

Analysis of quality of sowing by pneumatic sowing machines for sugar beet

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ABSTRACT

Purpose: The paper presents two sowing machines for interval sowing, differing in the mode of operation. The pneumatic vacuum sowing machine OLT and the pneumatic pressure sowing machine Aeromat - Becker for sowing sugar beet are compared. We were interested in adequacy of sowing at different working speeds. The purpose of the paper is to find out the optimum working speed for the individual sowing machine.

Design/methodology/approach: The measurements were performed with two sowing machines which are most widely used in Slovenia; the sowing machines were tested in completely identical conditions at different speeds of sowing.

Findings: The parameters such as working efficiency, depth of sowing, inter - row distance and distance between seeds in the sowing row were measured and calculated.

Research limitations/implications: Cultivation of sugar beet depends primarily on expert and technically correct sowing. Distance between seeds in the sowing row must enable the plants to have optimum conditions for their growth and development. For successful sowing it is necessary to know adequacy of the soil for sowing, technical properties of the sowing machine and biotechnical characteristics of the seed.

Practical implications: Sowing machines and expertly performed sowing are of great importance for cultivation of sugar beet. The principal aim of the paper is to establish whether the higher working speed influences the quality of sowing. The tests were aimed at defining the most suitable sowing speed for both sowing machines on the basis of measured data. Cultivation of sugar beet requires much money invested and work performed per unit of area. It is very important for the producers to be well familiarized with all agro - technical measures.

Originality/value: Taking into account all measured parameters the optimum sowing speed of the pneumatic vacuum machine OLT is 8 km/h and the optimum sowing speed of the pneumatic pressure sowing machine Aeromat - Becker is 10 km/h.

Keywords: Technological devices and equipment; Sowing machines; Working speed; Inter - row distance

1. Introduction

Optimum lot of plants and their arrangement per ha can be reached by suitable sowing machines and expertly performed sowing, which is of great importance in cultivation of sugar beet [1]. The sugar beet is cultivated for its root rich in sugar. Sugar (disaccharide saccharose) is the most important product of the sugar beet, a rich source of energy and food easy to digest. By

products are important for the food in animal production and in processing industry [2].

Omitting of cultivation of sugar beet in the EU on a long term basis may have serious consequences. The sugar beet is of great importance for crop - rotation and is a crop with the greatest energy and ecological potential [3].

One of the most important agro - technical measures is the sowing which is to be carried out on a well prepared land area to

be sown [4]. The sugar beet is sown on the final lot. Sowing must be accurate, therefore the quality of working of the sowing machine and the driver's precision are of key importance. The driver must follow up the trace of the coulter, he must drive as straightly as possible at constant speed and pay attention to operation of the sowing machine, quantity of the seed in the discharge container and possible clogging of sowing shares.

A lot of different sowing machines for sowing of sugar beet are available on the market [5]. Efficiencies of sowing by the pneumatic pressure sowing machine Aeromat - Becker and the pneumatic vacuum sowing machine OLT were compared.

The optimum time of sowing of sugar beet is short, therefore, sowing must be performed fastest possible. The time of sowing is restricted also by bad spring weather. The sugar beet producers have doubts as to the quality of the increasing speed of sowing. The problem appeared when the producers were faced with a too bad sprouting of sugar beet on their lots. Thus, higher costs of cultivation of sugar beet occurred due to smaller produce or repeated sowing. Due to doubts about the efficiency of fast sowing we decided to make a test of sowing at different speeds.

2. Material and work methods

The pneumatic pressure sowing machine Aeromat – Becker ensures interval sowing of sugar beet and other crops which do not spread out. Calibrated or non - calibrated seed can be sown, since different sowing plates are available. During sowing the sowing plate rotates and is filled with seed. Onto it the air flow is directed, which blows off surplus seeds. The sowing machine is equipped with six sowing apparatuses which were connected in the form of a parallelogram to the supporting frame (Figure 1).

The coulters were of disk form and were controlled hydraulically. The sowing machine was driven by a fan driven by the tractor connecting shaft. The sowing apparatuses were connected to the fan by a plastic tube. The sowing machine is placed onto two guiding and, simultaneously, driving wheels driving the transmission shaft which drives the sowing plates. The sowing machine is provided also with an air pressure meter indicating the current working pressure and possible changes in functioning of the sowing machine. The sowing shares were of slide block form followed by the burying device and single - part pressing disk having a rubber ring round the circumference [6].



Fig. 1. Sowing machine Aeromat, model 6K-T [7]

The pneumatic vacuum sowing machine OLT ensures interval sowing of various crops including sugar beet (Figure 2). It works according to the principle of the vacuum so that the seeds adhere to the sowing plate. It, too, ensures sowing of calibrated and non - calibrated seeds. The tested sowing machine had six sowing apparatuses having available different sowing plates. The sowing apparatuses are provided with a forced spring enabling the sowing machine to adapt to unevennesses of the soil. The two disk coulters are interconnected by tightening chains and are controlled mechanically. The vacuum pump is driven by the tractor connecting shaft. The sowing apparatuses are connected to the vacuum pump by plastic tubes. The sowing apparatuses are provided with a safety clamp which is activated when the sowing paths are clogged. The sowing shares are of slide block form and are connected to the two - part pressing disk [8].



Fig. 2. Sowing machine OLT, model PSK [9]

To reach optimum hectare produce of the sugar beet it is necessary to perform expertly also the following agro - technical activities such as: basic cultivation of soil, fertilizing, pre - sowing cultivation of soil, sowing and care of the growing crop [10, 11].

One of the most important agro - technical activities in production of sugar beet is sowing. The purpose of the paper was to compare two pneumatic sowing machines, most widely used in this region for sowing sugar beet. We wanted to establish how different working speeds influenced the quality of sowing and to determine the optimum sowing speed of the individual sowing machine [12, 13].

The quality of sowing implied the following parameters:

- inter - row distance - 45 cm,
- distance between seeds in sowing row - 21 cm,
- depth of sowing - 2.5 cm.

The working speeds were as follows: 4.5 km/h, 6 km/h, 8 km/h, 10 km/h and 12 km/h. Of course, the increase of speed supposes the increase of productivity and cost - effectiveness of sowing [14]. Also the working efficiency of both sowing machines was measured.

Measurement of travelling speed during sowing was performed by means of the measuring wheel. We decided on the measuring wheel because the existing tractometers are rather inaccurate. This applies particularly for tractors of older type, such as used by us. The measuring wheel was mounted on the tractor by means of a special beam, so that it ran in parallel with the rear right - hand wheel of the tractor. By an adjusting screw it was so adjusted that it pressed upon the soil sufficiently. Thus, undesirable slipping of the measuring wheel was avoided. Next, a display for indication of the travel speed close to the steering wheel was installed. Then the whole unit was connected to the tractor electric current. The speed could be read within 0.5 km/h

accuracy. By means of the measuring wheel and display of the current travel speed the travel at the desired speed was always possible. It is only necessary to select the proper gear ratio of the change - speed gear and to dose softly the gas.

3. Results with discussion

Figure 3 shows that the working efficiency on both sowing machines increases with the speed of sowing. However, on the pneumatic vacuum sowing machine OLT it is lower. This is due to longer time of turning of the sowing machine and stoppage at the end of the field which was equal to 4.6 minutes [15].

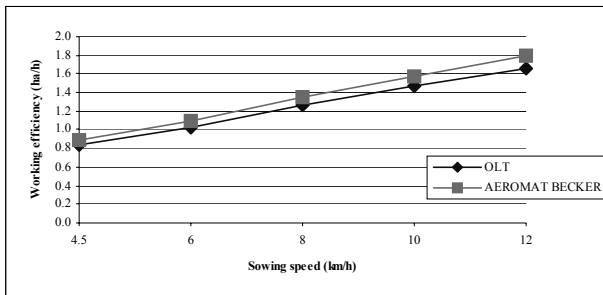


Fig. 3. Working efficiency of compared sowing machines

Figure 4 shows that on both sowing machines compared the sowing depth decreases with the increase in working speed. With 12 km/h it reaches the lowest value.

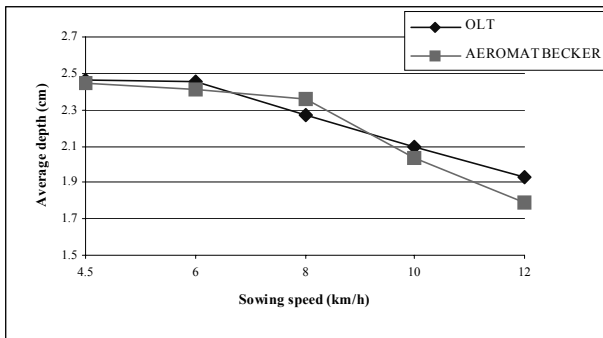


Fig. 4. Comparison of sowing depth of compared sowing machines

Figure 5 shows the change of inter - row distance with different speeds of sowing with the two compared sowing machines. It is characteristic of the OLT sowing machine that the tolerance of the inter - row distance increases with the increase in the sowing speed. The like applies to the sowing machine Aeromat - Becker, except that it has the worst measurement result with 8 km/h sowing speed.

Figure 6 shows the influence of the speed on the maximum, minimum and average values of distances between the seeds in the sowing row.

The increase in working speed results in unequal distances between the seeds in the sowing row. The distances were greatest with 12 km/h speed.

Figure 7 shows the influence of the speed on the maximum, minimum and average values of distances between seeds in the sowing row.

Unequal distances between seeds in the sowing row increase with the speed and are the greatest with 12 km/h speed.

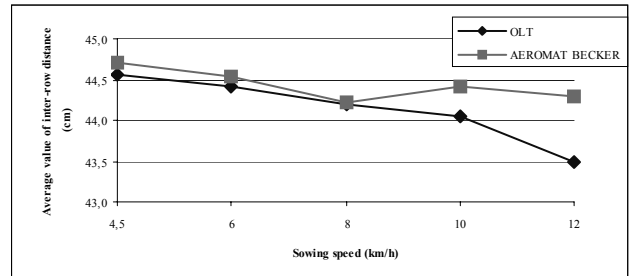


Fig. 5. Comparison of inter - row distance of compared sowing machines

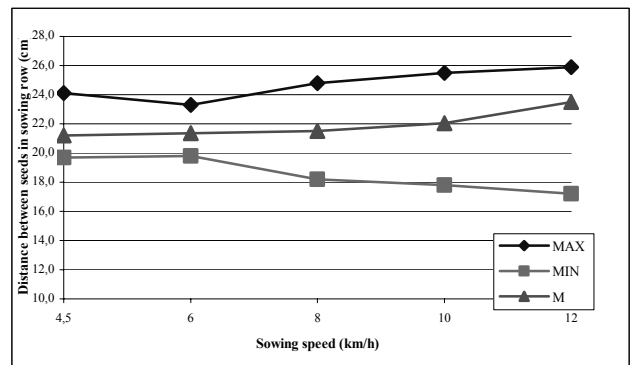


Fig. 6. Maximum, minimum and average values of distances between seeds in sowing row with pneumatic vacuum sowing machine OLT

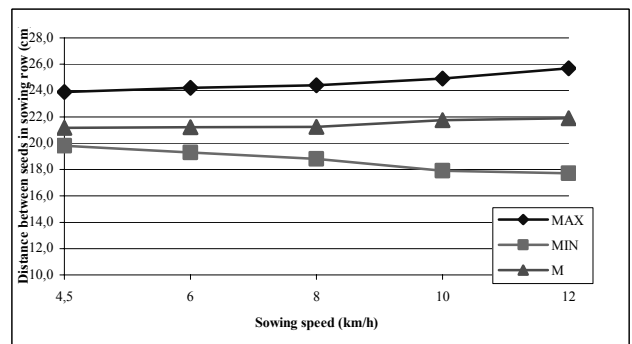


Fig. 7. Maximum, minimum and average values of distances between seeds in sowing row with pneumatic pressure sowing machine Aeromat - Becker

Figure 8 shows the standard deviation with different sowing speeds. It can be seen that the value of the standard deviation on the pneumatic vacuum sowing machine OLT strongly increases with 8 km/h speed and on the pneumatic pressure sowing machine Aeromat - Becker with 10 km/h sowing speed.

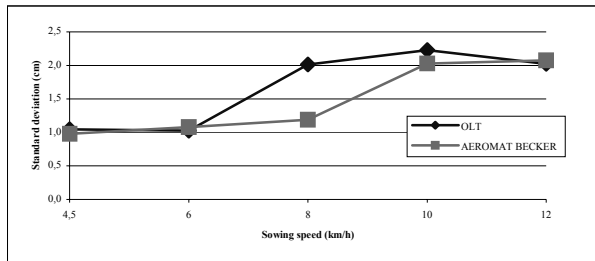


Fig. 8. Comparison of standard deviations of distances of seeds in sowing row on compared sowing machines

4. Conclusions

The quality of sowing is influenced by technical perfection of the sowing machine, accurately performed sowing test and tractor driver's accurate steering of the sowing machine.

It is recommendable for the driver to have an assistant when no electronically controlled device, signalling possible defects, is located on the sowing machine.

From the close proximity the assistant can find out the defects in operation of the sowing machine, the quantity of the seed in the discharge container, possible clogging of sowing shares etc.

The working efficiency increases with the sowing speed, while in the meantime the efficiency factor decreases. The working efficiency of the pneumatic vacuum sowing machine OLT is lower due to stoppage at the end of the field, where the coulters have to be turned mechanically.

The depth of sowing decreases with the increase of the speed. The average deviation is the greatest on the pneumatic pressure sowing machine Aeromat - Becker, where it is equal to 0.7 cm with 12 km/h.

The comparison of inter-row distances with different speeds shows that the tolerance of the inter-row distance increases. Once it exceeded the permissible deviation of ± 1 cm; otherwise the deviation is less than 1 cm and has no major influence.

The comparison of distances between seeds in the sowing row on the compared sowing machines shows that the sowing speed influences the uniformity of the layout of seeds and the final unit of area. On the pneumatic vacuum sowing machine OLT the optimum distance between seeds in the sowing row is reached with 4.5 - 8 km/h speed and on the pneumatic pressure sowing machine Aeromat - Becker with 4.5 - 10 km/h.

With the greatest speed measured, i.e. 12 km/h the deviation on the sowing machine OLT is as much as 2.5 cm and on the sowing machine Aeromat - Becker it is 0.9 cm which is still acceptable.

The measurement results of the compared sowing machines are interesting and show that the quality of sowing depends on its speed. It is possible to contest the sugar beet producers' argument

that only higher working speed of the sowing machine caused bad sprouting of sugar beet.

With both sowing machines sprouting was good even with 12 km/h speed. It must be borne in mind that then the distance between seeds in the sowing row is excessive and that the seed has been sown too little deep.

Therefore, the tractor drivers sowing with the abovementioned two sowing machines should consider the said optimum speeds.

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