Horst Cielejewski, Münster

Trends in forage harvesting technology

Below, important trends in forage harvesting are presented, which will be reflected by the machinery- and implement programme shown at the Agritechnica 2005. This preview only provides pre-information and cannot replace a trade fair visit. Completeness is not aimed for.

All links of the ìsilage harvestî process chain from the field to the trough must be adapted to each other as well as possible in order to provide high-quality grass- and maize silage. Therefore, important requirements must be met. For grass silage, the following aspects must be considered:

- the right cutting time for the individual grass varieties
- a cutting height of 5 to 7 cm
- the shortest possible field lying time
- a dry matter content of 30 to 40% with a small fluctuation range in the silage stack
- Swathing, collection, and in particular compression must be mutually adapted with regard to capacity
- Careful compression and covering have great influence on forage quality over the course of later storage
- Silage additives are not so much „savers“ of poor silage, but rather secure the quality of good silage.

More and more often, the entire silage chain is being offered by contractors and machinery rings. Thus, the responsibility for the entire management including fermentation biology and the quality of silage making lies in one hand. The service provider has the possibility of using his machines and implements efficiently and exploiting their capacity. Thus, he is able to offer high-quality, cost-effective service.

Dr. Horst Cielejewski is an advisor working for the Chamber of Agriculture Nordrhein-Westfalen in Münster and compiled the present overview on behalf of the DLG.

Keywords

Trends of development, forage harvesting, mowing and conditioning, swathing and collecting, chopping

Optimal cutting time requires highly efficient mowers

Optimal cutting times on grassland require highly efficient mowers. Area capacity is the product of mowing speed and working width. Under good conditions, a mowing speed of more than 20 km/h is possible because modern mower links and alleviators allow for good soil contour adaptation. Increasing the mowing speed further is difficult. For this reason, larger area capacities are mainly realized by enlarging the working width. The width of the individual front- or rear-mounted mower is limited by the weight. In addition, soil contour adaptation also has a limiting effect. The combination of up to three different mounted mowers as front-rear combinations enables working widths of approximately 10 m to be realized. Especially the triple combination has gained in importance due to its high efficiency, low weight, and cost effectiveness.

An increase beyond this level is made possible by self-propelled mowers. These are carrier vehicles with up to five mowers which reach working widths of up to 15 m and area capacities of up to 10 ha/h.

Trailed mowers do not require front hydraulics and front-PTOs. In addition, they are easier to handle than mounted implements. They have working widths of up to 6.5 m and reach up to 20% larger area capacities. However, they are also significantly more expensive. Therefore, they only pay off when capacity utilization is good, which restricts their sales chances.

Mower types are still available in the ìdrum mowerî and ìdisc mowerî variants. The lower weight and the smaller specific drive power requirements are advantages of disc mowers which are currently being highly rated, whereas robustness and a wide range of application speak in favour of drum mowers.

Fig. 1: At a working width of 9.2 m, the trailed disc mower GMS 4802 from JF-Stoll, which has a mowing width of 4.6 m, deposits a 2.8 m double swath. In the transport position, it is 3 m wide

The discussion about the „upgrading“ of mowers with a conditioner is continuing. The crimped grass evaporates more water, which shortens field lying times if the weather is appropriate. The question of whether grass should be deposited in swaths or loosely and widely is answered differently. The latter might allow „tedding“ as a work step to be dispensed with. Tedders and turners provide an even pattern in a longitudinal and lateral direction at a working speed of approximately 5 km/h. Like in mowers, larger working widths provide are an appropriate means of increasing capacities. Implements having a working width of up to 15 m are available. They are no longer suitable for the three-point hitch and must be designed as trailed implements. The transport- and the working position are switched hydraulically. Nevertheless, the work step tedding often appears to be the bottleneck in the process chain.

During swathing, area capacity must fit the process chain, and the form and the mass of the swath must be adapted to the following collection machinery (loader wagon, baler,

Fig. 2: The Volto 1320 T from Claas has 10 rotors with 6 tine arms each and reaches a working width of 13 m

or forage harvester). Middle swathers provide good, even swath quality and tolerate high working- and rotor speeds very well.

Large working width is necessary in order to offer the efficient collection machines a sufficient swath mass. When travelling back and forth, two-rotor swathers with lateral swath deposition can produce double swaths whose mass is sufficient. Large swathers with four rotors are even able to do this in one work step. Thus, large swathers are the most efficient technology.

Technically mature chassis, optimized rotor suspensions and sensing wheels provide good soil contour adaptation even at high working speeds so that efficient collection with little forage soiling is possible.

Loader wagons and choppers still have their importance and their areas of application

For collection, loader wagons and choppers have their importance and their areas of application. The loader wagon is used in particular for short field-silo distances. A content of 40 m^3 and a maximum permissible weight of more than 20 t provide large collection capacity. With up to 45 knives, cutter bars reach theoretical cutting lengths of 34 mm. Rotary loader wagons are also establishing themselves in the lower power class.

In large vehicles, the soil pressure problem is addressed with the aid of larger tyres which also continue to provide good traction. The same effects can be reached if the loader wagon is equipped with smaller dimensioned twin tyres. In sloping/mountainous terrain, this solution has the advantage that the centre of gravity of the vehicles is lower.

Small areas: bale silage has greater importance

On small areas, the forage harvest in the form of bale silage has gained in importance. In round and square balers, cutter bars with rotating pick-up units have established themselves. Common knife sets allow cutting lengths of up to 40 mm to be realized. However, implements having twice the number of knives are also available, which reduces cutting length to approximately 20 mm. Smaller cutting length allows for better compression (up to 15%) and thus fulfils an important prerequisite for good silage quality in big bales and easy dissolution.

Combined implements for baling and stretching-in have established themselves

Combined implements for baling and stretching-in in one work step, which allow one tractor and one worker to be saved as compared with the separate technique, have established themselves. In addition to the combination of known individual machines, a growing number of complete new developments are available, which are compacter and easier to handle.

Forage harvesters: additional power increase due to more engine power

In forage harvesters, the development towards more performance due to more engine power (significantly more than 440 kW/600 hp) is continuing. Consequently, large headers for maize (also row-independent) and grass are available. For work expenses, capacity utilization is decisive. Times of standstill due to maintenance/repair or errors in the transport chain must be minimized. Improved operator friendliness facilitates the driver's work. Common equipment features include cutting height guidance, swath scanning, adjustable counter-edges, cracker adjustment, automatic grinding systems, stepless cutting length adjustment, and application of silage additives. The transport chain must be adapted to the enormous collection capacities of these machines by using larger silo wagons. Storage and compression in the silo is increasingly proving to be the bottleneck and needs significant improvement.

Outlook

The efficiency of the process chain „silage production" is increasing more and more. The large, expensive machines must reach a high degree of capacity utilization in order to work at low cost. Often, available agricultural machines with their many detail improvements in cutter bars, tedders, swathers, and the different collection techniques are already offering good conditions because they are optimized and harmonize well with each other. Organization and logistics must still follow. Comprehensive service by contractors or machinery rings provides good prerequisites for the achievement of this goal. At the same time, the technical and fermentation-biological know-how, the necessary management, and responsibility are bundled.

The use of silage additives which are suitable for the envisaged solution of a problem is gaining more and more in importance. Compression in the silo thus remains the last critical station of silage making.

Fig. 3: The strongest Krone forage harvester Big X 1000 (here with a row-independent maize header in transport position) has two 6-cylinder in-line engines, which are connected by a synchromesh transmission on the crankshafts and provide a rated power of about 730 kW/1,000 hp