Hans Kirchmeier and Rupert Geischeder, Freising

Techniques of Pea Ensilage

Grain peas are usually cultivated as combinable crops. Due to the problematical harvest, however, they are not very common despite their agronomical advantages. Therefore, trials of grain pea ensilage have been carried out with the goal of producing high-quality forage. It has also been examined whether existing forage harvesting machinery can be used for this purpose. If the grown plant mattress is treated gently, it is possible to produce high-quality forage while keeping losses low if appropriate machinery is chosen.

Dipl.-Ing. agr. (FH) Hans Kirchmeier and Dipl.-Ing. agr. (FH) Rupert Geischeder are employed in the Department of Process Engineering in Plant Cultivation at the Institute of Agricultural Engineering, Farm Building, and Environmental Engineering (director: Dr. Georg Wendl) of the Bavarian State Institute of Agriculture and the Agricultural Engineering Association in Bavaria, Vöttinger Str. 36, 85354 Freising-Weihenstephan; e-mail: *hans.kirchmeier@LfL.bayern.de*

Keywords

Pea silage, shatter losses, forage production

Literature

Books are identified by •

[1] *Hebeisen,T.*: Eiweißerbsen nehmen den Spitzenplatz ein. Schweizer Bauer (2.11.2002), S. 18

[2] • *Schön,H.*: Landtechnik Bauwesen. BLV Verlag München, Band 3 (1998), 9. Auflage, S. 251

Leguminosae are known for their high feed quality and their positive effects on crop rotation [1]. In addition to pure feed leguminosae (clover, etc.), grain leguminosae are cultivated as combinable crops. Grain peas quite often cause problems due to poor stability, high harvest losses, and moisture. Thus, they ultimately also put an increased burden on combines. Ensilage enables these problems to be avoided and high-quality forage to be produced. Due to early clearance, the area is also available for a second seeding (intermediate crop). As a result of the combination of peas with a following intermediate crop, the nutrient yield of the area grows significantly. Moreover, the collected nitrogen makes a contribution towards the saving of fertilizer.

The goal was to examine whether existing forage harvesting machinery can be used to gain high-quality grain pea silage.

Material and Method

Despite advanced breeding, peas tend to lodge towards the end of maturity in particular. For this reason, it seemed important to examine the suitability of different mowers (rotary and disc mowers) at different times. Therefore, a silage pea trial was set up on the experimental farm Osterseeon in the 2002 season. The silage was cut on two different days (3 July and 19 July). On each day, both a rotary mower and a disc mower were used. The rotary mower was a two-disc front rotary mower with a working width of 2.1 m. The rear disc mower with a working width of 2.5 m featured 6 mowing discs. For treatment, no rotary tedder was used because such a machine would have destroyed the continuous plant mattress. The windrows were only turned with the aid of a rotary windrower or a windrow inverter. The harvest was carried out using a round baler (a variable chamber baler with chain elevators) in order to obtain units (bale measurements 1.2 • 1.2 m) which were able to be handled for feeding- and silage trials. In all work steps, the suitability of the machines was registered and evaluated. In addition, the dry matter content and the harvest losses were determined. For this purpose, the grains and the pods were counted after the individual work steps (mowing / treatment / collection) on an area of one square metre. Each count was repeated five times.

For comparison, a third lot was combined and grain losses were determined.

Results

Suitability of the Machines

At the early date (3 July 02), the work quality of both mower types was good. Both the disc mower and the rotary mower were able to get under the peas, which had already slightly collapsed, and to provide a clean cut At the later date, however, it turned out that the cut was not always satisfactory. Especially the higher cut of the disc mower, which results from the design, made it impossible to cut the peas cleanly at a later stage of development (lodging). Favoured by high soil moisture in the wet summer 2002, the plant material was pushed in front of the mower, which resulted in clogging. The rotary mower, however, worked without any problems.

Due to the relatively large working width of 2.5 m and the bulky plant mattress, the disc mower only allowed the material to be windrowed to a width of approximately 1.6 m even though a windrowing board was used. When the following machines (round baler or windrower) were used, this led to the windrow being driven over on the outer flanks because the spacing between the tractor tyres was only 1.2 m. While the plants are still moist, this can lead to feed soiling and/or losses during collection by following machines because there is no solid grassland sod. In the rotary mower with a working width of 2.1 m, the windrow was automatically narrowed to ~ 1.2 m by the two counterrotating drums. From previous trials, it is known that rotary mowers which separate the plants (3 or 4 drums) are not entirely suitable because they tear the tangled plants. In addition, their power requirements are high, and the plant material is crushed if PTO output is sufficient. However, this problem only occurs in larger, more heavily tangled plant populations.

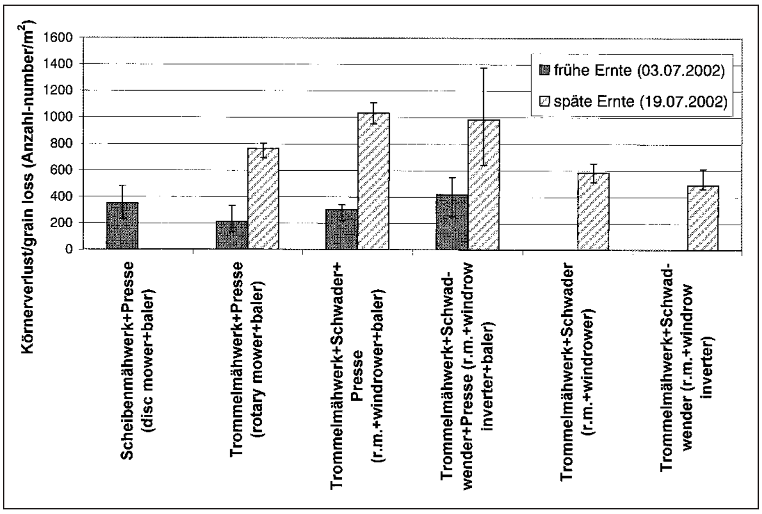

Fig.1: Grain losses of different processes at different cutting times

In order to dry the windrow from below, both a windrow inverter and a rotary windrower were used. Both windrowers were able to collect and deposit the material without any problems. In contrast to the rotary windrower, the windrow inverter was able to deposit the windrow completely in a turned position. Despite insufficient inverting by the rotary windrower, no differences in the dry matter content were able to be determined at the harvest time (37% dry matter each after a drying duration of one day at the early date). At the late date, the plants had already reached a dry matter content of 46% at the time of mowing because of the delay caused by the poor weather conditions. Therefore, further drying was not necessary, and the material was able to be baled immediately. Nevertheless, the windrowers were used in order to be able to compare the amount of losses with those incurred at the early date.

The baler used, which featured a variable baling chamber, was able to be employed without problems, i.e. malfunctions. This resulted in well compressed and perfectly shaped bales, which could be transported well and were able to be ensiled without problems. The use of the wrapper was problem-free as well. For safety's sake, the bales were stretched in with 8 layers instead of the common 4 to 6 wrappings in order to prevent potential damage during transport.

Losses

When the plants were mowed, it turned out that virtually no losses in the form of broken-off leaves or stems occurred. Instead, the losses consisted of torn-off or split-open pods and grains lying on the ground. At the early cutting date (3 July 02), losses were determined after treatment with the windrow inverter (Ø 41 grains / m^2) and the rotary windrower (Ø 30 grains / m^2) and after the completion of the harvest (*fig. 1*). After the use of the treating implements, losses were even significantly lower than after the harvest (baler use). Even in the most favourable variant – rotary mower + baler – (i.e. without windrow inversion, baled directly after drying), the losses increased fivefold (211 grains / m^2).

At the late cutting date (19 July 02), the losses were additionally determined right after mowing. Here, losses were already 10 to 20 times higher than during the early cut after treatment, reaching an average of 321 grains in the disc mower and an average of 600 grains in the rotary mower. However, the amount of losses was not influenced by the subsequent use of treating- and harvesting machinery to such an extreme extent (fig.1). Therefore, approximately 1,000 grains / m^2 were determined as the total loss including the harvest.

If one considers the fact that the grains lay mainly under the swaths and that only a maximum of 50% of the soil surface was covered by windrows, this translates into losses of about 10 dt per hectare on the average of the techniques at the late date (*fig. 2*). At the early date, losses were considerably lower. At 3.5 dt/ha, they even ranged below the average losses of almost 7 dt/ha which occurred during the combining of the reference lot.

As a general rule, it was established that the amount of losses increases with each treatment step and that the material should hence undergo as little treatment as possible. The time of ensilage, however, is far more decisive because the pods become brittle with increasing ageing of the plants and split open easily, which may result in higher losses than during combining.

Conclusions

Initial trials regarding the production of pea silage have shown that existing machinery is suitable for pea silage production given certain restrictions. Further trials remain to be carried out to determine the quality of the silage, the feed value, and the optimal harvest time. Tendentially, cutting before the senescence phase should be striven for because otherwise the crude fibre content of the residual plant increases significantly. Especially at early cutting dates, the mowing of the plants using either two-drum mowers or disc mowers does not cause any problems, and the danger of high losses due to broken-off or split-open pods is low. At this point, they range below the losses commonly incurred during the combine harvesting of peas. At the late date, however, the cut provided by the disc mower in particular is no longer satisfactory. In addition, losses increase significantly (up to more than 20% of the grain yield) and by far exceed common grain losses if compared with grain threshing (1 to 2%) [2].

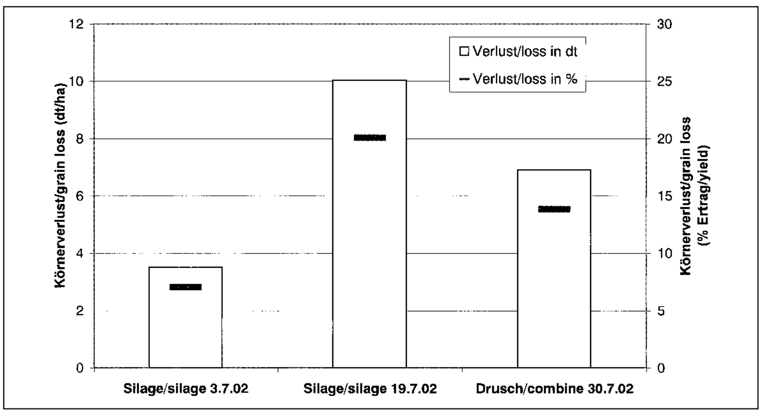

Fig. 2: Average grain losses at different harvest times