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Assessment of the influence of selected operating parameters of S071/B KRUK seeder on seeding *Sida hermaphrodita Rusby* seeds**

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A b s t r a c t. This paper presents the results of research on the quality of seeding *Sida hermaphrodita Rusby* (Virginia fanpetals) seeds with the S071 KRUK precision seeder in field conditions. It was observed that the best quality of sowing for the examined classes of distances in a row was obtained at the sowing disk peripheral speed of 0.23 m s^{-1} and the working speed of 0.8 m s^{-1}. In subsequent tests significant impact of the disk peripheral speed on percentages of single, duplicate and skipped plants was observed. Thus, it can be concluded that the peripheral speed of the sowing disk of the examined seeder impacts the precision of seed distribution in a row.

K e y w o r d s: precision seeder, *Sida hermaphrodita Rusby*, (V. f.) seeds, seeding quality

INTRODUCTION

Sida hermaphrodita Rusby, in America commonly known as Virginia fanpetals, was brought to Poland in the fifties of the previous century and since then has been used as a raw material providing energy. This plant belongs to the family Malvaceae. Hitherto observations and results of experiments show that, if cultivated for seeds, Virginia fanpetals can last for 15 to 20 years. The stalks of this plant are roundish with the diameter of 5 to 30 mm and hollow inside. The height of this plant at the end of the vegetation period may reach up to 400 cm. Virginia fanpetals can be reproduced generatively through sowing seeds, but also vegetatively. The growth and development of this plant is basically undisturbed in our climate. Prior to establishing a plantation of this plant, the most advantageous reproduction method should be chosen. It has been observed that 1 or 2 year old seeds germinate easily in humid and not crusty soil, but the initial growth of seedlings is very slow and the plantation requires intensive weed control. The most frequently applied method of Virginia fanpetals reproduction is sowing seeds, during which it is crucial to properly and carefully arrange individual seeds on a specified unit of surface and to maintain the same sowing depth. The best way to accomplish the above requirements is to apply machine seeding, which at the same time reduces labour intensity of the cultivation process. In recognition of the above requirements, a precision seeder equipped with a spoon-type seed-dosing apparatus was used in this study (Banasiak and Michalak, 2000; PN-91/R-55027, 1991; Service..., 2000).

MATERIAL AND METHOD

The main aim of the research was to determine the quality of sowing Virginia fanpetals seeds by means of the S071 KRUK seeder equipped with a spoon-type sowing device. The seeder was used in field conditions in the village of Korytniki, district of Krasiczyn, while sowing the seeds of Virginia fanpetals plant.

This seeder has two gauge wheels, a seed box, mainframe in which the spoon-type seeding system is placed, double driving chain transmission, furrow opener and a firmer (Fig. 1). The precision seeder mechanism is driven from the front ground wheel by means of a chain and sprocket transmission. The frame of the seeding system contains a transparent disk with turning small spoons whose sizes can be

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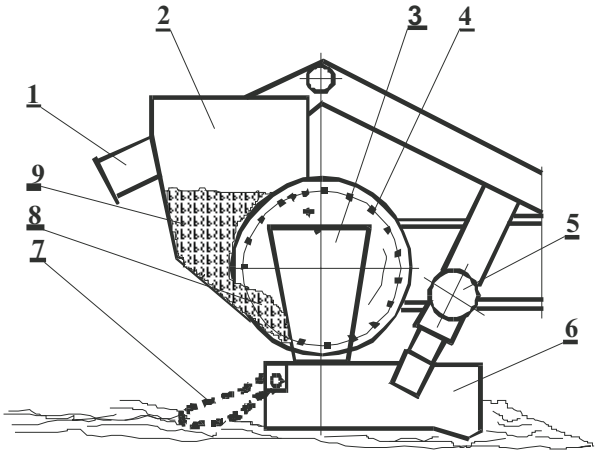

Fig. 1. Construction schematic and principle of operation of S071/B KRUK seeder sowing system: 1 – frame, 2 – reservoir, 3 – seeding trough, 4 – seeding disk with spoons, 5 – lock mechanism of furrow opener position, 6 – furrow opener, 7 – firmer, 8 – seed reservoir outlet, 9 – seeds.

adjusted to the seed size. While the seeding section is working, the spoon is led by a cam mechanism and scoops up seeds out of the seed reservoir. The spoon is led horizontally further on and its edges are kept parallel to the level, and when it proceeds to the upper part of the cam, it is turned by the cam mechanism, seeds fall into the trough and a furrow is opened by the furrow opener. The firmer covers the seeds with soil and the back wheel kneads the soil (Błażczak and Przybył, 2000; Walczyk J., 1992).

The seeder tests were supposed to identify the influence of changing peripheral speed of the spoon-type sowing disk on the accuracy of seed distribution in a row. Spoons were properly sized for the seeds. Assessment of the seeding quality of the Virginia fanpetals was conducted by means of research methodology developed for precision seeders and contained in ISO 7256/1 standard (Borkowska and Styk, 2003; Przybył J. and Błażczak P., 2000). Work quality of the seeder was judged on the example of Virginia fanpetals seeds (*Sida hermaphrodita Rusby*).

Geometrical dimensions and weight of 1,000 seeds was determined on the basis of 100 seeds selected at random, measured and weighed. Germination quality was determined on the basis of tests conducted just before proper seeding in laboratory conditions (Table 1).

T a b l e 1. Parameters of sown seeds

Parameters	Virginia fanpetals seeds
Length (mm)	2.6
Width (mm)	2.3
Thickness (mm)	1.7
Weight of 1000 seeds (g)	3.4
Germination quality (%)	33

Field research was performed at the seeder operating speed of 0.8 m s^{-1} and three different peripheral speeds of the seeding disk *ie* 0.42, 0.36, and 0.23 m s^{-1}. The number of spoons on the disk was 30. Distances between plants were measured on 5 m measurement sections in 5 repetitions. Then the percentage of single, duplicate and skipped plants was calculated. Single plants were considered to be those between which the distance was bigger than half of the average real distance and smaller or equal to 1.5 of the average real distance. Duplicated plants were considered to be those which grew at distances smaller or equal to half of the average real distance. Skips were considered distances bigger than 1.5 of the average real distance.

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 skips and overall number of skips on all measurement sections.The obtained results were subjected to further statistical analysis based upon variance analysis and multiple confidence intervals of T-Tukey at an assumed level of $\alpha = 0.05$.

RESEARCH RESULTS

Results of testing the quality of sowing Virginia fanpetals seeds with the S071/B KRUK seeder are shown in Table 2 and Fig. 2.

T a b l e 2. Results of testing the quality of sowing Virginia fanpetals seeds with S071/B KRUK seeder

Number of lot	Disk peripheral speed (m s^{-1})	Seeder operating speed (m s^{-1})	Average seeding depth to predefined seeding depth ratio	Seed coverage by soil (%)
1	0.42	0.8	0.98	100
2	0.36	0.8	0.98	100
3	0.23	0.8	0.98	100

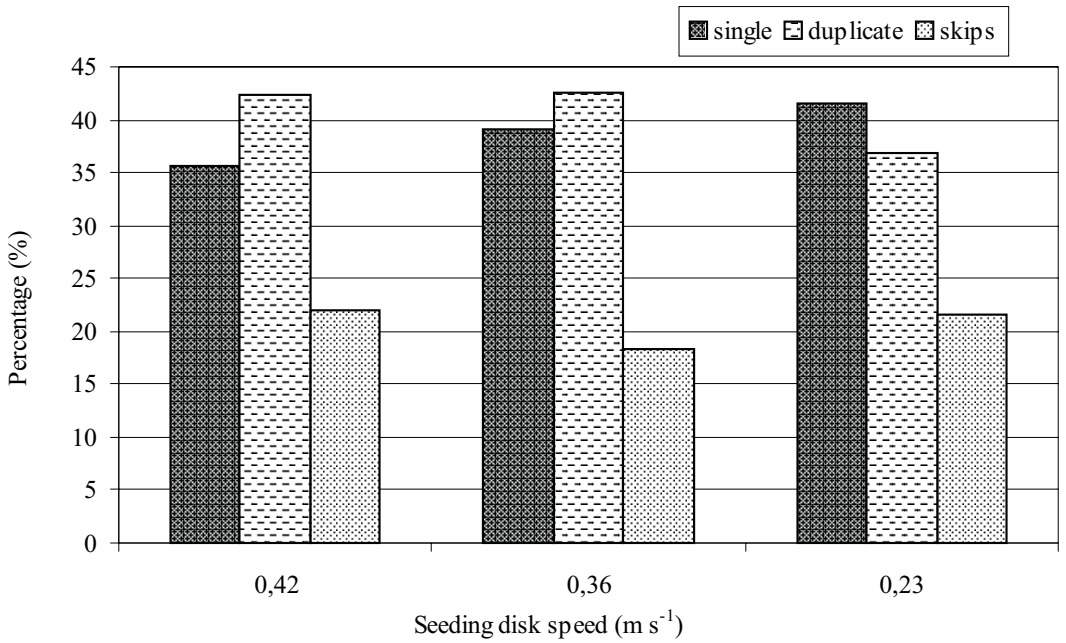

Fig. 2. Influence of peripheral speed of sowing disk of S071/B seeder on percentages of single, duplicate and skipped plants.

The diagram in Fig. 2 shows that the most advantageous percentage of Virginia fanpetals seeds in the examined distance classes in a row occurred at the peripheral speed of the seeder sowing disk of 0.23 m s^{-1}. At this speed, the share of single plants was 41.6%, duplicates 36.8% and skips 21.6%. At higher speeds, the rate of single plants decreased and the rate of duplicates and skips grew.

Statistical analysis of the obtained results showed significant differences between shares of single plants depending on the applied speed. At the same time, no significant differences were observed in the shares of duplicate plants at the speeds of 0.36 and 0.42 m s^{-1} at $\alpha = 0.05$. Statistical analysis of skips showed significant differences between speeds of 0.42 and 0.36 m s^{-1} as well as 0.23 and 0.36 m s^{-1} (Table 3). Thus, it can be concluded that disk peripheral speed significantly influenced the quality of sowing the seeds of Virginia fanpetals.

CONCLUSIONS

1. Significant influence of peripheral speed of the seeder sowing system on percentages of single, duplicate and skipped plants of *Sida hermaphrodita Rusby* was observed.

2. Most beneficial ratios related to the distribution of Virginia fanpetals seeds were obtained at the peripheral speed of the sowing disk of 0.23 m s^{-1} and operating speed of 0.8 m s^{-1}.

3. At a peripheral speed of the sowing apparatus higher than 0.23 m s^{-1}, the accuracy of seed distribution in a row significantly deteriorated, which was expressed in the decrease of single plants sown and increase of duplicates and skips.

T a b l e 3. Results of research on the quality of seeding the *Sida hermaphrodita Rusby* seeds by means of the operating section of S071/B KRUK seeder

Number of lot	Peripheral speed of the sowing disk	Seeder operating speed (m s^{-1})	Single plants	Duplicated plants	Skips
			(%)		
1	0.42	0.8	35.6 a*	42.4 a	22.0 a
2	0.36	0.8	39.0 b	42.6 a	18.4 b
3	0.23	0.8	41.6 c	36.8 b	21.6 a

*Different letters in superscript denote that at the examined operating speeds there occurred significant differences between the shares of single plants, duplicated plants and skips at the level of $\alpha = 0.05$.

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