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Trends in Forage Harvesting Technology

In this contribution, important trends in forage harvesting technology are presented, which will manifest themselves in the machinery- and implement programme shown at the Agritechnica 2003. This preview only provides pre-information and cannot replace a trade fair visit. Completeness is not aimed for.

For feeding, high-quality feed preserves of grass and maize are needed. This requires that all links of the process chain from the field to the trough must be optimized to the highest possible degree in order to meet the most important parameters. In the case of grass silage, for example, the following points 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 the silage between 30 and 40%;
- Swathing, collection, and compression are coordinated with regard to efficiency;
- Careful compression and coverage are important criteria for feed quality during further storage;
- Appropriate silage additives can help to secure the success of ensilage.

Given these requirements, the entire harvest chain is increasingly being offered by contractors/machinery rings, and this service offer is meeting with acceptance by the farmers. Thus, responsibility for the entire management of silage preparation lies in one hand. In addition, the service provider has the possibility to use machines and implements efficiently and to fully exploit their capacity, which translates into low labour costs and high-quality work output.

Mowing

The optimal cutting time on grassland can only be kept if highly efficient mowers are used. Area capacity is the product of driving speed and working width. Good mower links and optimized pressure relief allow mowers to work even at high driving speeds of more than 20 km/h (under good conditions) and to adapt to bumps and uneven spots. A further increase in driving speed is difficult to achieve.

Therefore, working width is the primary means of realizing greater area capacity. The width of the individual rear- or front-mounted mower is limited by the weight. Soil contour adaptation exerts an additional limiting effect. The combination of several mowers as a front-rear combination including the triple combination for tractors with a reversing system enables a working width of approximately 10 m to be reached.

Self-propelled machines allow a further increase to be achieved. Claas, for example, combines five 3 m mowers on one carrier vehicle, which results in a working width of 14.7 m (*fig. 1*). Under favourable conditions, such machines provide area capacities of 10 ha/h. As an alternative to mounted implements, drawn mowers with working widths of up to 6.5 m are available. They do not require front hydraulics with PTOs. In addition, they are easier to handle and more manoeuvrable than mounted implements of the same working width. Therefore, they achieve up to 20% larger area capacities. However, they are also considerably more expensive and need a very high rate of capacity utilization to work profitably.

Among the mower types, „drum mowers“ and „disc mowers“ are still the variants offered. The advantages of disc mowers are lower weight and lower specific drive power, whereas robustness and a wide range of applications speak in favour of drum mowers.

The combination of a mower and a conditioner is gaining acceptance more and more. The crimped crops evaporate more water, which results in shorter field lying times. It is being controversely discussed whether the mowed crops should be deposited in swaths or in loose, wide layers, which allows the work step „tedding“ to be dispensed with.

Turning and Swathing

Combined tedders and turners provide an even work pattern in both the longitudinal and lateral direction at working speeds of approximately 5 km/h. Like in mowers, larger working widths result in an appropriate increase in output. Implements with working widths of up to 15 m are available. They are no longer suitable for rear mounting and must be designed as drawn implements. The change from the work- into the transport position and vice versa is carried out hydraulically. Nevertheless, the work step tedding often appears as a narrow bottleneck in the process chain, which can be rendered less severe by using conditioners.

Swathing needs to be coordinated with the following collection machines with regard to swath form and tramline as well as area capacity. A large working width is necessary in order to be able to offer the efficient collection machines a sufficient swath mass. In back- and forth operation, two-rotor swathers with lateral swath deposition can pro-

Fig. 1: Claas presents a SP-mower, too, with a working width of more than 14 m. Foto Claas

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Fig. 2: A modern self-loading forage wagon with 2-rotor loading technology and a capacity of 48 m³

duce two individual swaths with a sufficient mass. Large swathers with four rotors and central swath deposition even reach the same result in one work step. Thus, large swathers are the most efficient technology.

Technically mature chassis, optimized rotor suspensions, and sensing wheels allow for good soil contour adaptation even at high driving speeds, which results in efficient clearing and little fodder soiling.

Collection

For collection, several technical alternatives are available. Especially at smaller field-silo distances, the loader wagon has its importance. A loading volume of up to 48 m^3 and a permissible gross vehicle weight of more than 20 t provide large collection capacity. Cutter bars with up to 45 knives enable theoretical cutting lengths of 34 mm to be achieved. More and more chassis are equipped with larger tyres in order to reduce soil pressure and to maintain the tractive force. However, this leads to the centre of gravity being raised, which is disadvantageous on sloping/mountainous terrain. The available alternative is equipping the two axles with four tyres each in order to achieve the same effect with smaller tyres.

In round and square balers, cutting assemblies with rotational gathering elements have established themselves. The usual number of 15 to 25 knives provides cutting lenghts of up to 40 mm. However, there are also implements featuring up to 49 knives, which reduce cutting length to ~ 20 mm. Smaller cutting lengths allow for better compression (up to 15%), and thus they fulfill an important prerequisite for high silage quality in big bales and easy dissolution of the bales.

More and more manufacturers offer combined implements for baling and stretching in, which enable one work step, one tractor, and one worker to be saved as compared with the separated technique. In addition to a combination of the known individual machines, more and more completely new developments are becoming available which are more compact and handier.

Mini-bales for horse feeding (divided big bales from Krone) or the ensiling of maize silage in individual bales are special markets with their own solutions.

Chopping

In forage harvesters, more engine power (> 425 kW) provides a further increase in output. Sufficiently large headers for maize (also row-independent) and grass are available. Analogue to combine development, minimized maintenance- and repair times as well as improved operator friendliness are also being introduced for forage harvesters (cutting height guidance, swath scanning, adjustable counter edges, cracker adjustment, automatic sharpener). A more even, stepless setting of the cutting length is reached by driving the drum and the gathering elements with the aid of a power-split planetary gear set.

The transport chain must be equipped with larger silo wagons in order to match the enormous collection capacities of these machines, and storage and compression in the silo must be significantly improved.

Further Prospects

The production of high-quality silage requires efficient process chains whose individual links are coordinated with regard to their capacity. The rate of capacity utilization of the large, expensive machines must be high so that they can work at low cost. From this, one can draw the conclusion that contractors and machinery rings should be commissioned to do this kind of work. This also makes a contribution towards the bundling of know-how, management, as well as responsibility and the securing of success.

The available agricultural machinery with its numerous detail improvements in mowers, tedders, swathers, and the different collection techniques provides very good prerequisites for these goals to be reached.

The wide variety of products and the use of silage additives which are suitable for the desired solution to a problem, are gaining more and more in importance. Compression in the silo thus remains the last critical step.

Fig. 3 and 4: For its big pack technique Big Pack MultiBale, Krone was awarded a silver medal. Above (photo: Krone): the big pack structured in portions; below (photo: Dr. Metzner): the double swinger as a prerequisite for this system.