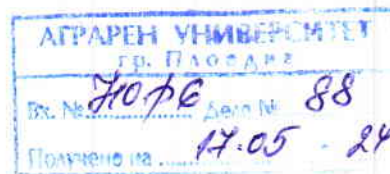


OPINION



on a dissertation paper for acquiring **PhD** scientific and educational degree in field of higher education 5. Technical sciences, professional area 5.13. General engineering in the scientific specialty: „Mechanization and electrification of plant growing”

Author of the dissertation paper: dpl. eng. Ilian Bozhidarov Bozhkov, PhD student with individual training at the department of Mechanization of plant growing at the Faculty of Horticulture with Viticulture at the Agricultural University – Plovdiv.

Topic of the dissertation paper: Stepless adjustment of the sowing rate of Saxonia A200 row drill

Opinion prepared by: Assoc. prof. dpl. eng. Galin Iliev Tihanov, PhD, Trakia University – Stara Zagora, field of higher education 5. Technical sciences, professional area 5.13. General engineering, scientific specialty „Mechanization and electrification of plant growing”, appointed as member of the scientific jury by order No. RD-16-366 / 12 Mar 2024 by the Rector of the Agricultural University – Plovdiv.

1. Up-to-dateness of the problem.

Sowing is an important stage in the technology of growing field crops. The machines for its implementation are called seed drills. With them, the sowing device is one of the most important working organs in the construction of the seeder. It plays a major role in the dosing, distribution and feeding of the seed material. In practice, there are seed drills with different designs of seed apparatus, but the most common ones are seed drills with toothed (pin) and chute seed apparatus built into them. With seed drills for field crops, the sowing rate is the optimal number of seeds that are sown per unit area. It is adjusted by changing the gear ratio between the drive wheel of the seeder and the seed apparatus. In the sense of the above, the dissertation paper solves an up-to-date problem of theoretical and practical significance.

2. Objective, tasks, hypotheses and methods of research.

The objective logically derives from the analysis of the problem. It is clear, well defined and reflects the essence of the dissertation paper - to develop a system for stepless adjustment of the seeding rate in seed drills with a "fused surface". The 6 tasks set are clear and allow to systematically achieve the objective. The tasks largely represent the author's hypotheses, which are developed and proven through theoretical and experimental scenarios.

Some of the methods used in the dissertation paper have been specifically developed for the research and can be used to solve practical tasks. The structure and elements of the methodology have been properly substantiated, and their interrelationship is logical and allows reliable results to be obtained.

3. Illustrating and presenting the results obtained.

The total volume of the dissertation paper is 114 pages and includes: a list of symbols and abbreviations used, an introduction, four chapters, general conclusions, references and six appendices. The results obtained from the experimental and theoretical research have been presented in two chapters with own developments. A total of 16 tables and 22 figures have been used. As quantity, they represent well the work

done by the PhD student and are a good basis for analysis and discussion. Some of the results obtained have been presented correctly, by application of planning of the experiments, dispersion and regression analyses.

4. Discussion of the results and literature used.

As is evident from the dissertation paper, it is clear that the PhD student is a direct participant in all phases of its development - setting the tasks, carrying out the developments, analyzing the results and formulation of the conclusions. The data are real and an adequate mathematical model has been used for their processing. The research itself is detailed, thorough and precise. The comments on the results obtained are credible, but they are rather short and lack sufficient discussion.

The PhD student has analyzed 112 literary sources, of which 81 are in the Cyrillic, 18 are in the Latin, and 13 are Internet addresses.

5. Contributions of the dissertation paper.

The following contributions are notable in the dissertation paper:

Scientific contributions

1. The transmission function in a mechatronic system controlling and supporting the process of sowing seeds in the Saxonia A200 seed drill has been theoretically determined. The variables in it are the sowing rate and the amount of seeds that are sown in 1 revolution of the seeding apparatus, which is directly dependent on their density and volume.

2. The functional relationship between seed density, transmission ratio and the amount of seeds sown has been determined. A mathematical model has been developed that is adequate and can be used to solve optimization and other research tasks.

3. A methodology has been developed for determining the main parameters of the electric drive of the seeding apparatus of the Saxonia A200 seed drill.

Scientific and applied contributions

1. A total of 2 versions of a mechatronic system for controlling the sowing rate have been developed - with a DC and an AC motor. At the core of both variants is the Arduino microprocessor (microcomputer), which is a tool for developing devices that interact with the physical environment. It is an open hardware and software platform for working with physical objects.

2. The amount of wheat seeds sown in 1 revolution of the toothed (pin) sowing apparatus of the Saxonia A200 seed drill has been determined – 30.067 g.

3. The gear ratio has been found to have a stronger effect on the variation in the quantity of seeds sown compared to seed density. About 61.1% of that variation is accounted for by the gear ratio. 33.3% were influenced by the seed density. A total of 94.4% of the variation in the quantity of seeds sown was accounted for by the two factors. Only 5.6% of the variation was accounted for by other factors not taken into consideration.

4. It has been proven that the type of drive system (mechanical or electric) of the sowing apparatus of the seed drill does not have a significant effect impact on the calculated operating costs. 2/3 of these costs are deductions for depreciation, major and current repairs, 1/4 for the formation of a salary fund and about 1/10 for fuel.

6. Critical notes and questions.

The main notes and recommendations have been provided to the author in advance at the extended department meeting on 05 Mar 2024, but regardless of this, the following weaknesses are noticeable:

- Numbering of the figures on pages 72 and 73 and of the equation on page 91 is missing.
- On fig. 4.5 on page 96 the figures for the percentage ratio are missing, but these are present in the self-abstract. There is also a discrepancy in the colors of this figure in the self-abstract and in the dissertation paper.
- There is a discrepancy in the number of literature sources used - 112 are indicated in the dissertation paper, and 114 in the self-abstract.
- In the Material and methods section, there is no item on the statistical processing methodology.
- In the self-abstract, it would be more accurate to start each chapter on a separate page.

How did you choose the seed material for the three crops - grass mixture 250 kg/m³, oats 537 kg/m³ and wheat 825 kg/m³?

7. Published articles and citations.

On the topic of the dissertation paper, the PhD student has presented 5 publications. He is the first author of two of them and a co-author of the other three. The total number of points is 50 (required 30 points) and exceeds the minimum set as a requirement for obtaining the PhD scientific and educational degree according to the Law on the Development of the Academic Staff. The publications reflect the essential part of the work. No article citation document has been submitted.

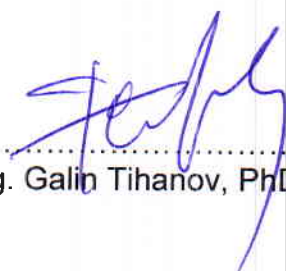
The presented self-abstract reflects objectively the structure and content of the dissertation paper.

CONCLUSION:

Based on the various research methods learned and applied by the PhD student, the correctly conducted experiments, the generalizations and conclusions made, I reckon that the presented dissertation paper complies with the requirements of the Law on Development of the Academic Staff in the Republic of Bulgaria and the Rules of the Agricultural University on its implementation, which gives me grounds to assess it **POSITIVELY**.

I allow myself to propose to the honorable Scientific jury to also vote positively and award to **dpl. eng. Ilian Bozhidarov Bozhkov** the PhD educational and scientific degree in field of higher education 5. Technical sciences, professional area 5.13. General engineering in the scientific specialty "Mechanization and electrification of plant growing".

10 May 2024
Stara Zagora

OPINION PREPARED BY: 
(Assoc. prof. dpl. eng. Galin Tihanov, PhD)