SESSION REPORT AND SUMMARY: SPECIFIC MECHANIZATION: MACHINES FOR SUGAR BEET AND POTATO

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1. Introduction

Session 3 explored the specific mechanization techniques for sugar beet and potato cultivation. This session, pertinent to the Hanover area - a key region for sugar beet and potato production, comprised a two-part structure: the first focused on a global perspective, particularly on Europe and Germany, and the second part was oriented towards technical aspects of mechanization, with insights from renowned companies in this field.

2. Global Sugar Beet Cultivation, Sugar Market, Sugar Companies

Presenter: Heinrich-Hubertus Helmke, (Association of Beet Growers North Germany)

2.1 Overview of Global Sugar Market

The global sugar market has experienced significant fluctuations in the last decade, primarily due to weather phenomena like El Niño and La Niña. These events have had a significant impact on global sugar yields, particularly affecting regions where sugar cane is predominant. These fluctuations have led to a current production estimate of around 180 million tonnes against a slightly higher global demand, resulting in a market deficit exceeding 2 million tons. This scenario contributed to an increase in sugar prices, with an average rise of approximately 15-20% in global and domestic markets. The emphasis was on sugar cane's dominance in tropical and subtropical regions, which contributes around 80% of global sugar production.

2.2. Sugar Cane and Beet Production Dynamics

A detailed comparative analysis was conducted between sugar cane and beet production. Sugar beet, accounting for about 20% of global sugar production, is essential in temperate regions like Europe and North America. The session included data showing sugar beet yields averaging 70 tons per hectare in these regions. Dual-crop countries' influence on the market, such as the United States and China, was analysed, revealing a diverse impact on global sugar prices and trade patterns.

2.3. Country-Specific Sugar Production Insights

Detailed insights into sugar production in key countries, such as India, Brazil, and Australia, were provided. India's fluctuating sugar production and export were detailed, with production sometimes reaching up to 30 million tonnes, influencing its exports significantly. The presentation also explored Brazil's extensive contribution, accounting for 14% of worldwide exports with annual export volumes of around 24 million tonnes. Australia, a significant exporter in the Asian region, was discussed, with its production primarily oriented towards the export market, contributing about 4 million tonnes annually to global sugar exports.

2.4. European Sugar Beet Cultivation Landscape

The landscape of sugar beet cultivation in Europe was thoroughly examined, focusing on northern France, Germany, Poland, the Czech Republic, Slovakia, and Scandinavian countries. It was noted that these regions have favourable climatic and soil conditions, with average sugar beet yields of about 75 tons per hectare. The European market's centralization was emphasized, with major sugar groups controlling about 90% of the region's production, leading to a significant influence on pricing and distribution strategies within the European Union.

2.5. Challenges and Developments in North German Sugar Beet Production

The session provided an in-depth analysis of sugar beet production in North Germany, discussing the region's specific challenges and developments.

- **Breeding and Genetic Improvement**: The need for continuous genetic improvements was highlighted, with advancements in breeding techniques, such as the implementation of genetically monogerm hybrid varieties. Disease resistance traits for Rhizomania and nematodes have led to yield improvements of up to 15%.
- **Nitrogen Use Efficiency**: A major development in North German sugar beet cultivation is the significant reduction in nitrogen fertilizer usage, from over 200 kilograms per hectare to approximately 100 kilograms. This has led to an increase in sugar yield from 5 tons to around 12 tons per hectare.
- **Pest and Disease Management**: The ongoing challenge of pest and disease management was addressed, emphasizing the importance of breeding for disease resistance, and developing new plant protection strategies.
- **Environmental and Political Pressures**: The presentation also covered the environmental regulations and political policies impacting sugar beet cultivation.
- **Structural Changes in Farming and Processing**: Significant structural changes in the sugar beet sector were noted, including a reduction in the number of growers and sugar factories, driven by economic pressures and market consolidations.
- **Market Volatility and Economic Sustainability**: The volatility of sugar prices was discussed as a major challenge for growers, with fluctuations of up to 30% in recent years affecting the economic sustainability of sugar beet farming.

3 European Market, Mechanization and Postharvest Processing of Potatoes

Presenter: Rolf Peters (Potato Consult UG & former manager of Potato Research Station Munster - Germany)

3.1. Overview of Global and European Potato Market

The global potato market exhibits a diverse and complex landscape. China's predominance in potato cultivation is noteworthy, with approximately 25% of the world's potato area, translating to 5 million hectares, and a contribution of 21% to global potato production, amounting to 80 million tons. This substantial output is partly a result of governmental directives promoting potato cultivation due to its high nutritional value. In stark contrast, Europe, particularly Germany, demonstrates more efficient agricultural practices, evidenced by significantly higher potato yields. Despite having a smaller cultivation area compared to China, European yields are nearly double, indicative of advanced agricultural technologies and optimized farming methods prevalent in the region.

3.2. Impact of Climate Change on Potato Cultivation

Climate change significantly impacts potato cultivation, posing new challenges to maintaining yield and quality. Potatoes thrive within a specific temperature range, with optimal growth observed between 18 to 23 degrees Celsius. The trend of rising temperatures over the past two decades has raised concerns about reduced crop yields and increased vulnerability to diseases. The escalation of extreme weather events, such as droughts and heat waves, further exacerbates these challenges, necessitating adaptive farming practices and resilient crop varieties to ensure sustainable potato production.

3.3 Irrigation Systems and Legislative Constraints

Irrigation systems play a critical role in potato farming, particularly in the face of changing climatic conditions. The widespread use of pivot and big gun irrigation systems by over 95% of farmers in key potato-growing regions reflects the adaptation strategies employed to counteract water scarcity and temperature fluctuations. However, the adoption of more efficient drip irrigation systems remains limited due to higher operational costs and labour-intensive maintenance. Legislative constraints, including regulations on water usage, permissible irrigation times, and technology-specific restrictions, further complicate cultivation practices. These legislative measures aim to balance agricultural needs with environmental conservation, but they also pose additional challenges for farmers in optimizing water use and complying with regulatory frameworks.

3.4. Evolution of Potato Harvesting and Storage Techniques

The evolution of potato harvesting and storage techniques is a response to both market demands and agricultural advancements. In Germany, the average yield of potato farming stands at approximately 45 tons per hectare, underscoring the efficiency of harvesting methods. Storage techniques vary based on potato types, with loose stores and pallet boxes being prominent for different varieties. The shift towards processed potato products has led to modifications in storage methods, accommodating the specific requirements of processed goods. The expansion of processing facilities in countries like Belgium, the Netherlands, and Germany is a testament to the growing demand for processed potatoes, which necessitates advancements in storage technology to preserve quality and extend shelf life.

3.5. Consumer Trends and Processing Industry Developments

Consumer preferences have shown a significant shift towards processed potato products, such as French fries, chips, and other convenience foods. This trend is particularly pronounced in more affluent populations, where processed foods are often favoured for their convenience. The global potato processing market is responding to these changing consumer habits, with significant developments in processing capacity and technology. The emergence of Asia and Africa as potential growth regions for potato cultivation and processing indicates a shift in the traditional market dynamics, predominantly centred around Europe. This realignment poses new opportunities and challenges for the potato industry, particularly in terms of adapting to varying consumer preferences, climatic conditions, and market demands in these emerging regions.

4. Harvest Quality, Soil Conservation, and Costs in Potato Harvesting: Future Trends

Presenter: Rupert Geischeder (ROPA Sittelsdorf – Germany)

4.1. Current State of Potato Harvesting Technology

Potato harvesting technology has undergone significant innovation, with current machinery focusing on preserving soil conditions. The technology predominantly employed in Germany comprises 80% in-house machinery, emphasizing the importance of regional and market-specific adaptations. Trail machines, both single and double-row types, dominate the field, highlighting their efficiency and versatility. The technology focuses on preserving the quality of the potato, a critical factor considering the crop's sensitivity and high water content. Precision in harvesting is important to maintain quality, requiring technological adaptations similar to hydraulic drive systems for speed control and advanced cleaning units.

4.2 Soil Conditions and Harvest Quality

Soil condition plays a crucial role in determining the quality of the harvested potato. The machinery must adaptively handle varying soil types, from rich loams to areas with significant stone content. This necessitates the development of sophisticated separation and cleaning systems capable of differentiating between the crop and extraneous soil matter. The goal is to minimize soil disruption while maximizing crop yield and quality. Innovations like the 'double select' system exemplify efforts to enhance the sorting process, thereby ensuring the harvested potatoes meet the highest quality standards.

4.3. Economic Analysis of Potato Harvesting Methods

Economic considerations are critical in assessing the viability of various potato harvesting methods. The balance between the cost of mechanization and the efficiency of the harvest is a pivotal aspect of this analysis. Studies indicate that while self-propelled machines offer higher capacity, they require a larger area to be cost-effective, typically around 250 to 300 hectares annually. In contrast, trailed machines are more suited for smaller areas, up to 200 hectares. This economic evaluation underscores the importance of selecting the appropriate machinery based on farm size and output requirements.

4.4. Technological Advancements and Future Directions

The future of potato harvesting technology is leaning towards greater digital integration and automation. Developments like yield mapping and telematics are becoming more prevalent, offering insights into crop performance and facilitating real-time decision-making. The industry is moving towards a more interconnected approach, where data from the harvesting machinery can directly inform farming strategies and optimize processes. Another critical area of development is the creation of modular systems that can adapt to different crop types, thereby enhancing the versatility and utility of the machinery.

4.5. Predictions on Mechanization Trends in Potato Harvesting

Predictions for future trends in potato harvesting mechanization indicate a continued shift towards more efficient, technologically advanced machinery. The trend is toward trail two-row harvesting technology, which offers a balance of efficiency and flexibility, especially crucial for contractors. These machines are expected to incorporate more automation and data-driven functionalities, aligning with the broader agricultural shift towards precision farming. Additionally, logistical aspects, such as non-stop harvesting and field-edge storage, are likely to gain prominence, catering to the demands for higher throughput and reduced storage costs.

5 Technology and Mechanization of Sugar Beet Harvest

Presenter: Michael Gallmeier (HOLMER Schierling/Eggmühl, group EXEL – France)

5.1. Market Influences and Challenges in Sugar Beet Production

The sugar beet market is characterized by its dynamic nature, influenced by varying producer price indices and environmental factors. Regions like the US, France, and Germany have seen significant fluctuations in pricing, with the reference year of 2016 marking a pivotal point. These market trends significantly impact farmers' decisions and cultivation patterns. For example, due to fluctuating prices, some farmers have opted out of sugar beet cultivation, while others have adapted to the changing market demands. The shift in machinery utilization from traditional markets to emerging ones has led to a need for infrastructure development, driver training, and sales support in new regions.

5.2. Adapting to Changing Environmental and Harvesting Conditions

Adapting to evolving environmental conditions is essential for efficient sugar beet production. Key adaptations include the development of machinery capable of handling varying soil conditions and crop characteristics. An example is the introduction of systems for automatic depth adjustment, optimizing harvesting based on soil and crop variations. This approach ensures minimal soil disturbance and optimal yield preservation. For instance, a system that adjusts the depth for each row based on the head size of the beet can lead to a reduction in soil compaction and improved yield efficiency.

5.3. Enhancing Harvesting Efficiency and Quality

Efficiency and quality in harvesting are paramount. Technological advancements, such as driver assistance systems, play a crucial role. These systems enable optimal machine settings for varying field conditions, significantly reducing sugar losses. For instance, an adaptive cleaning system that adjusts its speed based on crop load can reduce beet damage. Research from the Institute of Beet Research in Britain indicates that different harvesting systems can result in varying degrees of sugar loss, with aggressive systems leading to more significant losses compared to gentle handling systems.

5.4. Total Cost of Ownership and Sustainability Considerations

The total cost of ownership (TCO) and sustainability are increasingly critical. Strategies to reduce TCO include implementing new materials to reduce wear and tear, optimizing maintenance schedules, and using sensor-based systems for efficient operation. For sustainability, reducing machine weight to minimize soil compaction is crucial. Over the past 20 years, the average weight per row of harvesting machinery has been reduced from approximately 880 kilograms to 675 kilograms. This weight optimization is achieved through high-strength materials and load-appropriate design.

5.5. Future Prospects in Sugar Beet Harvesting Technology

The future of sugar beet harvesting technology is focused on enhanced data integration and autonomous features. The goal is to standardize interfaces for seamless data communication across the agricultural value chain. This standardization will enable better coordination between different stages of production, from seeding to harvesting. Future technologies may include autonomous vehicles and systems that can adjust harvesting parameters in real-time based on environmental conditions and crop characteristics.