DLG Test Report 6256F

Great Plains International

SL 400 combination cultivator/disc harrow

Power requirement and quality of work

DLG FOKUS TEST

11/14 Power requirement and quality of work

Test Center
Technology and Farm Inputs

www.DLG-Test.de

Overview

The FokusTest is a smaller-scale DLG usability test intended to allow product differentiation and special highlighting of innovations in machinery and technical products used primarily in agriculture, forestry, horticulture, fruit cultivation and viticulture, as well as in landscape and municipal management.

This test focuses on testing a product's individual qualitative criteria, e.g. fatigue strength, performance, or quality of work.

The scope of testing can include criteria from the testing framework of a DLG SignumTest, the DLG's extensive usability test for technical products, and concludes with the publishing of a test report and the awarding of a test mark.

The DLG FokusTest "Power requirement and quality of work" was carried out with the GREAT PLAINS DTX 300 mounted short disc harrow with deep loosening tines (working width: 300 cm (118 in.)). The measurements were taken on harvested, largely flat areas of wheat cultivation at the DLG International Crop Production Center in Bernburg-Strenzfeld (Saxony-Anhalt).

The DLG FokusTest "Power requirement and quality of work" examined the following testing parameters based on the DLG testing framework for soil cultivation equipment:

– tractive power requirement;
– actual travel speed and theoretical area treated per hour;
– actual working depth and cultivation horizon of the tools;
– profile of the soil surface before and after the working step;
– crumbling of the soil (aggregate size distribution);
– compactness after the working step;
– straw covering and straw incorporation;
– operation.

In addition, the tractor's fuel consumption was measured.

In order to document the field conditions during soil cultivation, the stubble heights, straw yield and ground moisture were determined and described.

Other criteria were not examined in this test.

Assessment – Brief Summary

The GREAT PLAINS SL 400 combination cultivator/disc harrow allows stubble cultivation (first soil cultivation step), as well as the subsequent deeper soil cultivation steps. The tests were carried out at two travel speeds (7 km/h (4.3 mph) and 9.5 km/h (5.9 mph)). The following working depths were specified and adhered to for these tests:

– First soil cultivation step: working depth of discs: 8 cm (3.1 in.); working depth of cultivator tines: 18 cm (7.1 in.)
– Second soil cultivation step: working depth of discs: 10 to 16 cm (3.9 to 6.3 in.); working depth of cultivator tines; 20 to 25 cm (7.9 to 9.8 in.)

The measurement runs were performed without disturbances; no blockages occurred and no lateral pull was identified.

In the first soil cultivation step, the tractive power requirement is 110 kW (150 PS) (at a working speed of 7.1 km/h (4.4 mph)) and 162 kW (220 PS) (at 9.6 km/h (6 mph)).

In the second, somewhat deeper soil cultivation step, the tractive power requirement is 94 kW (128 PS) (at 6.6 km/h (4.1 mph)) and 151 kW (205 PS) (at 9.3 km/h (5.8 mph)). As expected, there were corresponding gradations in the measured fuel consumption values. These are approx. 13.5 l/ha (1.4 GPA) and 15.5 l/ha (1.7 GPA) at travel speeds of 7 km/h (4.3 mph) and 9.5 km/h (5.9 mph) respectively.

The evenness of the surfaces and the compactness after cultivation were at a comparable level in all trial variants.

With the first soil cultivation step, 73 % of the straw is incorporated into the soil at a straw covering of 8.8 t/ha (3.9 TPA) and a working speed of 7.1 km/h (4.4 mph). At a working speed of 9.6 km/h (6 mph), 82 % of the straw is incorporated into the soil.

For the second, deeper soil cultivation step, the straw covering was 3.5 t/ha (1.6 TPA). Here, the proportion of incorporated straw increases as the travel speed increases from 51 % at 6.6 km/h (4.1 mph) to 66 % at 9.3 km/h (5.8 mph). For the deeper soil cultivation step, the distribution of the incorporated straw over the various soil horizons is almost identical at both travel speeds. 72 % of the incorporated straw is mixed into the upper soil horizon (0 to 5 cm (0 to 2 in.)), approx. 26 % into the second soil horizon (5 to 10 cm (2 to 4 in.)), and 2 % into the soil horizon between 10 cm (4 in.) and 15 cm (6 in.).

The discs' cutting angle can be configured quickly and easily (+). The working depth of the disc harrow is adjusted without tools by inserting or removing spacers on a piston rod. This requires the operator to climb inside the equipment's frame (–). In order to adjust the working depth of the cultivator tines, the operator must climb under the equipment and adjust the height of the blade arms (–). The SL 400 has a permanently installed lighting unit (+) and a facility (bracket) for the orderly storage of hydraulic lines (+).

Manufacturer and Applicant

Manufacturer:
Great Plains UK Ltd
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Product:
Towed SL 400 combination cultivator/disc harrow

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Description and Technical Data

According to the manufacturer, the GREAT PLAINS SL 400 towed combination cultivator/disc harrow is suitable for stubble cultivation, deeper soil cultivation and seedbed preparation. If additionally fitted with the "Turbo Jet" sowing unit, it can also sow oilseed rape, grass seed and intermediate crops during the soil cultivation process. Great Plains supplies the equipment in working widths of 4.0 metres (157 in.), 5.0 metres (197 in.), 6.0 metres (236 in.) and 6.7 metres (264 in.). The SL 400 used in the DLG test had a working width of 4.0 metres (157 in.). The mounted equipment is attached to the tractor via the linkage arms (category III).

The equipment has 10 cultivator tines between the two rows of discs on the disc harrow. It is therefore possible with the SL 400 to carry out shallow soil cultivation with straw incorporation in conjunction with soil loosening down to a depth of 25 cm (9.8 in.) in a single working step. For the working width of 4 metres, the device is fitted with 16 discs in each of the first and second rows of discs. All of the discs in the first row are curved in the same direction. All of the discs in the second row are curved in the opposite direction.

Figure 2:
Front and rear rows of discs with conical concave discs, with cultivator tines fitted between them for deeper soil cultivation

Figure 3:
Disc cutting angle adjustment (shown here: rear row of discs)

The disc spacing in the SL 400 is 266 mm (10.5 in.) and the line spacing is 133 mm (5.25 in.).

The cone-shaped concave discs of the tested machine (Figure 2) have a diameter of 500 mm (19.7 in) and are each mounted on a ball bearing, each of which has a grease nipple. If special grease is used for maintenance, each grease nipple must be lubricated after 200 hours.

Each disc is connected to the frame via a supporting arm. The flexible supporting arms also provide overload protection (also Figure 2). According to the manufacturer, this means each disc can lift out of the way individually on contact with an obstacle. This does not affect the working depth of the other discs. The operator can adapt the cutting angle of the two rows of discs to the respective field conditions. Four cranks are used to manually adjust the angle steplessly from 0 to 25 degrees. Each crank is fitted with a five-step scale (Figure 3).

Figure 4:
Depth adjustment by inserting spacers on two piston rods of the rear roller

Figure 5:
Rear roller – "Double Disc Light" steel packer roller with soil scrapers

Table 1:
Technical data for the "SL 400" combination cultivator/disc harrows

Technical data*	
Working width	4.0 m (157 in.)
Frame height	660 mm (26 in.)
Number of discs	32
Rows of discs	2
Line spacing of discs	133 mm (5.25 in.)
Number of cultivator tines	10
Line spacing of tines	42.5 cm (16.7 in.)
Number of bars	2
Distance from bar to bar	70 cm (27.6 in.)
Transport width	3.0 m (118 in.)
Weight with "Double Disc Light" rear roller	7200 kg

* Manufacturer's data

The working depth of the disc harrow is configured via the linkage arms of the tractor's lifting gear and via the penetration depth of the rear roller. In order to adjust the working depth on the rear roller, the operator must insert or remove spacers on two piston rods (Figure 4).

The working depth of the 10 cultivator tines is adjusted individually for each tine. To do this, a bolt must be removed on the respective tine. Once the operator has shifted the tine manually to the desired height, the bolt is passed back through the hole in the tine in order to fix the share at the corresponding height (also Figure 2). According to the manufacturer, this allows the respective tines to be adjusted individually, for example in order to loosen up compaction caused by the towing vehicle for soil cultivation or compacted soil in the machine tracks. Hydraulic depth adjustment is fitted as standard to the SL with a working width of 6.7 metres (264 in.). The 10 cultivator tines on the tested equipment have a line spacing of 42.5 cm (16.7 in.).

The SL 400 combination cultivator/disc harrow (working width: 4.0 metres (157 in.)) used in the DLG FokusTest was equipped with the two-part "Double Disc Light" steel packer roller with a total of six rear roller options and rear drawbar. This roller has a diameter of 600 mm (23.6 in.). Soil scrapers are mounted between the 20 steel discs. The spacing between the discs is 200 mm (7.9 in.). The two-part roller is mounted on four ball bearings, each of which has a grease nipple. Figure 5 shows the rear roller used in the DLG test. On the headland, the soil cultivation equipment is lifted off via the chassis.

When the combination cultivator/disc harrow is converted from working position to transport position, the right and left parts of the frame are folded vertically upwards by hydraulics. The equipment is secured for transport with two hooks that prevent the two side parts from unfolding unintentionally. The transport securing is re-

Figure 6:
Device for preventing the two side parts from unfolding unintentionally

leased by a single-acting hydraulic cylinder (Figure 6), which can be operated via a control unit in the tractor cabin.

Other observations

The SL 400 is fitted as standard with a lighting installation and four red/white-striped marker boards (two signs pointing backwards, two facing forwards). The equipment is optionally available with an air brake, and this was present in the tested equipment.

The brackets provided (Figure 7) allow easy hanging of the five hoses of the hydraulic circuits (unlocking of transport securing, folding, raising/lowering the chassis) after removal.

The equipment is also fitted with a sealable hard plastic tube in which the operating instructions can be stowed.

In addition, the tested equipment was fitted with two sealable steel boxes, which can be used to store shares or tools, for example. Both boxes are mounted on the side parts of the frame. When the equipment adopts the transport position, the boxes fold upwards with the two side parts.

Figure 7:
Facility for hanging hydraulic hoses when shutting down the short disc harrow

Figure 8:
DLG 3D dynamometers for measuring the tractive force requirement

The DLG FokusTest "Power requirement and quality of work" tests soil cultivation equipment based on the corresponding DLG testing framework in field tests and under practical conditions. For this purpose, measurements are taken on suitable trial areas at standard travel speeds and working depths.

In order to document the trial conditions, the testers determine the terrain characteristics, the stubble heights, the straw left behind on the area, and the soil moisture content, as well as documenting the prevailing weather during the test.

In the DLG FokusTest, the basic configuration of the soil cultivation equipment is adapted to the respective field conditions. Therefore, neutral runs are performed on the test area before the actual measurement runs begin in order to determine the suitable configuration for the machines.

Directly before or during the measurement runs, samples are taken in order to determine the soil moisture content, and the stubble heights are measured for the purpose of documenting the trial conditions. A description is made of the soil type and the arrangement of the areas.

The tractive power requirement is measured using the DLG Test Center's modular measuring system. The travel speeds and route distances are recorded using a Correvit L400 from the company KISTLER MESSTECHNIK. In addition to this, the fuel consumption can be documented using the DLG's mobile fuel-measurement technology.

The actual travel speed and working width are used to calculate the theoretical area treated per hour. This does not take account of possible overlaps or turning times.

A laser sensor is used to determine the surface profile before and after cultivation, as well as the penetration depths of the tools (for the SL 400: discs and cultivator shares) and the average working depth. The laser sensor scans the surfaces at right angles to the direction of travel without touching them, and the measured values are then used to compile a height profile. In order to describe the evenness of the area, the standard deviation (SD) for the height profile of the cultivated soil surface is calculated from the individual measured values. The lower the calculated standard deviation, the more even the cultivated soil surface. The cultivation horizon is exposed for the purposes of calibration (Figure 11). The measured values for the cultivation profile of the tools are then used to determine the maximum penetration depth and to calculate the average working depth (for the cultivation horizon of the discs and the cultivator shares in the case of the SL 400).

In order to represent the crumbling effect of the cultivation equipment, the aggregate size distribution in the working layer is measured and described. For this purpose, soil samples are taken carefully and non-destructively from the cultivated soil layer and then air-dried to constant weight. The soil samples dried in this way are then fractionated by sieve analysis, and the proportions in the various soil fractions are used to calculate the weighted average diameter (WAD). The smaller the WAD, the greater the proportion of smaller soil aggregates.

The recompacting effect is determined based on the compactness of the soil, which is determined using core cylinder samples. The core cylinder samples are taken to a depth of

Figure 9:
Kistler Correvit L400

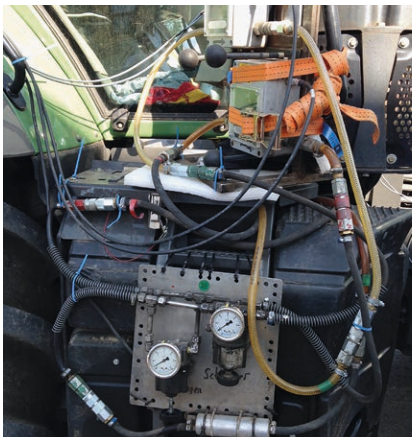

Figure 10:
Mobile DLG fuel-measurement technology

6 cm (2.4 in.) for shallow stubble cultivation and to a depth of 12 cm (4.7 in.) for deeper soil cultivation.

The straw covering is determined before and after soil cultivation. For this purpose, all of the straw is collected up over areas of 0.5 m² at several representative locations on the trial field before being air-dried and weighed. The quantity of straw incorporated into the soil due to cultivation is calculated from the difference between the two results.

The distribution of the incorporated straw in the individual soil horizons is determined using the grid screen method according to Voßhenrich (2003). The soil profile is exposed to a depth of 20 cm (7.9 in.) across the entire working width. In doing so, care is taken to ensure a cleanly cut profile wall. A grid screen is then used to assess and classify the incorporated proportion of straw for each assessment square (5 cm x 5 cm (1.97 x 1.97 in.)). The results are represented graphically (Figure 12). Different colours are assigned to the various classes for the straw proportions. The higher the proportion of straw in a grid, the darker the colour in the representation. To give a better overview, the diagram is divided into three sub-diagrams (left section of width, central section of width, right section of width). The totals of the assessment values for each soil horizon are recorded in the diagram (bottom right) as parameters for the distribution of the incorporated straw.
This is used to calculate the proportions of incorporated straw.

Figure 11:
Example image of a cultivation horizon

The diagram below shows an example result from the DLG test with the GREAT PLAINS SL 400 towed combination cultivator/disc harrow (deeper, second soil cultivation step, travel speed 9.3 km/h (5.8 mph)).

The operation is evaluated primarily based on the following working steps:
- configuration of working depth;
- adjustment of disc cutting angle;
- adjustment of levelling unit (where present);
- installation and/or storage of the hydraulic lines;
- mounting and/or removal of the lighting unit.

The results are evaluated based on a DLG evaluation scheme. Other working steps going beyond these can also be described.

Working depth

Section 1 of width (left)

Working depth																									
0–5 cm	50	10	10	0	10	75	25	10	10	10	25	25	25	10	25	10	10	50	50	10	10	10	10	25	75
5–10 cm	10	0	0	10	0	25	10	10	10	0	25	10	10	10	10	10	25	25	10	0	0	0	10	0	10
10–15 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
15–20 cm																									
20–25 cm																									

Section 2 of width (left)

Working depth																									
0–5 cm	50	100	50	25	10	50	50	10	10	50	25	25	10	10	10	25	25	25	50	50	25	10	10	25	10
5–10 cm	10	25	10	10	10	10	10	10	10	25	10	10	10	10	0	10	10	50	10	50	10	0	10	50	0
10–15 cm	0	10	0	0	0	0	0	10	10	0	0	0	0	0	0	0	0	10	0	0	0	0	10	10	0
15–20 cm																									
20–25 cm																									

Section 3 of width (left)

Working depth																						Total	Relative proportion
0–5 cm	50	10	10	10	10	10	50	10	25	25	10	10	10	10	0	10	10	25	50	50	25	1740	67%
5–10 cm	10	10	10	0	10	10	10	10	10	10	25	10	0	10	10	0	10	0	0	10	10	775	30%
10–15 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	80	3%
15–20 cm																						Σ 2595	100%
20–25 cm																							

Proportion of straw [%]						
	0	10	25	50	75	100

Figure 12:
Representation of straw incorporation into the soil according to the grid screen method (Voßhenrich, 2003)

Test

The measurement runs were performed in August 2014 on a harvested wheat field at the DLG International Crop Production Center (IPZ) in Bernburg-Strenzfeld (Saxony-Anhalt). The trial field is largely homogeneous and has soil of the type “loess clay” with a soil rating of 87 points according to the Reichsbodenschätzung (German soil survey). During the test, the weather was sunny with light winds and temperatures of around 20 °C (68 °F). The soil was wet during the measurement period. The determined soil moisture content during the test was between 22.9 % and 25.3 %. The straw was chopped by the combine harvester during harvesting and left on the field. The straw distribution and the chopping quality of the combine harvester were assessed visually and evaluated as good.

Table 2:
Trial variants

	First soil cultivation step = stubble cultivation		Second soil cultivation step	
Soil type, soil rating points	loess clay, 87 points			
Soil moisture content	22.9 % to 25.3 %			
Previous working steps	combine harvesting with straw chopper		combine harvesting with straw chopper, first soil cultivation step with GREAT PLAINS X-PRESS 6.6 m short disc harrow	
Straw covering before cultivation	8.8 t/ha (3.9 TPA)		3.5 t/ha (1.6 TPA)	
Target working depth	disc harrow: 8 cm (3.1 in.) loosening tines: 18 cm (7.1 in.)		disc harrow: 15 cm (5.9 in.) loosening tines: 25 cm (9.8 in.)	
Travel speed	7 km/h (4.3 mph)	9 km/h (5.6 mph)	7 km/h (4.3 mph)	10 km/h (6.2 mph)

Table 3:
Travel speed, working depth, tractive power requirement, fuel consumption and area treated per hour

	First soil cultivation step = stubble cultivation		Second soil cultivation step	
Actual travel speed	7.1 km/h (4.4 mph)	9.6 km/h (6 mph)	6.6 km/h (4.1 mph)	9.3 km/h (5.8 mph)
Maximum penetration depth of disc harrow	7.9 cm (3.1 in.)	8.0 cm (3.1 in.)	16.4 cm (6.5 in.)	17.5 cm (6.9 in.)
Average working depth of disc harrow	6.3 cm (2.5 in.)	6.6 cm (2.6 in.)	12.1 cm (4.8 in.)	12.0 cm (4.7 in.)
Maximum penetration depth of cultivator tines	18.3 cm (7.2 in.)	18.1 cm (7.1 in.)	24.3 cm (9.6 in.)	23.5 cm (9.3 in.)
Average working depth of cultivator tines	9.8 cm (3.9 in.)	9.4 cm (3.7 in.)	16.7 cm (6.6 in.)	15.2 cm (6 in.)
Tractive power requirement	110 kW (150 PS)	162 kW (220 PS)	94 kW (128 PS)	151 kW (205 PS)
Fuel consumption	14.3 l/ha (1.53 GPA)	16.4 l/ha (1.75 GPA)	12.9 l/ha (1.38 GPA)	14.9 l/ha (1.59 GPA)
Theoretical area treated per hour	2.84 ha/h (7.01 ac/h)	3.84 ha/h (9.48 ac/h)	2.64 ha/h (6.52 ac/h)	3.72 ha/h (9.19 ac/h)

A first, shallow soil cultivation step and a second, deeper soil cultivation step were carried out in the DLG test. The first soil cultivation step took place on an area of wheat stubble as the first working step after combine harvesting. For the second, deeper soil cultivation step, the trial area had already been shallow cultivated once before the test (working depth: 6 to 8 cm (2.4 to 3.1 in.)) with the GREAT PLAINS X-Press 6.6 m short disc harrow. A period of 23 days passed before the second soil cultivation step with the SL 400; 71 mm of precipitation fell during this time. On the area of stubble, an average stubble length of 18 cm (7.1 in.) was measured (minimum: 11 cm (4.3 in.), maximum: 26 cm (10.2 in.), standard deviation: 2.9 cm (1.1 in.)). The straw covering (chopped straw and stubble before the soil cultivation step) was 8.8 t/ha (3.9 TPA) on average (minimum: 6.4 t/ha (2.9 TPA), maximum: 11.8 t/ha (5.3 TPA), standard deviation: 1.6 t/ha (0.7 TPA)). For the second, deeper soil cultivation step, the straw covering on the trial area was 3.5 t/ha (1.6 TPA) on average (minimum: 2.0 t/ha (0.9 TPA), maximum: 6.0 t/ha (2.7 TPA), standard deviation: 1.3 t/ha (0.6 TPA)). Table 2 shows the basic field conditions and the various trial variants.

A Fendt Vario 936 tractor was available for the test (rated power at 2200 rpm: 330 PS, maximum power at 1900 rpm: 360 PS).

Travel speed, working depth, tractive power requirement, fuel consumption and area treated per hour

Table 3 summarises the results for the actually achieved travel speed and working depth, for the resulting tractive power requirement and fuel consumption, and for the calculated, theoretical area treated per hour.

The target travel speeds and working depths are achieved in the DLG test. The tractive power requirement increases as the travel speed increases from 110 kW (150 PS) to 162 kW (220 PS) in the first soil cultivation step and from 94 kW (128 PS) to 151 kW (205 PS) in the second, deeper soil cultivation step. As expected, there were corresponding gradations in the measured fuel consumption values. These are approx. 13.5 l/ha (1.4 GPA) and 15.5 l/ha (1.7 GPA) at travel speeds of 7 km/h (4.3 mph) and 9.5 km/h (5.9 mph) respectively.

For the SL 400 with a working width of 4 metres (157 in.), the calculated values for the theoretical areas treated per hour were around 2.8 ha/h (6.9 ac/h) at a travel speed of approx. 7 km/h (4.3 mph) and around 3.8 ha/h (9.4 ac/h) at a travel speed of approx. 9.5 km/h (5.9 mph).

Surface structure, compactness and crumbling

The standard deviation (SD) is used to describe the roughness of the surface, and the weighted average diameter (WAD) of the produced soil aggregates is used to describe the crumbling. The evenness of the surfaces and the compactness after cultivation were comparable in all trial variants. Somewhat less crumbling was observed in those variants with a lower travel speed. Table 4 presents a summary of the test results.

Table 4:
Surface structure, compactness and crumbling

	First soil cultivation step = stubble cultivation		Second soil cultivation step	
Actual travel speed	7.1 km/h (4.4 mph)	9.6 km/h (6.0 mph)	6.6 km/h (4.1 mph)	9.3 km/h (5.8 mph)
Roughness [average SD* from three repetitions]	2.3 cm [2.1 / 2.4 / 2.3] 0.91 in. [0.83 / 0.94 / 0.91]	2.4 cm [1.8 / 2.6 / 2.9] 0.94 in. [0.71 / 1.02 / 1.14]	2.3 cm [2.4 / 2.4 / 2.2] 0.91 in. [0.94 / 0.94 / 0.87]	2.6 cm [2.4 / 2.7 / 2.7] 1.02 in. [0.94 / 1.06 / 1.06]
Compactness	1.41 g/cm³	1.41 g/cm³	1.37 g/cm³	1.38 g/cm³
Crumbling [WAD**]	24.69 mm (0.9720 in.)	22.02 mm (0.8669 in.)	24.98 mm (0.9834 in.)	22.49 mm (0.8854 in.)
Aggregate size proportions [%]				
< 2,5 mm	12.31 %	14.26 %	14.95 %	16.92 %
2,5 to 5 mm	12.84 %	14.50 %	13.47 %	15.03 %
5 to 10 mm	13.54 %	14.87 %	13.05 %	14.19 %
10 to 20 mm	17.41 %	17.25 %	15.78 %	16.08 %
20 to 40 mm	22.70 %	20.06 %	19.77 %	16.58 %
40 to 80 mm	19.95 %	18.69 %	19.91 %	19.85 %
> 80 mm	1.25 %	0.37 %	3.07 %	1.35 %

* Standard deviation
** Weighted average diameter of soil aggregates

Figure 13 shows an example of the graphical representation from the survey of the soil surfaces at the time of the first soil cultivation step (stubble cultivation) at a travel speed of 7.1 km/h (4.4 mph). The coloured lines represent the profiles of the soil surfaces before cultivation (red) and after cultivation (green), as well as the exposed cultivation horizon of the discs (light blue) and the cultivation horizon of the cultivator tines (dark blue). The red arrow in Figure 13 shows the maximum penetration depth (= working depth) of the discs, which is 11.5 cm (4.5 in.) in the chosen example. A value of 6.7 cm (2.6 in.) is calculated for the average working depth of the discs (see orange arrow). The maximum penetration depth of the cultivator tines is

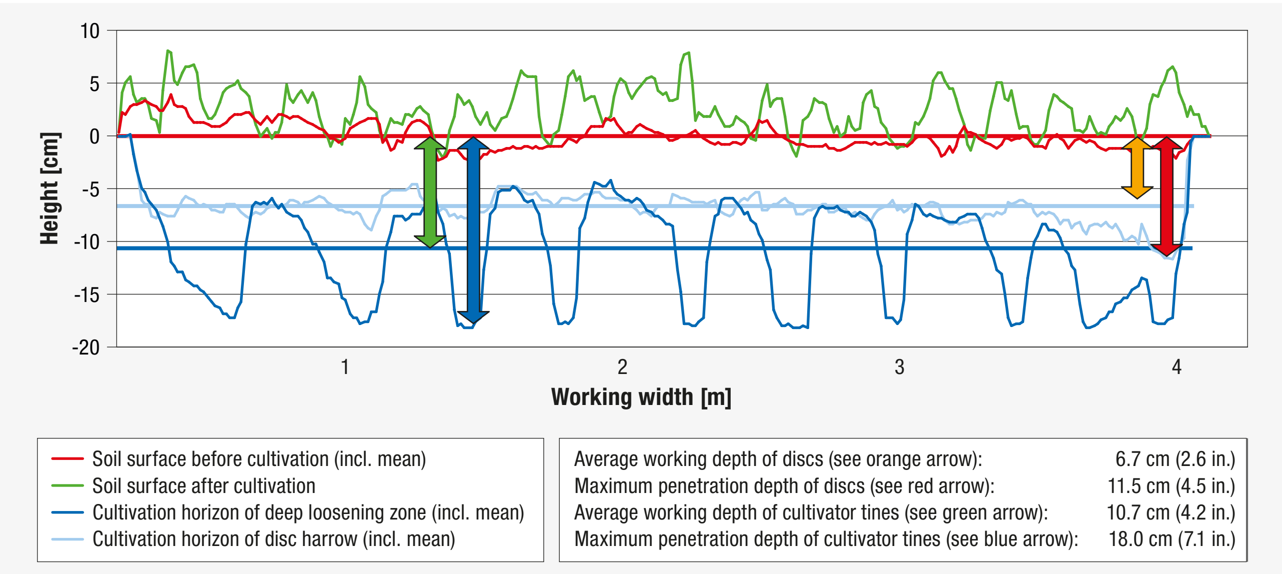

Figure 13:
Measurements of soil surface and cultivation horizon in the event of a repetition of stubble cultivation

Table 5:
Incorporated quantity of straw per soil horizon in the second working step (straw covering before cultivation: 3.5 t/ha (1.56 TPA))

Incorporation results with a straw covering of 3.5 t/ha (1.56 TPA) prior to cultivation		
Travel speed	6.6 km/h (4.1 mph)	9.3 km/h (5.8 mph)
Incorporated straw	51 % (1.8 t/ha (0.80 TPA))	66 % (2.3 t/ha (1.03 TPA))
Distribution in soil horizons		
0 to 5 cm (0 to 2 in.)	73 % (1.31 t/ha (0.58 TPA))	71 % (1,63 t/ha (0.73 TPA))
5 to 10 cm (2 to 4 in.)	25 % (0.45 t/ha (0.20 TPA))	27 % (0.62 t/ha (0.28 TPA))
10 to 15 cm (4 to 6 in.)	2 % (0.04 t/ha (0.02 TPA))	2 % (0.05 t/ha (0.02 TPA))

18.0 cm (7.1 in.) (see dark-blue arrow). A value of 10.7 cm (4.2 in.) is obtained for the average working depth of the cultivator tines (see green arrow). The standard deviation (SD), used as a measure of the roughness of the soil surface after cultivation with the short disc harrow, is 2.1 cm (0.8 in.) in the chosen example. It can be seen from the dark-blue line that the “soil ridges” between the lines of the cultivator shares are not broken up. This can be explained by the increased soil moisture content during soil cultivation.

Straw covering and straw incorporation

Before the first soil cultivation step, the straw covering on the trial area was 8.8 t/ha (3.9 TPA) (chopped straw and stubble). The first working step (stubble cultivation) incorporated approximately 73 % of the straw covering (6.4 t of straw per hectare (2.9 TPA)) into the soil at a travel speed of 7.1 km/h (4.4 mph). At a travel speed of 9.6 km/h (6 mph), 82 % of the straw covering (7.2 t of straw per hectare (3.2 TPA)) was incorporated into the soil. As an example, Figure 14 shows a cultivated sub-area following the first working step (at a travel speed of 9.6 km/h (6 mph)).

Figure 14:
Cultivation pattern left behind by the SL 400 combination cultivator/disc harrow in the first working step (working speed: 9.6 km/h (3.8 mph))

Prior to the second, deeper soil cultivation step, the trial area had already been tilled once with the GREAT PLAINS X-Press 6.6 m short disc harrow. The straw covering remaining on the trial area for the subsequent working step was 3.5 t/ha (1.6 TPA). In the second, deeper soil cultivation step with the SL 400, approximately 51 % of the straw (1.8 t/ha (0.8 TPA)) was incorporated into the soil at a travel speed of 6.6 km/h (4.1 mph). At an increased travel speed of 9.3 km/h (5.8 mph), the proportion of incorporated straw increased to 66 % (2.3 t/ha (1 TPA)). The travel speed had only a slight influence on the proportional distribution of incorporated straw across the various soil horizons. Approximately 72 % of the straw is incorporated into the first soil horizon (0 to 5 cm (0 to 2 in.)) and approx. 26 % is incorporated into the second soil horizon (5 to 10 cm (2 to 4 in.)) (see Table 5). As an example, Figure 15 shows a sub-area after the second soil cultivation step (at a travel speed of 9.3 km/h (5.8 mph)).

Assessment of operation

The disc cutting angle can be configured easily using four crank handles. These crank handles are easily accessible to the operator, as they are attached outside of the equipment’s frame (+).

The working depth on the disc harrow is adjusted by folding spacers in or out of place on two piston rods of the rear roller. This requires the operator to climb inside the equipment’s frame (–). In order to adjust the working depth of the cultivator tines, the operator must climb under the equipment (–).

On the equipment being tested, all of the hydraulic couplings were marked with coloured cable ties.

A cable tie of the same colour is attached to the associated hydraulic cylinder. This makes it easy for the operator to identify the hydraulic cylinder to which the corresponding hydraulic couplings belong. After removal from the machine, the hydraulic hoses can be hung on the brackets provided (Figure 7). The storage facility for the hydraulic hoses is evaluated as "good" (+) according to the DLG evaluation framework.

The equipment has a permanently installed lighting system, which need not be removed for soil cultivation (+).

Table 6 shows an overview of the results of the evaluation of operation.

Figure 15:
Cultivation pattern left behind by the SL 400 combination cultivator/disc harrow in the second working step (working speed: 9.3 km/h (3.7 mph))

Table 6:
Evaluation of operation for the GREAT PLAINS SL 400

Test criterion	Test result	Evaluation*	Comments
Configuration of disc harrow working depth	unsatisfactory	–	In order to adjust the working depth of the disc harrow, the operator must climb into the equipment's frame.
Configuration of disc harrow cutting angle	good	+	The cutting angle adjustment is attached outside of the frame in an easily accessible manner. Adjustment does not require tools. The cutting angle can be configured to values of 5 to 25 degrees.
Configuration of working depth of cultivator tines	unsatisfactory	–	The working depth of the cultivator tines is adjusted from underneath the equipment. The manufacturer installs the technology described on page 4 for manual working-depth adjustment, allowing the operator to regulate each tine's working depth independently.
Storage of hydraulic lines	good	+	The equipment has coloured marking of the hydraulic hoses and a facility for their orderly storage.
Mounting/removal of lighting system	good	+	The lighting system is permanently installed and need not be removed prior to soil cultivation.

* Evaluation based on the DLG evaluation schemes for soil cultivation equipment

Summary

In the DLG FokusTest "Power requirement and quality of work", the GREAT PLAINS SL 400 combination cultivator/disc harrow was tested at various working depths and travel speeds on harvested areas of wheat.

The SL 400 allows both stubble ploughing (first soil cultivation step) and the subsequent deeper soil cultivation steps. The measurement runs were performed without disturbances, and no blockages occurred. No lateral pull was identified.

During the first soil cultivation step, the tractive power requirement is 110 kW (150 PS) (at a working speed of 7.1 km/h (4.4 mph)) and 162 kW (220 PS) (at 9.6 km/h (6 mph)). In the second, somewhat deeper soil cultivation step, the tractive power requirement is 94 kW (128 PS) (at 6.6 km/h (4.1 mph)) and 151 kW (205 PS) (at 9.3 km/h (5.8 mph)). As expected, there were corresponding gradations in the measured fuel consumption values. These are approx. 13.5 l/ha (1.4 GPA) and 15.5 l/ha (1.7 GPA) at travel speeds of 7 km/h (4.3 mph) and 9.5 km/h (5.9 mph) respectively.

The disc angle can be adjusted easily. No tools are needed to adjust the working depth of the disc harrow. However, this does require the operator to climb inside the equipment's frame.

The working depth of the cultivator tines is adjusted from underneath the equipment.

Further information

Within the field of the DLG's technical work, the DLG Committee for Technology in Crop Production deals with the topic of soil cultivation.

Instruction leaflets and documents relating to this technical work carried out on a voluntary basis are available for free in PDF format at: **www.dlg.org/technik_pflanzenproduktion.html**

Test execution

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DLG Testing Framework

FokusTest
"Power requirement
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