QUALITY ASSESSMENT OF CARROT SEEDING USING PRECISION BELT SEEDER S011 ALEX

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Summary. The goal of the research was to examine the quality of sowing carrot seeds with S011 Alex seeder of the belt type. The research was conducted on Karotan and Joba carrot varieties, at three working speeds of the seeder, i.e. 0.7, 1.0 and 1.4 m/s. It was shown that this seeder ensured full coverage with soil of all sown carrot seeds and maintained the preset depth of sowing. Best quality sowing was achieved at a working speed of 0.7 m/s. At the speed of 1.0 m/s the quality slightly deteriorated, while at the speed of 1.4 m/s the achieved results in terms of singulation and percentage of skips were significantly worse compared to the results achieved at the speed of 0.7 m/s.

Key words: carrot, precision seeding, seeding quality

INTRODUCTION

The quality of seeding affects proper growth and development of cultivated plants [Gaworski and Poławska 1993]. Vegetable seeds should be sown with precision seeders, which apart from maintaining fixed width of inter-row spaces ensure proper placement of seeds in rows and preservation of the preset depth at which the seeds are planted. This allows to limit to a minimum the quantity of the sown seeds, which, since seeds are a highly priced material, is a cultivation cost reducing factor [Gaworski 1998].

Not long ago in Poland only universal and garden seeders were used for vegetable seeding, while foreign precision seeders were used only marginally. Lately however, the interest of vegetable producers in precision seeding has grown. In order to meet the market requirements, private company Weremczuk, located in Lublin, started production of a tractor-pulled seeder of the belt type. It is significantly cheaper than a foreign-manufactured seeder of a similar class. It is meant for seeding different kinds of seeds, which is possible thanks to the usage of belts with differently sized holes, distributed along one, two or three rows. Uniformity of seeds distribution along the rows is mostly dependent on the number of holes in the belt and the speed at which it moves, which should be correlated with the speed of the seeder movements [Kowalczuk and Węgrzyn 1995, Varina *et al.* 2001, Özmerzi *et al.* 2002].

MATERIALS AND METHODS

The main goal of the research was to examine the quality of carrot seeding performed by a belt type precision seeder S011 Alex operating at different working speeds.

The construction of the S011 Alex seeder is based on a frame with a three-point suspension system to which, by means of joint parallelograms, working sections are attached. Belts attached to particular sections are power driven from the central shaft which in turn is driven by land wheels by means of chain transmission. The seeding section of the seeder is made up of the seed container, seeding system, furrow opener, guiding wheel, pressure wheel and the firmer.

Figure 1 presents the construction scheme of the seeding system of the seeder.



Fig. 1. Construction scheme of belt seeding system of S011 Alex seeder: 1 – drive wheel of seeding belt, 2 – guiding roller, 3 – seeding belt, 4 – pushing roller, 5 – flap, 6 – tension roller, 7 – seeding edge, 8 – away plate, 9 – belt guide

Seeds from the seed container slide down along the channel to the seed chamber, on the bottom of which there is the seeding belt with holes, wound between the drive wheel and the guiding rollers. From the bottom the seed chamber is closed with the belt guide, which is responsible for seed distribution control and for the creation of the seeding edge. Over the end of the guide, there is the pushing roller which turns in the direction opposite to the movement of the belt. The roller sweeps away the seeds which did not find their way to the belt holes and it bends the belt downwards, which helps the seeds to leave the holes and fall in the furrow opened by the furrow opener. In order to limit the quantity of seeds sliding down from the seed container to the seed chamber, a replaceable flap was attached whose size corresponds to the kind of the sown seed. In front of the furrow opener there is the soil surface levelling wheel, followed by a pressure wheel pressing the sown seeds against the bottom of the furrow which is then followed by the firmer. The amount of the sown seed depends on the speed at which the belt moves which is regulated by changing the gear in the drive transmission. Depending on the needs, belts with holes distributed along one, two or three rows are used. The seeding depth is regulated by changing the position of the furrow opener in relation to section guiding wheels.

The quality of seeder work was assessed on the basis of carrot seeding of Karota and Joba varieties, performed at three different working speeds, i.e. 0.7, 1.0 and 1.4 m/s. The belt that was applied had 96 holes of 3.5 mm in diameter, placed in two rows.

- Quality assessment criteria for the seeding were:
- average seeding depth to the preset seeding depth ratio,
- degree of seed coverage with soil,
- precision of seed distribution in rows.

The seeding depth was determined by measuring the distance between the furrow's bottom where the seeds were planted, and the top edge of the soil covering the seeds made by the firmer. The above procedure was carried out in 20 repetitions, for each working speed of the seeder. The degree of seed coverage with soil was determined on 5-meter measurement sections selected at random, in 5 repetitions for each speed. Then the uncovered seeds were counted and calculated as percentage of the theoretical number of seeds sown by the seeder.

Precision of the seed distribution in rows was determined after all germination was completed by measuring distances between plants on 5-meter measurement sections, in 5 repetitions for each working speed of the seeder.

In order to process the obtained results, ISO 7256/1 norm was used, whose recommendations are applied by foreign methodologies.

Those plants were considered properly sown between which the distance was bigger than half of the real one and smaller or equal to 1.5 of the real one. Those plants were considered duplicated which grew at distances smaller or equal to the half of the real one. Distances bigger than 1.5 of the real one were considered skips. Then the following were calculated:

- percentage of single plants expressed as quotient of the number of single plants and overall number of plants grown on all measurement sections,
- percentage of duplicated plants expressed as quotient of the number of such plants and overall number of plants grown on all measurement sections,
- percentage of skips expressed as quotient of the number of these skips and overall number of skips on all measurement sections.

The obtained research results were subjected to further statistical analysis based upon a variance analysis and multiple confidence intervals of T-Tukey at an assumed level of $\alpha = 0.05$.

RESULTS AND DISCUSSION

The results are presented in Table 1 and Figures 2 and 3.

Table 1. Results of quality analysis of carrot seeding of Karotan and Joba varieties done with S011 Alex seeder

Seeder working speed	Average seeding depth to the preset seeding	Seed coverage by soil
m/s	depth ratio	%
0.7	0.98	100
1.0	0.98	100
1.4	0.98	100



The seeder ensured full coverage with all the sown carrot seeds and the actual seeding depth did not differ much from the preset seeding depth.

Fig. 2. Influence of working speed of S011 Alex seeder on the percentage share of Karotan variety carrot in distance classes in rows

The diagram in Figure 2 shows that the best percentage share of Karotan variety carrot in the examined distance classes in rows occurred at the speed of 0.7 m/s. At this speed the share of single plants was 55.5%, of duplicated plants was 29.0% and of skips was 15.5%. At the speed of 1.0 m/s the share of single plants was 53.0%, of duplicated plants was 28.6% and of skips was 18.4%. The respective figures for the speed of 1.4 m/s were 45.6%, 30.2% and 24.2%.

Statistical analysis of the obtained results showed significant differences only between the share of single plants and skips at the 0.7 and 1.4 m/s working speeds.



Fig. 3. Influence of working speed of S011 Alex seeder on the percentage share of Joba variety carrot in distance classes in rows

The diagram in Figure 3 shows that the best percentage share of Joba variety carrot in the examined distance classes in rows occurred at the speed of 0.7 m/s. At this speed the share of single plants was 53.5%, of duplicated plants was 30.8% and of skips was 15.7%. At the speed of 1.0 m/s the share of single plants was 48.3%, of duplicated plants was 33.8% and of skips was 17.9%. The respective figures for the speed of 1.4 m/s were 45.7%, 32.7% and 21.6%.

Statistical analysis of the obtained results showed significant differences only between the share of single plants and skips at 0.7 and 1.4 m/s working speeds, and between the share of skips at 1.0 and 1.4 m/s working speeds.

CONCLUSIONS

Based upon the conducted research, the following conclusion can be formulated:

1. S011 Alex belt seeder ensured full soil coverage of all the sown seed at all the examined working speeds in case of both carrot varieties and preserved the preset seeding depth.

2. Best quality seeding results for Karotan and Joba carrot varieties were achieved at the working speed of 0.7 m/s. At the speed of 1.0 m/s slight deterioration of the seeding quality occurred, while at the speed of 1.4 m/s there were significant differences between the share of single plants and skips compared to the 0.7 m/s results.

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