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Trends for tractors and transport vehicles

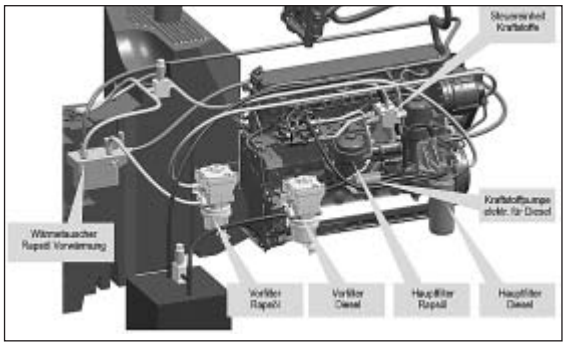

Fig. 1: The DEUTZ engines TCD 2012 and 2013 – here a system sketch with the components for Fuel Management® - are designed for operation with rape seed oil

Below, important trends in tractor development and transport are presented which will characterize the Agritechnica 2007. This preview cannot replace a trade fair visit. It only provides pre-information and does not claim to be complete.

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Keywords

Tractor development, transport technology, novelties at the fair

For more than a decade, registration figures for tractors have not been as high as in 2006. In combination with lively demand from Eastern Europe, the manufacturers reached their capacity limits. Bottlenecks in component supply resulted in delivery periods of more than half a year for some models.

Emission regulations require new technology

Since the beginning of this year, tractors in the 75 to 130 kW power range must also fulfil the strict exhaust emission regulations of stage III A. In some cases, this required extensive modifications of the engine and the cooling system. Some manufacturers use internal exhaust gas recirculation to reduce NOx emissions, whereas others apply external, cooled exhaust gas recirculation as a more sophisticated method even in this medium power segment. This results in slightly lower consumption values, which is an increasingly important sales argument for tractors if their capacity is sufficiently exploited. As of the coming year, stage IIIA must also be fulfilled in the low power class (37 to 75 kW) (cf. contribution on page 418).

Even though the results of the 100-tractor programme were depressing in some cases, farmers demand engines suitable for rapeseed oil. In the past, the risk of changeover with the aid of a retrofit kit was not borne by the suppliers. Instead, special insurance had to be taken out as part of machine breakdown insurance in order to cover this risk, which often called the profitability of changeover into question. Deutz now offers an engine designed for the use of rapeseed oil which automatically chooses the fuel suitable for the individual application with the aid of a two-tank system. For the first time, the engine manufacturer also assumes full warranty. Deutz-Fahr and Fendt adapted this system to their tractors and grant the final consumer full warranty.

Almost all manufacturers offer boost power

Especially farmers who grow forage attach value to compact tractors, which, however, must provide sufficient power during transport and mowing. Boost power technology is very well adapted to this requirement. At high driving speeds, the transmission as the most expensive component of the tractor can transmit considerably more power than during ploughing, for example, without being damaged. In addition, power taken off the PTO does not put a burden on the travel drive. Modern, electronically controlled engines can generally provide more than rated power if their cooling system is designed appropriately. For this reason, many manufacturers release this boost power if certain components are not in danger of being overloaded. This technology is particularly suitable if it spares the farmer the purchase of a more powerful tractor from the next larger series and if he profits from the lower costs of the smaller series. Within a series, the tractor with power boost is likely not to be much cheaper than the next larger model without power boost, and except for the case of a transition from a four-cylinder to a six-cylinder model, power boost does not provide any advantages with regard to weight and dimensions. Except for Fendt, the seven top manufacturers in the registration statistics offer certain models with power boost, which, however, are very different with regard to the conditions for the release of engine power.

Electric power network in the tractor

In the 20s, Ferguson developed the hydraulically operated three-point hitch. Hydraulic systems became more and more important. In many cases, they replaced the mechanical drive or allowed complex drawn or mounted implements to be driven. In the past years, the development of electric power transmis-

sion equipment made significant progress. Electronic d.c./a.c. converters (frequency converters) are now highly efficient, and the generators and engines have also become more compact and more powerful. In automotive engineering, these developments enabled combustion engines to be efficiently combined with electric motors in so-called hybrid drives. Since braking energy can generally only be used during transport rides, the application of this automotive drive concept in tractors is not expected. If, however, the total efficiency of electric power transmission reaches the efficiency of hydraulic power transmission, it makes sense to equip tractors with electric powersplit transmissions. Currently, hydraulic travel drives have closed oil circuits and are not connected to the on-board hydraulic system. The electric energy of an electric-powersplit transmission, however, is available to all potential consumers on the tractor and could therefore largely replace the on-board hydraulic system. As compared with hydraulic energy, electric energy can be stored better so that the power of the travel drive can be increased at least in the short run. For this purpose, it is not necessary to feed electric power into the drive train. It already helps a lot if electrically driven, permanently running units, such as the fan, the air conditioner, the water pump, the air compressor, and others are supplied from this energy store. In this case, more engine power is available for the travel drive, though only temporarily. All in all, the capacity of the combustion engine is exploited better, and dynamic torque weakness (e.g. during acceleration) can be bridged.

As the first manufacturer, John Deere is introducing an electric power network in its E-Premium series. The possibilities outlined before are not yet all realized, but the basis for such a system is created. At the current stage, this design is already providing functional advantages which may justify the additional design sophistication.

At an engine speed of 1 800 min^{-1}, a generator directly flanged onto the crankshafts already generates 20 kW of electric power. This energy is used to drive the fan, the air compressor, and a water pump and supplies the 12 V electrical system, whose power is increased by more than 50%. While the vehicle is standing, a power outlet allows 230 V appliances to be operated, or a three-phase current socket provides power for 230/400 V devices (5 kW). These outlets often replace a mobile electricity generator. Even at low engine speed, the electrically driven air compressor provides fast pressure increase. The air conditioner behaves in a similar manner. The rotating speed of the fan can be adapted very precisely to the required cooling capacity and can simply be inverted for radiator cleaning. The fact that the rotational speed of the fan is independent from engine speed is one explanation why the combustion engine develops boost power at just 1 250 min^{-1} and can offer 8% more torque at 1 600 min^{-1} as compared with the conventional model. Maximum boost power increases by 5%. Due to the better total efficiency of the auxiliary unit drive, John Deere expects effective fuel savings of approximately 5%, which, given the current state of the art, is virtually impossible to achieve with the aid of technical modifications of the engine alone.

Fig. 2: Some auxiliary units in the 7030 E series from John Deere are powered electrically (company photo)

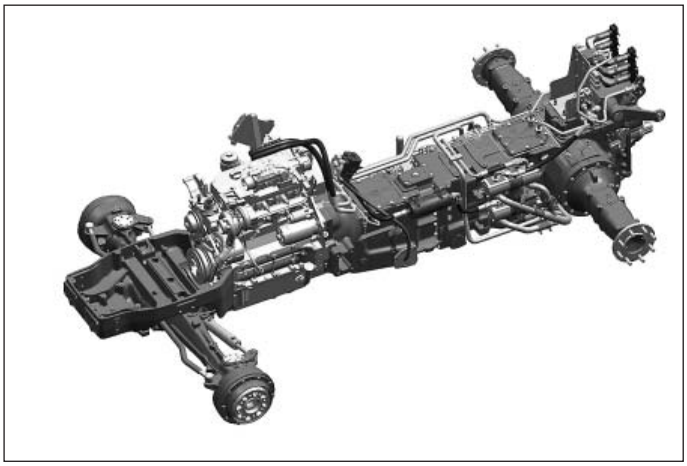

Fig. 3: For the first time, Same-Deutz-Fahr offers a continuously variable drive for its viticultural tractors (company photo)

Continuously variable powersplit transmissions now also for viticulture

Ten years ago, continuously variable powersplit transmissions were awarded prizes at the Agritechnica for the first time. Meanwhile, the leading manufacturers offer this technology in the power range from 65 kW to 265 kW. The second generation of these transmissions is already presented as a prototype (Steyr). In viticulture, where work for the driver is particularly difficult due to the operation of the complicated mounted implements, the continuously variable drive, which is easy to operate on the slope, not only provides additional comfort and better work quality, but also more safety. For this purpose, Same Deutz-Fahr developed a special powersplit transmission, whose basic principle of merging in the planetary transmission, two transmission ranges, and a powershift reversing transmission is similar to transmissions already available on the market, but which meets the special requirements of narrow-track tractors thanks to its patented, uniquely narrow and compact design.

Completely automated field work

The parallel tracking systems which have meanwhile been introduced into the market by almost all tractor manufacturers facilitate the driver´s work on the way between the headlands considerably. In the past, the driver had to interfere on the headland and steer the tractor in the direction of the other track. John Deere entirely obviates the need for this driver interference. In the new system iTecPro, only the first track must be set. The automatically activated headland management system does all manual operation work for the driver, and satellite navigation automatically steers the tractor into the right track. The driver is only responsible for the control of all processes and can interfere in the case of malfunctions. The series equipment of tractors in the upper power class from CNH, Fendt, and John Deere already includes preparation for equipment with a parallel tracking system.

Ride comfort for the protection of health

The manufacturers are increasingly emphasizing the mandatory observation of legal requirements with regard to the vibrational load at the driver´s place and are improving their vibration insulation systems. The EU Vibration Directive 2002/44/EEC stipulates that machines sold as of 2007 may not exceed the daily limit (8 h) of 1.15 m/s^2.

The semi-active suspension of the cab is new. Claas and Valtra offer a system which automatically adapts the damping effect of the rear pneumatic suspension elements to the driving conditions. A similar suspension system for the driver´s seat was presented by

the company Sears at the latest Agritechnica. The control system used by Claas is based on the signals of three acceleration sensors at the cab, the driving speed, the braking system, and the steering angle. For the adaptation of the damping effect, the viscosity of the damping fluid is varied with the aid of a magnetic field (Claas), or the cross section of the suspension bore is adjusted electrically (Valtra).

In the systems used by both manufacturers, automatic adaptation can be overridden by the driver by choosing the presetting "field" or "street" (Claas) or by means of continuously variable adaptation (Valtra).

The seat manufacturer Grammer adapts the spring characteristics of the cab suspension to the driving conditions. The precisely timed release and blocking of an additional air volume improves the resonance behaviour of the cab suspension. Control is taken over by the controller of the semi-active seat suspension.

With a new suspension concept for the front axle, John Deere provides more ride comfort in tracklaying tractors and improves their soil contour adaptation significantly. The newly designed axle features pendulum suspension like the front axle of a standard tractor. The pendulum point is suspended hydraulically and level-controlled. The two tracks can interlace, which reduces punctiform load introduction on uneven ground.

Articulated steering up to 419 kW

In the past years, the maximum power of standard tractors increased continuously and meanwhile reaches 265 kW. With boost power, output is even slightly higher. The transmission of this power and even higher outputs at low driving speeds on the field is limited by the tyres. For this reason, tractors with more than two axles are being discussed. The front wheels of tractors with articulated steering are as large as the rear wheels. Therefore, they can also transmit more tractive power. The articulated steering tractors of the Challenger series from the AGCO group now have up to 419 kW.

Efficient theft protection for tractors

With their keys, tractors which sometimes cost more than € 100 000 are not at all secured against theft. The standard keys of the manufacturers may be practical for the user because one key fits all tractors. However, they make it easy for potential thieves to steal tractors. Even if the tractor is insured, everyone must bear the damage of a theft in the form of high premiums. For this reason, it is high time to protect tractors better. Fendt equips the 900 series with an immobilizer approved by the insurers (Key Control).

Front power lift for curve rides

Front-rear combinations will remain the classic machines for the individual mechanization of mowing in the future. The overlapping of the front and rear mower reduces efficiency in practice. The bigger the distance between the front and the rear mower is, the more the two mowers must overlap. Especially during tight curve rides, a strip of grass remains uncut if one wants to use the full cutting width of the rear mower. Valtra solves this problem with the aid of a front power lift which is swivelled proportionally to the steering lock angle. Up to 35°, the front power lift follows the steering lock without activation of the front PTO. The ratio of the steering lock and the swivelling angle of the front power lift can be chosen freely depending on the application. For front-rear combinations, complete programs are available. As an option, the two lifting cylinders equipped with sensors allow the lower links to make a hydraulic pendulum movement, which facilitates implement mounting and improves the soil contour adaptation of front mowers.

Safety for heavy transports

At least for silage and slurry transport, rigid drawbar trailers with several axles are gaining in importance. In order to avoid track damage, the second and/or third axle is generally designed as a steered axle. During fast road rides, the steered axles may not be able to move freely because otherwise the trailer might begin to rock. In addition, steered axles do not provide lateral stability on sloped fields. Several trailers which tipped over are proof of this problem. The driver often forgets to turn the lock on or off. Fendt automates this process using the Vario terminal. As soon as the Fendt Identifier on the tractor identifies the trailer, the system becomes active and locks the steering axle when a certain adjustable speed is exceeded or while the tractor is reversing.

Meanwhile, a preliminary standard is available for the arrangement of the hydraulic master cylinders for forced steering (ISO/DIN 26402). However, implement coupling still requires additional work, and the lock angle remains limited. In the ForCon system, Fliegl solves this problem with the aid of a sensor integrated into the ball coupling. This sensor also compensates for the lateral inclination of the trailer in relation to the tractor (rolling), which is not yet possible with hydraulic master cylinders. If all axles of the trailer are steerable, electronic steering control makes it rather easy to realize track offset (crab steering) in trailers. The company Kotte is pursuing a similar approach. In the system used by this manufacturer, the electric steering angle transmitters must be mechanically connected to the standardized hitching points of the tractor, but rolling and pitching are fully compensated for.

With increasing tongue load, the loading capacity of the trailer increases, and the tractor has more traction on the field. Fendt now offers a tongue load of 4 t and 60 km/h as standard, which increases transport capacity even more. The coupling points for forced steering according to ISO/DIN 26402 are integrated into the modular system.

Novel Transport Solutions

In the past, it was often to impossible to overload silage to a truck at the field´s edge because the overloading process took too long and the necessary overloading height could not be reached with the aid of conventional machinery. Venhuis is now presenting a special overloading wagon which can directly fill a truck using a scraper floor and a hydraulically lifted loading trough. Fliegl mounts an efficient conveying auger to a push-off wagon in order to fill the road vehicle. Advance is controlled automatically such that the distributing rollers fill the auger optimally, but do not clog it. For wood chips, a throughput of up to 13 m^3/min is reached.

The silo near the field is a future-oriented alternative to overloading. Transport is egalized, and for the first time in agriculture the chance arises to transport return freight. A suitable transport container enables the liquid substrate of the biogas plant to be transported back to the field while carrying silage for the biogas plant on the way back. For this purpose, the company SIGA Nova developed a trough tipper with a double bottom, which is conventionally filled with silage. For the transport of liquids, the bottom is lifted, which creates a stable barrel.

Fig. 4: Manitou recommends its Manitac especially for transport tasks, which can be used for other agricultural tasks as well