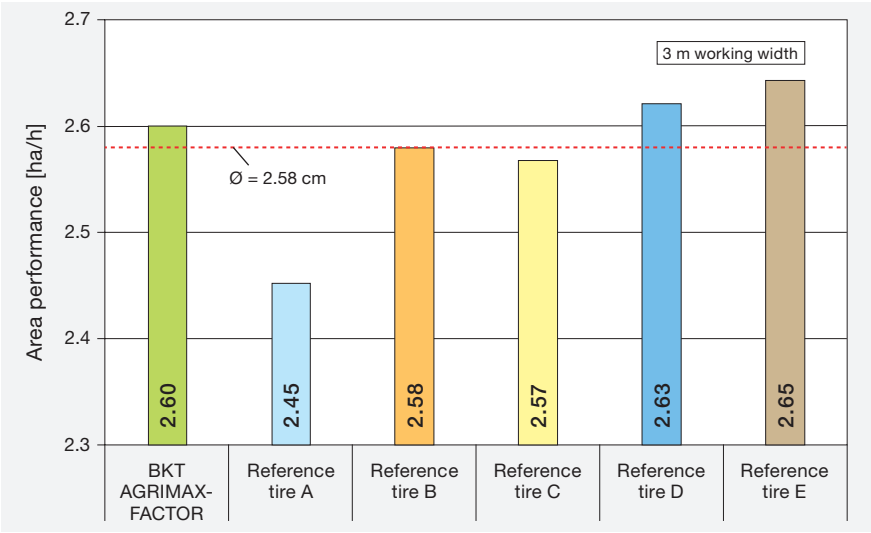

Figure 14:
Area performance at a tire inflation pressure of 0.6 bar and a braking force of 45 kN

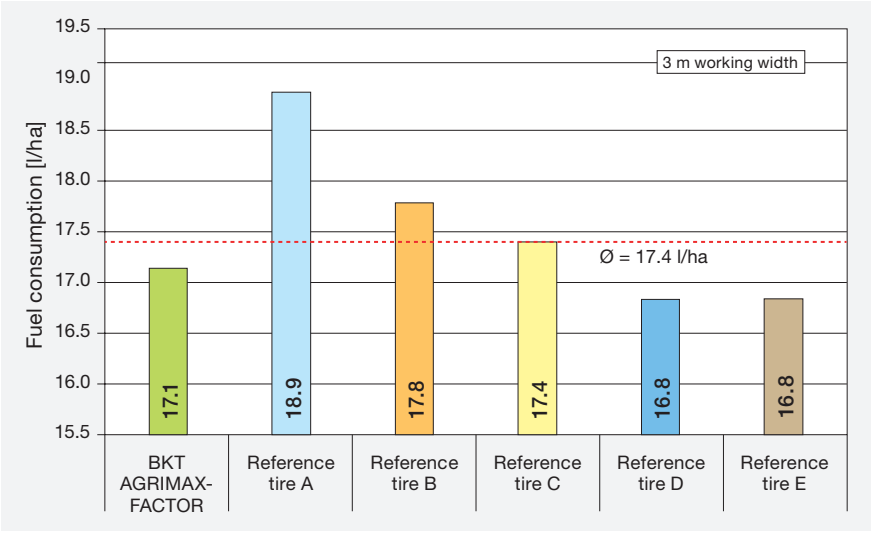

Figure 15:
Consumption [l/ha] at a tire inflation pressure of 0.6 bar and a braking force of 45 kN

Fuel consumption during transport runs on the chassis dynamometer

The differences in fuel consumption during the transport runs are within a range of 3 % to 4 %.

During the 40 km/h variant in the transport test (DLG-PowerMix), the BKT AGRIMAXFACTOR tires have a specific fuel consumption of 367 g/kWh. During the 50 km/h variant in the transport test, the BKT AGRIMAXFACTOR tires have a specific fuel consumption of 372 g/kWh.

Similar results are found for fuel consumption per tonne per 100 kilometres (l/t · 100 km). During the 40 km/h variant, the fuel consumption with the BKT AGRIMAXFACTOR tires is 4.06 l/t · 100 km.

During the 50 km/h variant, the fuel consumption with the BKT AGRIMAXFACTOR tires is 4.10 l/t · 100 km.

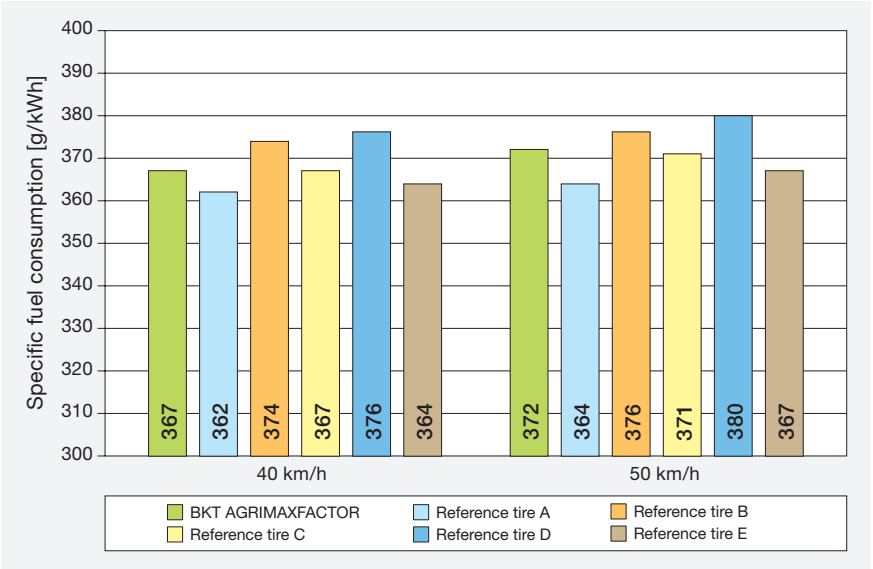

Figure 16:
Specific fuel consumption g/kWh

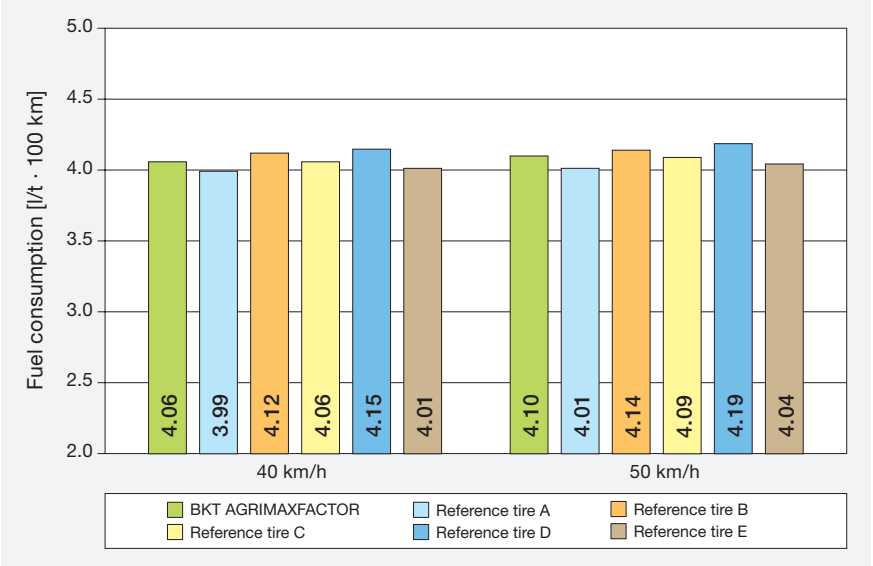

Figure 17:
Fuel consumption in l/t · 100 km

Conclusion

This report details the testing of the tractor tire combination BKT AGRIMAXFACTOR 710/70 R 42 and BKT AGRIMAXFACTOR 600/70 R 30 in line with the DLG Test Module “Resources Protection”. The internal tire pressure is reduced to 0.6 bar to determine the effects on resource conservation compared to an internal tire pressure of 1.3 bar.

The evaluation is done based on the measurement of the tire contact area, ground pressure, track depth, fuel consumption in the field test and transport runs on the DLG chassis dynamometer, traction/slip curve, tractive power, and area performance.

The BKT AGRIMAXFACTOR tires have achieved positive results in terms of tire contact area, ground pressure and track depth. The BKT AGRIMAXFACTOR tires have the lowest measured ground pressure compared to their competitors. As to the track depth, the BKT AGRIMAXFACTOR tires have the second-smallest value, resulting in a lower degradation of the soil area.

With regards to fuel consumption in the field test and in transport runs on the DLG chassis dynamometer, the BKT AGRIMAXFACTOR tires achieves good values. The same applies to the area performance.

The specifications and properties of the BKT AGRIMAXFACTOR are comparable to those of tires with VF (Very High Flexion) technology.

Further information

Testing agency

DLG TestService GmbH, Gross-Umstadt location, Germany, in cooperation with the Kiel University of Applied Sciences, Faculty of Agriculture, Dept. Agricultural Engineering

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

DLG test framework

DLG Test Framework for Agricultural Tires (current as 07/2023)

Department

Vehicle technology

Examiner

Prof. Dr. Yves Reckleben
(University of Applied Sciences Kiel)

Martin Hanstein (DLG)*

Photos and graphics

DLG, Kiel University of Applied Sciences, Department of Agriculture, Dept. Agricultural Engineering and BKT Europe SrL

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DLG – the open network and professional voice

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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.

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Internal test code DLG: 2312-0052

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