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Current Developments and the State of Combine Harvester Technology

The selection of combine harvesters available is very diversified and various threshing and separating systems are offered by the manufacturers. The spectrum of machine power offered is very large and the maximum engine power is continuously being increased. Many detail improvements are being made, so that the threshing capacity can be exploited under all harvesting conditions.

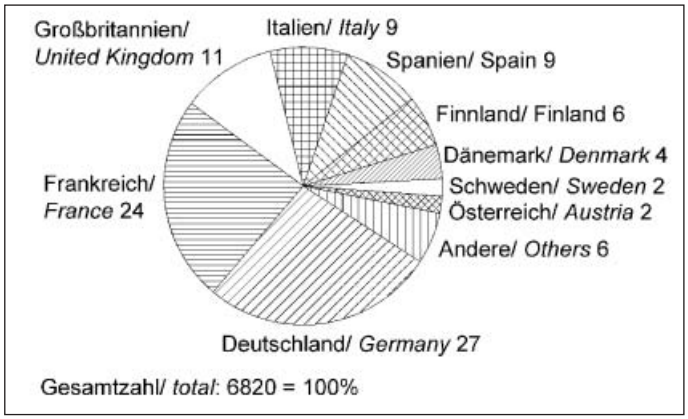

Fig. 1: Combine market 2004, market distribution by country, data acc. to [2]

After a slump in combine harvester sales with 1874 units in 2004, the sale of combine harvesters in Germany has again recovered. In 2005, 2228 combine harvesters were sold and now in 2006 the VDMA has forecast a slight increase in sales to 2350 units [1]. In 2004, Germany produced 5095 combine harvesters for the world market. The market size of West-Europe in 2004 amounted to 6820 units. Despite its market decrease, Germany had the biggest share (*Fig. 1*), closely followed by France with 1630 units and followed by Great Britain with 760 units [2]. The three major manufacturers, Claas, CNH – with its brands Case IH and New Holland, as well as John Deere dominate in Germany with 93 % of the market and in West-Europe with 83 % of the market [3].

Developments in performance

With the Lexion 600, Claas has again the harvester with the highest performance on the market. It incorporates a grain tank volume of 12000 l and a cutting width of 9.12 m for the West-European market. Above all due to the rated power of 368 kW by the V8-engines from Daimler-Chrysler the competition is tumped. In 2006 all manufacturers have improved their models in detail, in order to optimize the threshing, cutting and cleaning performance under diverse working conditions and to increase performance to cope with higher yields.

Figure 2 shows the product diversity of the market in Germany for combine harvesters. The variety of offered machines is noticeable from the various threshing-drum width and separation systems available. Small machines with conventional tangential threshing mechanisms and 4 walkers are still being marketed. Threshers with 5 or 6 walkers are also available with a tangential threshing mechanism or with a multi-drum mechanism, depending on the particular model and manufacturer concerned. Machines with high performance multi-drum threshing mechanisms are usually equipped with higher-powered engines. They are also often equipped with larger grain-tanks compared to combine harvesters with the same drum width and only one tangential threshing mechanism. The higher total weight therefore requires greater engine performance to drive the vehicle. Machines incorporating 8 walkers and multi-drum threshing mechanisms are also grouped within the same performance class as those threshers with six walkers. These are similarly also equipped with multi-drum threshing mechanisms, with a comparable drum width of 1.68 m and have a similar engine power.

Non-walker threshers shown in *Figure 2* are classified according to the width of the cleaning unit. The increased engine power of these machines in the mid-range is in the order of 25 % compared with machines with the same width and multi-drum threshing mechanisms. In the top performance class the engines can deliver up to 50 % more power.

Headers

To adjust the headers to the different harvesting conditions, simplifications in the operation are provided by the manufacturers.

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Keywords

Combine, market development, technical optimization

Literature

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[3] *Kutschenreiter, W.*: Analyse Mähdreschermarkt - Weniger Maschinen, mehr Leistung. Neue Landwirtschaft 16 (2005), H. 11, S. 50-53
[4] - : Landmaschinenkatalog 2006 (CD-ROM). Landwirtschaftsverlag Münster-Hiltrup, 2006

The control of the reel speed by changed forward speeds, the automatic lowering of the reel when the header is raised at the end of a field and the repositioning to the last settings will ensure a continuous crop flow into the combine..

For a uniform crop flow at various harvesting conditions, the manufacturers adopt two different strategies. Headers with adjustable table lengths are offered by various manufacturers. The distance from the cutter bar to the auger can be adjusted for example over a distance of 17 cm in 3 steps (John Deere) or infinitely variable over a distance of 30 cm and with additional filler panels in one step of 50 cm (Claas). Case IH has developed an infinitely variable adjuster with a range up to 56 cm without using filler panels, which simplifies the conversion from grain to rape. Headers with active feeding devices from the cutter bar to the intake auger have been available from Massey-Fergusson and Fendt for a long time. A belt conveyor, subdivided in several segments, enables the use of the header for grain with varying stem lengths as well as for rape without laborious adjustments. John Deere has developed a similar header together with the company Zürn. The individual segments are furnished with an automatic tensioning device for the conveyor and are closed along the sides. To facilitate cleaning of the header, e.g. when changing the batch, the individual segments can easily be raised (*Fig. 3*).

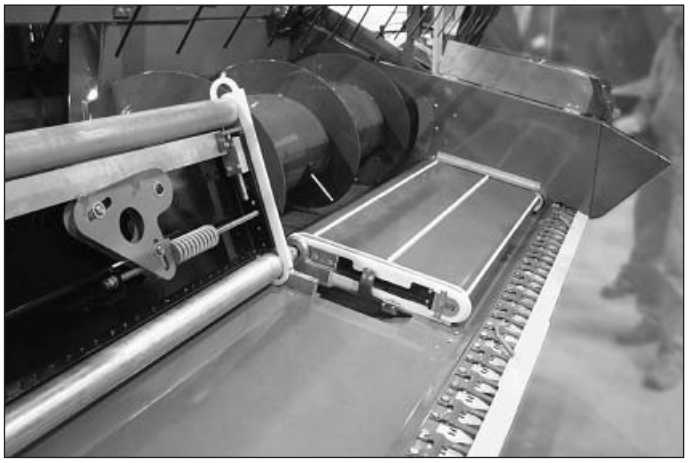

Fig. 3: Premium-Flow cutterbar by Zürn and John Deere, left: lifted segment with tension device, without belt

Straw and chaff management

More and more farmers are doing conservation tillage. Therefore the demands for straw chop quality and the straw distribution are becoming more significant. Until now straw choppers with deflectors were combined with separate chaff spreaders. Together with John Deere, the Rekordverken in Sweden have developed a new concept with 4 different variations for chaff spreader and straw chopper. Alternatively the chaff can either be widely spread and a chaff free straw swath formed or, only the straw is chopped and also spread or, the chaff is channeled to the straw and a swath formed from both or, the chaff and straw are chopped and spread together.

When using headers of 9 m or more width, choppers with deflectors will reach their limit. Claas therefore divides the operations of chopping and spreading into 2 separate units. The power spreader which is located under the chopper and consists of 2 centrifugal-rotors also impinges with the chaff from the cleaning system. The throw-out angel can be varied by oscillating plates. By adapting the movement of the diffuser, the distribution width and a side-wind compensation can be adjusted accordingly. As a further solution Claas uses 2 spreader fans with oscillating distribution chutes for dynamic spreading of the chopped straw and chaff.

To achieve a satisfactory decomposition of the chopped straw, it should not only be cut short but also well spliced. The machine manufacturers use different combinations and types of knives, cross cutters and grater units. With increased conditioning of the straw its distribution over the whole working width is getting worse.

Operation and automation

Large and complex combine harvesters need to be used efficiently during the entire harvesting period. This could be put into practice by releasing the driver from his everyday routine tasks, so that he could concentrate on the functional checks and the optimization of the machine. Because of this, automatic steering systems have become widely common in the last few years. Next to the long existence of the proven mechanic corn whiskers, solutions for grain are also now available. CNH is now offering for their brands a laser sensor to be mounted under the cab roof. The edge of the cereal crop is scanned, and the machine drives parallel to this. John Deere and Agco use the D-GPS as a solution to drive the machine parallel to a previously marked-out track. Similar systems are also supplied by companies specializing in equipment upgrades. Claas also supplies both laser sensor and D-GPS systems, which can be used separately or in combination so that the advantages of both can be used.

In order that an optimum throughput, which has been previously setup by the driver, can constantly be maintained, and again to re-establish the optimum throughput as a result of fluctuations in yield and harvesting conditions, several different throughput controllers have been introduced to the market. Agco has introduced a speed controller for the Fendt and Massey-Fergusson brands, which is based on the load of the threshing drum. For the Claas throughput controller, the crop layer thickness of the crop material in the chain conveyor to the threshing drum is used together with the recorded engine performance as input signals for controlling the driving speed of the combine harvester. John Deere uses the load on the threshing drum or on the rotor as well as the engine load for the throughput controller. In another controller mode, there is also the option to take the amount of losses into account. This particular mode is also available for walker combine harvesters, whose steep characteristic of the loss-throughput curves have a high demand on the control system.

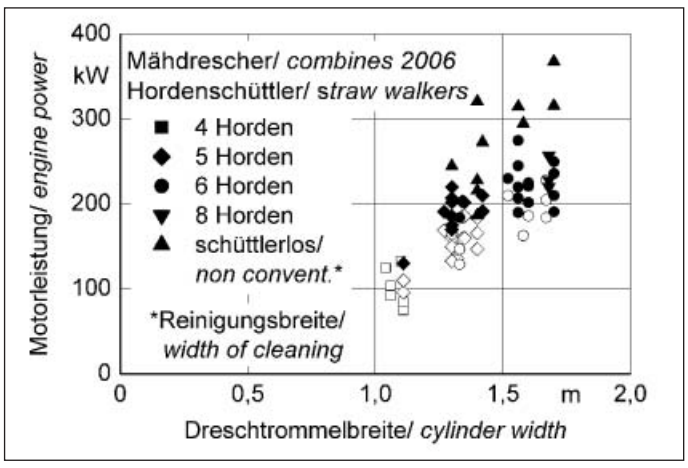

Fig. 2: Engine power of the combine market offers 2006 in Germany, symbols without filling without multidrum threshing system, data acc. to [4]