SESSION REPORT AND SUMMARY: SPECIALIZED MECHANIZATION: TECHNOLOGIES FOR GRASSLAND MANAGEMENT

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1. Introduction

In this session, there were 3 presentations showing the available agricultural land, crop land and grassland areas. The ways of growing grassland according to intensity, possible ways of grassland managing practice as well as perspectives for future management are shown. Then the challenges in relation to smart farming and technology for future forage production are presented. The new parameters to consider forage production and impact on KUHN machines development are presented at the end of the session.

2. Introduction into permanent grassland management

Speaker: Stefan Thurner, Bavarian State Research Centre for Agriculture (Germany)

2.1. Grassland worldwide and development

Of the total available area on planet Earth, agricultural land area occupies 36.8%, of which 32.9% refers to cropland area, and 67.1% to grassland area. Compared to 2001, agricultural land area slightly shrinking by 1.9%, while cropland area increased by 5.3% and grassland decreased by 3.5%. Compared to cropland and forest grassland, it offers the greatest CO2 reduction, preserving biodiversity, protection against erosion and multiple ecosystem services.

2.2. Grassland managing practice worldwide

Grasslands are often located on secondary lands where there are limitations to the production of cultivated crops, such as small areas on slopes, canals or soils with insufficient moisture. Grasslands can be used extensively and intensively. In the extensive method, they are natural or semi-natural and are primarily used for grazing domestic animals. In case of intensive use, numerous farming operations are applied, such as sowing, fertilizing, irrigation, mowing, all with the aim of producing hay and silage. Grazing is important because it ensures the preservation of grasslands, and because of movement, it is good for animal health. In grazing, animals can move on the same surface, and they can also move from one to another with different fields. Grazing data is mostly taken manually and there is no Farm Management Information System, but only a small number of digital systems. With the intensive growing system, there are several mowings, that is, harvesting during the year. The crop can be used fresh or as silage, and it is possible to combine the use of the crop for grazing and making silage. Silage can be made into bunker silos or bales, and it can also be chopped for hot air drying. Precision sensors for yield determination can be used on self-propelled forage harvesters.

2.3. Perspectives for future grassland management

Future grassland management requires precise recording of yields using sensors and satellites, in order to obtain precise data for each area. Also, variable seeding, spot spraying of dock weed, mergers to reduce losses, loader wagons with automatic seed regulation and barn hay drying systems with dehumidifiers are needed. Harvest of grassland and processing harvested materials is coupled to extreme losses which need to be improved by new technologies and software solutions in FMIS. The use of an efficient Farm Management Information System is fundamental for improving product quality and work efficiency.

3. The frontiers of forage mechanization at the service of efficient livestock systems in a Climate Smart Agriculture strategy

Speakers**:** Fabrizio Mazzetto and Andreas Gronauer, University of Bolzano (Italy)

3.1. Challenges in relation to smart farming tech

Climate Smart Agriculture emerged as a need to harmonize the requirements for food and environmental protection on the one hand, and adapting to climate change on the other. Today, the agricultural sector faces the following requirements: to ensure a sustainable increase in food production and income of workers in this sector, adaptation to climate change and reduction of greenhouse gas emissions where possible. In order to fulfill these requirements, innovations are needed for: improving Farm management, integration of traceability functions into day-to-day management activities, promotion of production processes towards environmental sustainability and application of technologies for automating control functions in field processes. Precision farming relies on Industry 4.0, which is characterized by process digitalization, automation, connectivity, treatment of huge amount of data and quick data interpretation. Smart agriculture represents the ability to make decisions based on targeted information, previously collected through a global monitoring of production processes. It relies on Industry 5.0, which is characterized by responsible innovations, human centric, environmental sustainability and resilience. Forage processes have not changed for a long period of time, but due to the available tools offered by Industry 4. and 5. it is necessary to make effort in innovating forage mechanization and related conservation processes.

3.2. Technology for the hot spots in future forage production

It seems that technologies initially developed for mountainous regions or difficult accessible regions can offer inspiration for further use in large farms with easily accessible grassland. For ensiling as well as for haymaking, there are a number of important biological processes that start after cutting and ensiling that ultimately defining the feeding quality or acceptability. In most cases there is very little process monitoring during these stages and perhaps AI and digital twins can offer some way out here. Measurement of protein and dry matter content by NIRS still needs improvement with regard to accuracy. Compared to precision farming for everything that has to do with grassland, three basic technologies are needed and must be realized:

- Data standards
- Energy harvesting systems for Animals to provide a livelong energy supply for sensor integration as well as for connectivity and
- Location information for stationary techniques and for the animals' stay in buildings with data that can be integrated into the comprehensive farm management system.

Only then the FMIS shown can be realized and these challenges must be clarified quickly and first of all and foremost in scientific research.

4. Harvest Hay&Forage solutions: trend and vision meet new challenges!

Speaker**:** Victor Meyer, KUHN

4.1. New parameters to consider

The forage production has changed in recent decades with the introduction of new plant species into the diet of livestock. The production of those plant species differs depending on both the cultivation method and the expected parameters in terms of yield, quality, harvest time, nutrient content, etc. Production is further complicated by climate changes in the form of an increase in the average annual temperature, extreme heat, strong storms and heavy rainfall. Forage is not only used for feeding animals, but also as biomass for energy production, which complicates the production process. A particular problem is the lack of skilled labor as machines become more and more complex. In order to attract the necessary workforce, it is necessary to create machines that will meet high ergonomic criteria, which would facilitate working with them.

4.2. Impact of machine development

In order to complete the work within the stipulated time, machines are constructed with an larger working width and higher capacity. The disadvantage of this is that the mass of machines and inertial forces increase, which is why we need to look for solutions that will enable the reduction of energy consumption without affecting the quality of forage. One of the solutions for increasing the quality of forage is belt raking to minimize impurities. In order to prevent crop losses, modern raking and balling machines are essential for efficient drying of the forage and minimizing dry matter losses. Solutions for reducing energy consumption, facilitating the work process and increasing productivity are: ISOBUS functions, Headland management system, Tractor Implement Management, Section Control, AUX-N joystick, as well as numerous adjustments from the cab.

4.3. Agriculture 4.0 in Hay&Forage production

The implementation of Agriculture 4.0 enables telemetry and traceability to become critical components in modern farming practices, on the basis of which farmers can monitor and optimize their operations with greater precision. Also, numerous automatic functions and help in decision-making are applied, while the application of robots is not currently present, but their application should be expected with the next generation of machines.