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COMPARISON AND ANALYSIS OF PNEUMATIC PRESSURE AND VACUUM SOWING MACHINES

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Abstract: Two sowing machines in completely identical conditions at different speeds of sowing were tested. The pneumatic vacuum sowing machine OLT and the pneumatic pressure sowing machine Aeromat - Becker are compared. We were interested in adequacy of sowing at different working speeds and to find out the optimum working speed for the individual sowing machine. The parameters such as depth of sowing, working efficiency, distance between seeds and inter-row distance were measured and calculated. The tests were aimed at defining the most suitable sowing speed for both sowing machines on the basis of measured data. The pneumatic vacuum machine OLT has the optimum sowing speed 8 km/h and the sowing machine Aeromat - Becker 10 km/h.

Key words: Depth of sowing, working speed, inter-row distance, distance between seeds.

1. INTRODUCTION

The most important agro-technical measure is the sowing which is to be carried out on a well prepared land area to be sown (Skalicky, 1999). 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 coulters, 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. 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 (Rybar, 1999). 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 (Minx, 1993).

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.

2. PURPOSE OF MANUSCRIPT AND MEASUREMENT OF TRAVELLING SPEED

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 (Ploj et al., 2006).

The quality of sowing implied the following parameters (Mursec et al., 2006): 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 (Mursec & Cus, 2003).

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 (Munda, 2006).

3. SOWING AND MEASUREMENTS

Sowing of sugar beet on a field in the level area was effected. The field had been ploughed in autumn. Towards the furrow was closed and the field well leveled. The preparation of soil for sowing was performed by a soil preparation machine. For sowing the sugar beet of Dorotea species was selected. Sowing was performed in slightly cloudy weather, but the soil was suitably dry and there were no problems the moisture could pose. With each sowing machine sowing was performed at five different speeds (4.5 km/h, 6 km/h, 8 km/h, 10 km/h and 12 km/h). During each test an area of 0.1728 ha was sown. The length of the individual test lot was 160 m and 24 rows were sown. Sowing was performed by one tractor, first with the pneumatic vacuum sowing machine OLT and then still with the pneumatic sowing machine Aeromat - Becker (Figure 1). Sowing was performed as accurately as possible and took place without unforeseen difficulties. We were interested in the efficiency of the individual sowing machine. In order to determine the efficiency factor of the individual sowing machine the information of the effective time of sowing by the individual sowing machine at certain working speed and the time of turning at the end of the field was needed.

Measuring of the sowing depth requires much patience and accuracy. It was effected one day after sowing. The depth was measured for each sowing machine separately and for each sowing speed, with fifteen repetitions, in total. The sown strip of about 10 cm width was leveled longitudinally by means of 2.5 m long board. Then a layer of earth was carefully removed; attention had to be paid not to displace the seed. Then, a spirit level was placed over sowing furrow and the sowing depth was measured rectangularly to the position of the spirit level. On the field, also the measurements of the inter-row distance and distance between plants in the sowing row were performed. The

measurement was performed for both sowing machines and for all sowing speeds. During measurements only the outer rows of the sowing machine, i.e. the first and the sixth rows were not considered. The inter-row distances of those rows largely depend on the tractor driver's precision. Although the field was well prepared everywhere, measurements started at 30 m in the interior of the rows, particularly due to the speed. The measurement of the inter-row distances was repeated fifteen times for each working speed. For measuring the distances between plants in the row a length of 3.2 m was selected at the places, where no plants were missing due to bad sprouting.

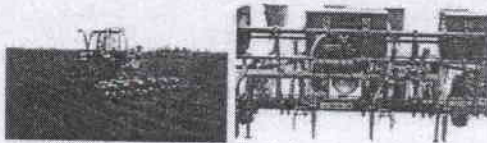


Fig. 1. Aeromat, model 6K-T (left), (www.inobrezice.com), OLT, model PSK (right), (www.olt.hr).

Speed (km/h)	Max (cm)		Min (cm)		M (cm)		σ (cm)		KV (%)	
	OLT	AB	AB	OLT	AB	OLT	AB	OLT	AB	OLT
5	2.7	2.8	2.2	2.2	2.460	2.447	0.12	0.15	4.88	6.31
6	2.8	2.8	2.1	2.0	2.453	2.407	0.17	0.22	7.12	9.04
8	2.6	3.3	1.8	1.8	2.267	2.360	0.23	0.34	10.27	14.33
10	2.6	2.6	1.7	1.6	2.093	2.033	0.26	-0.29	12.63	14.44
12	2.4	2.3	1.6	1.2	1.933	1.787	0.23	0.29	11.74	16.33

Table 1. Sowing depth with pneumatic vacuum sowing machine OLT and Aeromat - Becker.

5. CONCLUSION

The manuscript presents two sowing machines for interval sowing, differing in the mode of operation. Cultivation of sugar beet depends primarily on expert and technically correct sowing. 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. It is very important for the producers to be well familiarized with all agro-technical measures. 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

4. RESULTS WITH DISCUSSION

4.1 Depth of sowing

Table 1 shows the influence of sowing speed on the depth for pneumatic sowing machine OLT and Aeromat - Becker. For OLT are the best results of average depth reached with the sowing speed of 4.5 km/h and 6 km/h. Then the deviation from the average depth is less than 0.5 mm. The results show that the sowing speed decreases with the increase in speed. The smallest sowing depth occurs in case of 1.93 cm and 12 km/h. At the Aeromat - Becker desired depth of 2.5 cm was most approached with 4.5 km/h speed, when the average depth of sowing was equal to 2.44 cm. Acceptable depths of 2.4 cm and 2.36 cm also occur in case of sowing speed 6 km/h and 8 km/h. With 10 km/h sowing speed the depth was reduced already for almost 0.5 cm. A very bad result of the average depth of sowing occurs with 12 km/h speed and is equal to 1.78 cm.

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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