



REVIEW

of the PhD thesis for obtaining an educational and scientific degree "Doctor" in: field of higher education, **6. Agricultural sciences and veterinary medicine**, professional field **6.1 Plant growing**, scientific specialty **Vegetable crops production**

Author of thesis: Alexander Kirilov Trayanov, full-time doctoral student PhD at the Department Horticulture in Agricultural University - Plovdiv

Title of the thesis: "Productivity and quality of the seeds of carrot by optimization of nutrient regime in their seed production"

Reviewer: Assoc. prof. Dr. Dimka Haytova, Agricultural University-Plovdiv field of higher education **6. Agricultural sciences and veterinary medicine**, Professional field **6.1. Plant growing**, scientific specialty **Vegetable crops production**, appointed as a member of the scientific jury by order № RD-16-228/15.03.2021 of the Rector of the Agricultural University - Plovdiv

1. Briefly presentation of the candidate.

PhD student Alexander Trayanov was born in 1990. He completed his higher education with a bachelor's degree in Plant Protection in 2013. In the period 2014-2015 he studied in the international master's course in Plant medicine and acquired the Master's degree. His professional career is related to work as a junior expert in the Plant Protection Department at the RFSA-Plovdiv at the BFSA (2015) and a junior expert-agronomist at the of Maritsa vegetable crops research institute - Plovdiv (2016).

By order № RD-26-24/16.02.2017 he was enrolled as a full-time PhD student in department of Horticulture, with scientific supervisor Prof. Dr. Nikolay Panayotov.

During the period of conducting his research work and in implementation of his individual curriculum he has been trained in the modules: "Mineral nutrition of vegetable crops"; "Selection and seed production of vegetable crops"; "Seed science and factors of seed production"; "Data base"; "Treatment of experimental data"; "Training methodology"; "Methodological basis of physiological studies and leaf gas exchange"; "English". In the second year of his studies he successfully passed an exam in the specialty "Vegetable Production". He speaks excellent English and good Russian. I personally know Alexander Trayanov and I have direct impressions of his work during the whole period of study and research work. I think its good communication and organizational skills and ability to better planning and execution of tasks allowed him to deal with conducting the experiments and writing a doctoral thesis.

2. Relevance of the problem.

The basis of successful production of vegetable crops is the use of quality seeds. Scientific publications in the field of seed production of vegetable crops in Bulgaria are limited. An extensive study to optimize fertilization as an essential element of technology of seed production of carrots has not been conducted.

The topic of the dissertation considered important for agronomic science and practice problem. Its determination is important to improve the conditions of mineral nutrition of seed plants of carrot, and therefore to increase their productivity and viability. The relevance of the topic can be seen not only agricultural, but also in economic and social terms.

3. Aim, task, hypothesis and methods of the study.

The aim of the dissertation is formulated clearly and precisely in relation to the title. Three tasks have been developed. Their implementation helps to achieve the set aim. The aim and tasks are in full unison with the working hypothesis. It concerns the optimization of the nutritional regime in the seed production of carrots in order to increase the yield of seeds and improve their quality. Its realism and acceptability are revealed and confirmed in the process of deriving the experimental work and from the obtained results.

The PhD student, with the help of his supervisor, has managed to achieve a high level of methodological support of the research. With this the dissertation acquires an original character. In defining the tasks and writing the different research methods, the good theoretical preparation of the PhD student and his knowledge of modern methods in research, acquired in the implementation of the educational part of his individual plan, are demonstrated.

Scientific experiments have been carried out for three years. The variants of the experiment are 18 and include two regimes of fertilization - with once and twice application of fertilizers. Fertilization levels have been selected correctly, in accordance with the recommended amounts of mineral fertilizers from previous studies by Madzharova (1966), Kolev (1977) and Minkov (1984). The experiments have a precise experimental design. They are set by the block method in 4 replications, with a distinction between experimental and reporting plot. Internal guards are also included. It helps to differentiate the influence of different fertilization regimes. The Tuschon variety was used. Experimental work is based on a range of large numbers of indicators. They are logically selected and meet the aim and tasks.

4. Visualization and presentation of the obtained results.

The general type, volume, structure and content of the thesis meet the criteria for such type of scientific work according to the Law on the Development of Academic Staff in the Republic of Bulgaria and the Regulations of the Agricultural University for its implementation.

The total volume is 218 standard pages, the sections are arranged structurally, in a logical sequence and include: title page; content - 4 pages, introduction - 2 pages; literature review - 24 pages; aim, tasks and hypothesis -

1 page; materials and methods - 10 pages; soil and climatic conditions during the experiment - 10 pages; results and discussion - 145 pages; conclusions and recommendations - 3 pages; literature - 15 pages; additionally added the sections - contributions - 2 pages and a list of publications to the dissertation - 1 page. The results are illustrated by 60 tables and 21 figures. Four photos are showing the different stages of the experiment and the condition of the plants from the experiments.

5. Discussion of the results and used literature.

The detailed literature review shows a good knowledge of the PhD student on the research topic. The state of the problem is discussed in detail. 158 literary sources are cited, 37 of them in Cyrillic and 121 in Latin. Over 46% of the total number is modern sources after 2000, and 17.72% of them are in the last 5 years. The fact that the author does not limit himself to a review of the scientific literature only in this chapter also makes a good impression. He cites the findings of other authors in the interpretation of the results of the present study in chapter "Results and discussion".

Extended and depth experimental work has been carried out. It includes a study of the influence of different fertilizer rates and timing of fertilization on phenology and generative behavior of seed plants. Seed productivity, morphological characteristics of seeds and seed quality are determined. Depending on the applied fertilization regime, the chemical composition of the seeds and their storage are established. Economic analysis helps to assess the full effect of the inclusion of the studied optimization in the technology of carrot seed production.

The large number of tested variants and the observing of over 40 indicators have allowed the PhD student to demonstrate in a solid way his ability to conduct scientific research and analyze the results.

As a result of the scientific work, a rich material of experimental data has been accumulated. They are summarized, illustrated and processed statistically. They are enough for detection of trends, patterns and relationships between indicators for research and fertilization with different rates and regime of their introduction. The conclusions of the dissertation are formulated after analysis of the obtained results.

It has been proven that the development and productivity of carrot seed plants are influenced by the applied different fertilization regimes. A stronger effect is reported with the twice application of mineral fertilizers. It also leads to a stronger increase in yield. In the distinguished variants (twice application of $N_9P_9K_{10}$ and once application with $N_9P_9K_{20}$) the increase compared to the control is approximately 30%. The author points out that this increase in the first method of fertilization is achieved with lower levels of phosphorus and potassium fertilizers than recommended.

Germination energy, germination and field germination, as well as absolute seed weight increase significantly due to $N_9P_9K_{20}$ fertilization, being higher for once fertilization. This combination also has a stronger positive effect to reduce the germination period and to increase the uniformity. The dependence of germination with evenly increasing levels of fertilization is described by

polynomial regression with high coefficients of determination.

Strong positive correlations were found between vegetative and generative behaviors of the carrot seed plant and seed yield. As a result of the applied levels and regimes of fertilization, the heteroblasty between the seeds of the individual orders is reduced in many of the indicators.

As a result of higher economic efficiency and notional profit, as well as the highest productivity, with increased seed quality, twice fertilization with $N_9P_9K_{10}$ and once fertilization with $N_9P_9K_{20}$ are recommended for use in seed production of carrots.

6. Contributions of the thesis.

The content of the conclusions is outlined the main contributions of the thesis. They are the personal work of the PhD student. I accept contributions of the thesis entirely.

Scientific contributions

1. For the first time in the conditions of our country, a stronger influence of the twice application of mineral fertilizers, compared to the once fertilization, on the development and productivity of the plants in seed production of carrots has been established.
2. A polynomial regression between evenly increasing levels of fertilization with the yield of carrot seeds and their germination, with high coefficients of determination, has been determined.
3. It was found that the productivity of carrot seeds and their sowing qualities are formed mainly by the seeds formed in the umbels of the first and second order.
4. Strong positive correlations were found between vegetative and generative behaviors of the carrot seed plant and seed yield, as well as between the number of umbellate in a umbels with the number of flowers and the diameter of the umbel.
5. The obtained results, in scientific aspect, can serve as a good theoretical basis for scientifically-based application and solution of the problems related to mineral fertilization in carrot seed production.

Scientific and applied contributions

1. It is pointed out that with the application of the tested levels and regimes of fertilization the heteroblasty between the seeds of the different orders decreases.
2. It is emphasized that the best productivity from carrot seeds is obtained with twice application of $N_9P_9K_{10}$ and once use of $N_9P_9K_{20}$, which is recommended to be applied in practice.
3. It is proved that the carrot seed storage has been improve most strongly as a result of a once application of $N_5P_{19}K_{20}$ as well as twice fertilization with $N_9P_9K_{20}$ and $N_9P_{19}K_{20}$.
4. It has been found that the viability of carrot seeds can be improved by the applied fertilization methods and regimes, especially after once application of $N_5P_9K_{10}$ and twice of $N_9P_9K_{10}$.

7. Critical remarks and questions.

In general, I highly appreciate the form and content of the peer-reviewed PhD thesis. However, I also have some critical remarks:

1. In the chapter "Literature review" in some of the sections, the sequence from an earlier to a later year of publication is not followed.
2. In the chapter "Material and methods" does not indicate the origin of the Tuschon variety and there is no variety description.
3. In the chapter "Results and discussion" in many places the sequence of a cited table in the text and its placement after its reference is not followed. A similar decision of the author is observed in many of the figures.
4. The adopted model for compiling figures makes them difficult to perceive and read. It would be more appropriate for the individual variants to be numbered consecutively from 1 to 18, and with their full name to be presented in a legend outside the graphics themselves.
5. In the legend to the figures for the regression dependences, the quantities of fertilizers are written in kg/ha, which differs from the indicated writing in the dissertation methodology (fig.18,19,20,21).
6. In the table for the economic evaluation a technical error has been made in the header. It is more correct to write: "% of the recommended control"
7. Contribution 5 can be added ... "and may become a reference point for research in other root crops of the Apiaceae family".

I have the following questions for the PhD student:

1. What is the significance of the central umbel in the seed production of carrots?
2. Is it appropriate to separation of the seed lot on fractions depending on the order of receipt of the seed?
3. For how long and under what conditions are the carrot seeds stored in order to establish a decrease in their sowing qualities?

8. Published articles and citations.

The results of the research are presented by the PhD student at scientific forums in Bulgaria (3) and abroad (2). In connection with the dissertation, 4 articles have been published. In three of which Alexander Trayanov is an independent one. PhD student is a co-author of the fourth article. Two of the articles have been published in scientific journals and 2 in Proceedings of conferences. No reference with noticed citation is attached.

Reference for achievement of the national criteria for science is attached. It is clear that the PhD student realization the requirement under the minimum national criteria for science for acquiring PhD degree with a total of 53.33 points, with a required 30.

The presented abstract objectively reflects the structure and content of the dissertation. The volume is 40 pages, illustrated with 22 tables and 16 figures, and a short summary in English. It gives the opportunity to have a realistic idea of the scientific value of the PhD thesis.

CONCLUSION:

Based on the different research methods learned and applied by the PhD student, the correctly performed experiments, the summaries and conclusions made, I think that the presented PhD thesis meets the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria and the Regulations of the Agricultural Academy for its implementation which gives me a reason to give to evaluate it a **POSITIVE**.

I allow myself to suggest to the honorable Scientific Jury also to vote positively and to award Alexander Kirilov Trayanov the educational and scientific degree "Doctor" in the scientific specialty Vegetable production

Date: 15. 04. 2021

Plovdiv

Reviewer:



(Assoc. prof. Dr. Dimka Haytova)