

Detlef Ehlert and Siegwart Kraatz, Potsdam-Bornim

# Mowing by Steel Band

*Resulting from the construction and the test of two research models in the years 2002 and 2003, first results in the development of a band mower are presented here. Low specific weight, large working width, simple design and low power requirements are the main advantages for the cutting of stalk crops by a toothed steel band.*

Cutter bars and double knife mowers with oscillating knives are used for the mowing of grass, cereals and leguminous. These mowers do not work with a constant cutting speed but in a speed spectrum from zero to a limited cutting speed resulting from the oscillating movement. The cutting speed is limited to a few meters per second because of high mass forces.

## State of mowing technique

It can be resumed in principle, that oscillating mowers can work only under the condition of low driving speeds and therefore they have a limited capacity. Cutter bars have many blockages mainly in dense and herb crops and insufficient cutting results caused by knife wear are obtained [1].

The rotation mowers in the form of drum mowers or disc mowers are a second group. They evolved into the dominating technique for mowing under the conditions of modern European agriculture [2, 3]. Both drum mowers and disc mowers work according to the same principle of free cut without counter-fingers. A cutting speed  $> 70 \text{ m s}^{-1}$  is necessary to perform the free cut by the inertia force of the crop material. Therefore rotation mowers have a high need of power. The cutting knives and accelerated solid parts (e.g. stones) generate a high danger of accident, caused mainly by the high kinetic energy of the rotating parts. The thickness of the mowing knives is in the range of 3 to 4 mm. The knives do more smash than cut if principle based wear occurs.

In the patent literature, solutions are demonstrated to cut plants by a chain attached with knives (e.g. U.S. patents 4,070,810 - 1978; WO 96/32832 - 1995). Other inventors replace the chain by a endless V-belt (e.g. DT 2228 383 - 1973; DE 2707030 - 1982).

Cutting bands are a further presented solution mainly for small lawn mowers. The band is kept sharp

by a grinder (DE 4231665 - 1992) or the band is toothed (e.g. U.S. patent 3,425,196 - 1969; DE 3427900 -1984) to maintain the function. The bands are made of steel or in combination with other materials (e.g. tissue, synthetics, composites). Often counterparts in the form of fingers are used to prevent the evading of the crop stems to support the cutting process.

Either cutter bars with joints (DE 2929184 -1979) or the flexible combination of single mowers (U.S. 3,656,285 - 1972) are possible to improve the ground contouring for band mowers.

## New band mower

The Institute of Agricultural Engineering Bornim has been developing a mower for two years, based on the principle of a toothed steel band. The mower is mounted in front of a tractor to perform a simple construction and good observation conditions.

Rubber coated wheels with 0.7 m diameter were used for the first research model in 2002. The wheels were taken from band saws for wood processing (Fig. 1).

To solve at first the functional problems, a small 3 m wheelbase was chosen. The first research model had a hydrostatic drive for a good variation of the rotations per minute and to prevent overloads. Both principles cutting with and without counter-fingers were considered in the research for developing a band mower.

Market available saw bands for wood processing were tested in the first phase of the investigations. They did show a very limited suitability for the cutting of grass. Not all functional problems were successfully sol-

Dr.-Ing. D. Ehlert is head and S. Kraatz is employee in the department of Engineering for Crop Production at the Institute of Agricultural Engineering Bornim e.V., Max-Eyth Allee 100, 14469 Potsdam, Germany; e-mail: [dehlert@atb-potsdam.de](mailto:dehlert@atb-potsdam.de)

## Keywords

Stalk crops, mower, cutting band

Fig. 1: First research model of band mower, 2002





Fig. 2: Second research model of the band mower, 2003

ved in the vegetation season.

Based on the experiences of the first year a second research model was designed and manufactured in the following winter months. Therefore this band mower had also a 3 m wheelbase. Because of not optimum design of the used wheels, special wheels with 700 mm diameter were designed and manufactured (Fig. 2). From the experiences of the year 2003 it was concluded that the shape and the material of the cutting band and the guidance in the cutting bar is decisive for the function of the mower.

At present a third research model with a wheelbase of 5 m is in the development, because of important findings for the improvement of the function under difficult and hard conditions.

## Results

The presented results are based on the last level of knowledge. Further progress in the mower development can be expected. The second research model shown in Figure 2 (without conditioner and protection cover) has 160 kg in total mass for 2.80 m working width. Each meter of additional working width would effect only 25 to 30 kg increase in weight. This results from the concentration of expensive mass input in the wheels, the frame and the bearing parts. A band mower with a working width of 4.80 m would have a weight of about 220 kg only under these prerequisite. This results in a very low total specific mass of  $46 \text{ kg m}^{-1}$  - a clear advantage in relation to rotation mowers.

Generalised conclusions can not be made for band damages in the case of the contact with foreign objects, e.g. stones, parts of metal or strong branches. It can be expected that

the rotation mowers are more robust because of the working principle.

First power measurements performed, resulted in 3 to 5 kW for idle gear without cutting crops. The power need for cutting depends strongly on the crop conditions and driving speed of the tractor. An energy consumption of less than 10 kWh per hectare for the power take-off shaft was measured for sparse crop conditions in grass, alfalfa and sun flowers.

## Conclusions

The principle of a band mower can be used for mowing stalk crops with a low energy input. Band mowers have a very low specific weight and are of simple construction. The expected main working field are therefore large scale arable areas with a low probability of the occurrence of obstacles.

## Acknowledgements

Particular thanks goes to the staff Mr. Axel Anlauff und Mr. Uwe Frank for the work in preparing and performing the tests to investigate and to improve the band mowers.

## Literature

Books are identified by•

- [1] • Horstmann, J.: Untersuchungen zur Reduzierung von Antriebsschäden im Getriebe eines Scheibenmähers bei Hinderniskontakt. Dissertation, Fortschritt-Berichte VDI, Reihe 14, Nr. 90, VDI-Verlag, Düsseldorf, 1999
- [2] NN: Halmfütterernte in Großbetrieben. Broschüre zur DLG-Landtechnik-Vorführung '98, Agrarfarm Knau e.G.
- [3] Lenge, R.: Scheibenmäher schneiden immer besser ab. Sonderdruck aus top agrar 5/2002