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Trends in tractors

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Agritechnica 2025 is looming large, with numerous new tractor innovations expected. Some manufacturers have already presented these and/or registered them for the Agritechnica Innovation Award competition, while others are holding back until the trade fair in November. This trend report includes new developments that were known and approved for publication by mid-September 2025.

Internal combustion engines

Stage 5 emissions standards for non-road vehicles have been in force for several years, and the further development of tractors is currently no longer driven as strongly by legislation on nitrous oxides and particulates as it was in the past. Today, the focus is more on reducing CO₂ emissions and consequently on the use of alternative fuels. Many manufacturers have approved the drive units of their current model series for operation with RME (rapeseed methyl ester) and HVO (hydrogenated vegetable oil). These are among the so-called drop-in fuels that can replace fossil diesel without any adjustments to engine and tank technologies.

In the background, work is being done on the usability of other alternative fuels, such as ethanol or hydrogen. Like RME and HVO, ethanol is a liquid fuel, but its volumetric energy density of around 21 MJ/l is significantly lower than that of diesel (around 36 MJ/l). Ethanol can be used in internal combustion engines that operate according to the Otto cycle with external ignition. This alcohol fuel is likely to be of particular interest to countries that can produce it themselves from sugar cane or maize, such as Brazil. Case IH is introducing a Puma 240 tractor with a modified 6-cylinder engine for markets like these. The N67 unit is based on the NG (natural gas/methane) version, but has been modified in various areas to run on ethanol.

Engine peripherals

In the case of classic diesel engines, manufacturers are increasingly focusing their attention on the "peripherals". Several new tractor series equipped with automatic reversing fans will be presented at Agritechnica 2025. There are also new developments in devices that can increase the drag torque of engines when driving downhill in order to protect the service brakes (wear-free continuous brakes). In addition to the familiar options of "baffle plate" and "constriction of the flow cross-section for VTG loaders" (VTG: Variable Turbocharger Geometry), CNH also uses a decompression valve in its new large tractors developed in Europe. This technology, which uses an additional valve per cylinder, originates from the truck industry and allows the compression pressure to be released at the end of the second stroke. As a result, the piston is pushed down less forcefully in the third stroke, which leads to significantly higher engine drag torques. Fendt also utilises the VTG loader option in its new 700 (Gen7.1) and 800 (Gen5) series and in addition relies on a so-called "hydraulic auxiliary brake". The working hydraulic pump pumps oil against resistance, thereby converting kinetic energy into heat energy. This type of continuous brake has also been offered by SDF for several years.

Two years ago, Fendt presented an automatic system for extracting dust from the engine air filter. This is now being expanded to include the cabin air filter and is available for the new 800 Gen5 and 1000 Gen4 series. The revised 1000 series continues to use MAN's familiar D26 6-cylinder engine (12.4 litre displacement), but all models now feature DynamicPerformance (DP) with increased power output of up to 30 hp. Consequently, the top model 1052 achieves a maximum output of 550 hp. Because not all attachments are designed for such high power outputs, Fendt offers the new "AdaptivePower" function. This means that, on larger models, the power curves of smaller models can also be selected via the FendtONE terminal. That protects implements from overload and also enables lower fuel consumption (e.g. through more moderate acceleration during transport work).

Gearboxes/chassis

With the introduction of the new 500 Fendt (Gen4) series, Fendt is once again extending the VarioDrive concept with permanent all-wheel drive up to 25 km/h and now offers this across the board in the 500, 600, 700, 800, 900 and 1000 series. CNH developed its own stepless gearboxes with hydrostatic-mechanical power split. The previous version with 2/1 driving ranges (forward/reverse) has been expanded to include a third forward driving range (3/1) for installation in the new T7 SWB models with a short wheelbase. In addition, the larger CVT box with 4/2 driving ranges (F/R) has been adapted to the higher performance of the new large tractors. JCB is switching to stepless gearboxes from ZF for its new Fastrac 6000 series and is also changing its engine supplier to FPT (both components were previously supplied by AGCO).

AEBl Schmidt will be the first manufacturer to install the 'Line Traction Version 3' (LT3) drive concept. It was developed in collaboration with Müller in Bonndorf in a series-production vehicle, the AEBl TERRATRAC slope implement carrier. With LT3, not only can the longitudinal differential (speed

compensation between the two drive axles) commonly found in such vehicles be dispensed with, but also the transverse differentials (speed compensation between the wheels of an axle). The drive shafts of all four wheels therefore always rotate at the same speed. In the downstream planetary final drives, the power flow runs – as usual – from the sun gear via the planetary carrier to the wheel hub. However, unlike conventional final drives, the ring gear in the LT3 drive is not permanently connected to the axle housing, but is instead supported hydrostatically by an external cam disk and radial pistons. When the TERRATRAC drives through a curve, the proportional valves integrated into the hydrostatic circuits (one per wheel) can be opened in a targeted manner, resulting in controlled counter-rotation of the hollow wheels. This in turn results in a reduction in the planetary carrier speed and therefore the wheel speed. The wheel furthest from the curve always plays the role of the "master", which means that the ring gear is completely supported here. For the other wheels ("slaves"), which travel shorter distances in curves, the proportional valves are opened until the respective target speeds are set depending on the steering angle, speed and vehicle geometry (wheelbase and track). The practical advantage is that each wheel is driven at the correct speed, even when cornering. This improves traction, reduces damage to the sod and increases safety when turning on slopes, where conventional drive concepts with differentials would require the locks to be released.

Great attention is also paid to the chassis. To take advantage of the benefits of modern radial tyres, manufacturers are increasingly offering tyre pressure adjustment systems ex works, including integrated solutions. Claas and McCormick also offer central lubrication systems for the front axles in their price lists for the new large tractor models. At Claas, these can also be used to lubricate the TERRATRAC track drives. The new large tractors from CNH now also feature independent suspension with integrated disc brakes in the central section of the chassis (similar to Fendt and John Deere) instead of a swing axle. The Advanced Vehicle Suspension system coordinates the suspension systems for the front wheels and cab with the vibration damping in the rear linkage.

Hydraulics

In large tractors, the trend towards two completely separate hydraulic circuits, each with a variable displacement pump, continues. One circuit can be used, for example, to supply continuous consumers such as blower drives for air seeders, while the other circuit can be used to supply "sporadic" consumers such as chassis cylinders or track markers. To ensure that sufficient hydraulic oil is available, tractor manufacturers are increasingly installing separate tanks, which also reduces the amount of dirt entering the gear oil.

Load-sensing (LS) hydraulic systems have been standard equipment on premium tractors for years. The 'Power Beyond' extension with P, R and LS connections (pump/pressure line, return/tank, load sensing) is also available for supplying implements with their own valve blocks. As a result, fewer hydraulic lines need to be connected and the tractor's own directional control valves can be bypassed, leading to

improvements in efficiency. LS systems are regulated according to a constant difference (around 25 bar) between the pump pressure and the highest load pressure applied to the directional control valves. The longer LS lines in "Power Beyond" affect this control variable, which can have a negative impact on the hydraulic functions of attachments (e.g. delayed response or uneven running).

Premium tractors are likely to be increasingly equipped with electronically controlled load sensing systems (e-LS) in the future. At Fendt, these are already standard equipment on the 500 Gen4, 600, 700 Gen7.1 and 800 Gen5 series. It is also expected that manufacturers of implements will increasingly switch to e-LS, and ROPA already offers its first machine of this type with the "Keiler II RK22" potato harvester. However, the use of tractors and attachments with e-LS still requires a hydraulic LS connection, and the advantages of purely electronic communication cannot be fully exploited. Fendt and ROPA therefore jointly developed "e-LS connect", which allows load pressure signals to be exchanged between the tractor and implement purely digitally via ISOBUS, eliminating the need for an LS cable.

Electrification

Battery-powered series tractors in the lower power range are now available on the market, but the big breakthrough is still likely to be some time in coming. A major obstacle is the high cost of batteries, which almost doubles the selling price compared to comparable diesel models. It is to be expected that battery-electric tractors will have lower variable costs, but there is currently no empirical data to suggest whether the higher investment costs can be offset in a TCO (total cost of ownership) analysis.

Chinese manufacturer ZSHX Advanced Tractors aims to shake up the European market with the XEEVO E904i. It was designed from the ground up as a battery-powered tractor and is expected to cost only around € 100,000. The drive concept features two electric motors arranged side by side. One is used for the drive, the other for driving the rear PTO and working hydraulic pumps. The continuous/peak power outputs are 66/90 kW respectively. The LFP battery with a capacity of 105 kWh is installed in the front half-frame of the tractor. v It is designed for charging/discharging capacities of 115 kW, which is to enable fast charging with DC current within one hour.

John Deere will present a battery-powered tractor with 96 kW (130 hp) at Agritechnica. This is based on a model platform that was also designed from the ground up for electric drive technology and autonomous driving. The latter is based on camera/LiDAR systems and purely electric "by-wire" control of steering, brakes, etc. The E-Power models can be equipped with up to five NCM battery packs of 39 kWh each, resulting in a gross total capacity of 195 kWh. The voltage level is around 800 V, which corresponds to that of luxury cars and lorries. The e-axis is completely new and includes one electric motor each for the drive and the rear PTO (continuous output of 96 kW/130 hp each). The drive system is single-stage, which means that no driving range switching with clutches is required. Another electric motor is provided to drive the working hydraulic pump, which in an initial phase is still designed as a variable displacement pump. In addition to these three electric motors for the working drives, there are

four more for on-demand driving of "peripheral components": cooling fan, heating/ventilation/air conditioning, gearbox lubricating oil pump and battery thermal management. In addition to the standard version, the E-Power series will also be available in "Narrow", "Low Profile" and "High Crop" versions. This diversity and the entry of major manufacturer John Deere, which has been reporting high sales figures in these segments in its home market of the USA for years, could finally give battery electric tractors a boost.

The start-up companies ONOX and TADUS also continue to be active in the field of battery-powered tractors. The former relies on a tractor concept with three electric motors: one motor with 50 kW for the drive and two with 35 kW continuous power each for the front and rear PTO. In addition to the integrated 20 kWh battery, 30 kWh replacement batteries can be carried on the vehicle: in the front or rear three-point hitch or on the side between the axles. At 48 V, the voltage level is rather low for this performance class, but is below the high-voltage limit of 60 V applicable to electric vehicles.

TADUS already presented an electric tractor prototype at Agritechnica 2023. It was based on a Systra system tractor and featured a drive concept with five electric motors: one each for the front and rear axles, one each for the front and rear PTO, and one for the working hydraulic pump. At Agritechnica 2025, TADUS will announce a new 100 kW battery-electric tractor, which will again feature a "distributed drive architecture". Unfortunately, no further information is currently available.

Tractor drive trains with high-power electronics are also being developed by manufacturers in Asia. TAFE from India submitted the study "EVX 75 Diesel Electric Hybrid Tractor" for the "Agritechnica Innovation Award". The performance values of a classic tractor with 75 kW (100 hp) are to be achieved with a 55 kW (75 hp) diesel engine, two electric motors and a 25 kWh EVX75 battery. Chinese manufacturer Zoomlion, on the other hand, is attempting to position itself in the upper performance classes and is introducing an electrically driven gearbox-rear axle unit for tractors up to 400 hp. This comprises two coaxially arranged electric motors, which can be used separately or together for the drive system and rear PTO.

Cab/assistance systems

There continues to be a great deal of activity in the field of electronics and assistance systems. Claas developed an "adaptive drive train management system" for the new Axion large tractors. This is based on various efficiency curves for the engine, gearbox, hydraulics and auxiliary units, as well as an adaptive algorithm. With the "Auto Load Anticipation" sub-function, the system memorises the power requirements and load jumps during the first trip to and from the field, e.g. at the headland when lowering soil cultivation implements. During subsequent journeys, the tractor automatically adjusts the engine speed and gear ratio before the load jumps occur. This is intended to prevent the well-known "choking"

on the one hand and to ensure that the required power is always provided at operating points with optimum efficiency on the other.

Deutz-Fahr will introduce the Advanced Driver Assistance System (ADAS) together with its new tractor series in the upper 6-cylinder mid-range class. The standard package includes the familiar functions found in cars and lorries: lane departure warning, turn assist and object/person detection. With the "Advanced" add-on package, these can be expanded to include adaptive cruise control with collision warning and traffic sign recognition. Tractor-specific features are to be taken into account in the assistance functions. This includes the presence of front and rear implements on the tractor itself, driving on side roads without markings, or following forage harvesters closely when mowing maize fields. ADAS is based on a completely new electronic architecture and various sensor and camera systems. Deutz-Fahr aims to increase safety when driving on roads or reversing in the yard, while at the same time creating the technical conditions for autonomous driving.

With "SmartLift2", which is being used for the first time in the new top-of-the-range Lintrac 160 LDrive model, Lindner aims to make working with front loaders more comfortable and efficient. When the system is switched on, the 4-wheel steering is activated, the steering behaviour is adjusted, the hydraulic characteristics are changed and the control of the power-split stepless gearbox is optimised for sensitive driving.

Assistance systems are increasingly being extended to trailers in order to increase safety during transport trips. Several manufacturers now offer a "drag brake" function that detects thrust on the tractor when driving downhill or decelerating and automatically applies the trailer brakes with pneumatic brake pressure of up to approximately 2 bar. The automatic locking of trailing steering axles at a certain driving speed is also becoming increasingly common.

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