REVIEW

on a dissertation for obtaining the educational and scientific degree "Doctor" in: area of higher education: 6. Agricultural sciences and veterinary medicine; professional field: 6. 1. Crop Science, the scientific speciality Vegetable crops.

Author of the dissertation: **ALEXANDER KIRILOV TRAYANOV**, PhD student at the Department of „Horticulture" at the Agricultural University, Plovdiv.

Topic of the dissertation: **"PRODUCTIVITY AND QUALITY OF THE SEEDS OF CARROT BY OPTIMZATION OF NUTRIENT REGIME IN THEIR SEED PRODUCTION"**

Reviewer: Prof. Dr. Hriska Manusheva Boteva, "Maritsa" Vegetable Crops Research Institute of Plovdiv, area of higher education: 6. Agricultural sciences and veterinary medicine, professional field 6. 1. Crop Science, scientific specialty: Vegetable crops, appointed a member of the Scientific jury with order № RD-16-282 / 15. 03. 2021 by the Rector of the Agricultural University.

1. Brief introduction of the candidate

The doctoral student Alexander Kirilov Trayanov was born on August 22, 1990 in the town of Petrich. He completed his higher education in 2013 at the Agricultural University, Plovdiv with a bachelor's degree in Plant Protection, and in 2015 he obtained a master's degree in the same specialty. In the period 2015 - 2017 he worked as a junior expert, Department of Plant Protection at the Bulgarian Food Safety Agency in Plovdiv and junior expert agronomist in „Maritsa" Vegetable Crops Research Institute of Plovdiv. Since 2017 he has been enrolled as a full-time doctoral student at the Department of Horticulture, specialty "Vegetable crops", with research supervisor Prof. Dr. Nikolay Panayotov.

In order to improve his qualification in 2018 he participated in a workshop in Wageningen, The Netherlands on the topic: "Cooperative learning for sustainable development", where he learned about different approaches and ways to successfully teach in an academic environment.

During his studies, the PhD student has participated in two research projects: "Healthy foods for a strong bioeconomy and quality of life" and "Study of the impact of fertilization and irrigation on weediness, productivity, chemical composition and fruit quality in tomatoes" to Thracian University - Stara Zagora.

He speaks good English and excellent Russian. It handles basic computer programs very well.

2. Relevanie of the problem

Carrots are a major root vegetable crop of great economic importance, but compared to world achievements, the yields obtained in our country are unsatisfactory. One of the main factors for increasing productivity is the quality of

the seed. In the country, despite the established experience and traditions, as well as the availability of appropriate natural and climatic conditions, almost no seed production. Studies in our country with carrot culture are very limited. To the extent that they exist, they refer to the resolution of agro-technical issues related to the production direction or to the course and rate of absorption of nutrients during the different vegetation periods. There are also attempts to optimize the diet of this crop, but in production for fresh consumption. Research work has been more intensive in the 1960s and 1980s and very scarce in the last 15-20 years. In the introductory part, the PhD student convincingly proves the need to study and solve problems related to carrot seed production. The reasons for this are multifaceted, one of which is that in recent years there has been a lack of scientific activity and development of technological solutions in the seed production of this crop. One of the possible ways to increase the productivity and viability of seeds is to providing nutrition regime..

What has been pointed out so far shows that the topic is relevant, the idea is to optimize the norms and the frequency of application of mineral fertilizers in seed crops from carrots, ensuring sustainable yields of seeds with guaranteed high quality. The development has a high scientific and scientific-applied value, which makes the dissertation relevant and practically applicable.

3. Purpose, tasks, hypotheses and research methods.

The thorough literature review allows the PhD student to summarize the results obtained by bulgarian and foreign authors, accurately and clearly formulating the ***Purpose and Objectives*** of the dissertation, in accordance with the title. To achieve this goal, 3 specific tasks have been set. They are logically related and reflect the main stages of the study.

The aim of the study is based on the ***Scientific hypothesis***, which assumes that different levels of nitrogen, phosphorus and potassium, as well as the frequency of their introduction, especially when it is closer to flowering and seed formation, will increase productivity, improving the quality and reducing the variety of carrot seeds.

Methodical formulation of the experiment is clearly defined, which allows the tasks to be performed correctly and in detail. As a result, significant scientific and applied science information has been obtained.

The experiments was carried out during the period 2017-2019 in the the experimental field of the Department of Horticulture at the Agricultural University – Plovdiv with the Tuchon variety. Increasing levels of N-0,5,7,9 kg / da, P_2O_5-0,9,14,19 kg/da and K_2O-0,10,15,20 kg/da at two application periods were tested. One-time fertilization - by applying the entire amount of phosphorus and potassium fertilizers in autumn and nitrogen during planting and double fertilization, where half of the phosphorus and potassium fertilizers are applied in autumn, the other half in spring before planting, and nitrogen fertilizer - half before planting, and the other part during the growing season at the beginning of flowering. Fertilization levels are correctly selected, based on previous studies reflected in the methodology.

The experimental set-up of the laboratory and field experiments are set correctly according to the respective schemes, in a sufficient number of variants and repetitions, which is a good attestation for the obtained results.

The effect of the studied factors is assessed by a large number of indicators that are logically selected and meet the goal: phenological observations, vegetative and generative manifestations; seed productivity and yield elements; quality, chemical composition and storage of seeds. Modern methods of analysis are used, which allow to obtain reliable data.

The PhD student has completed the study with an assessment of economic efficiency, which is of practical importance. Reliable statistical methods have been used in processing the obtained results, which allows correct and correct analysis of the data. All this is a good certificate for the educational value of the PhD student.

The soil-climatic characteristics of the area and the experimental field, and the analysis of the registered data are a necessary part of the doctoral dissertation and show that during the experiment they are within the biological requirements and do not have a limiting effect on carrot growth and development.

4. Visualization and presentation of the obtained results.

The dissertation is written on 218 pages, arranged according to the requirements. The style in which it is written is strictly scientific, with proper use of terminology. Structurally it is well balanced and includes: Introduction (2 pages); Literature review (24 pages); Hypothesis, purpose and tasks (1 page); Material and methods (10 pages); Soil and climatic characteristics (10 pages); Results and discussion (145 pages); Conclusions and recommendations (3 pages); Contributions (2 pages); Literature (15 pages). The dissertation is well illustrated and supported by 60 tables and 21 figures. The additional illustration with author's photos is essential and shows the main moments from the betting of the experiments.

5. Discussion of the results and literature used.

The presented ***literature review*** is current, related to the topic of the dissertation. The PhD student has set out in detail the state of the problem and gives a creative assessment of the literature used, which shows a very good awareness and is evidence of good theoretical knowledge of the studied problems.

158 literature sources are cited, of which 37 are in cyrillic and 121 in latin, which shows that in our country research on this issue is limited and is convincing evidence of the relevance of the study. It covers a 63-year period, with 24% of the total number being current research published after 2010.

In the section ***"Results and discussion"***, which occupies 67% of the total volume of the dissertation, the experimental data are summarized and interpreted, which are formed in nine sections, corresponding to the set tasks.

The influence of different norms and terms of fertilization on the biological manifestations of carrot testicles was observed. It has been established that it

accelerates the course of the individual phenophases of the testes by increasing the amounts of nitrogen, phosphorus and potassium, when they are applied twice. Based on the conducted researches it has been proved that the vegetative and generative development of the seed plants is significantly influenced by the increase of the nitrogen fertilizer norm from 5 to 9 kg/da, as the double fertilization promotes stronger vegetative growth and accumulation of more air dry mass, increases the content of total chlorophyll in the leaves.

Based on the obtained results, a strong positive correlation was found between the main vegetative and generative indices and yield. It has been proven that the increase of nitrogen norms in combination with higher levels of phosphorus and potassium stimulates the formation of a larger number of branches, the betting and the formation of more partitions in the complex canopy and a larger number of flowers.

There was a larger increase in seed yield with double application of $N_9P_9K_{10}$, followed by a single fertilization with $N_9P_9K_{20}$, which is formed mainly by seeds planted in the awnings of the first and second order.

The main part of the dissertation is dedicated to determining the parameters for seed quality. An increase in germination energy, germination and absolute mass of seeds was found during a single fertilization with $N_9P_9K_{20}$. Yield and germination with a uniform increase in the level of fertilizers are described by polynomial regression, with high coefficients of determination. The tested norms and terms of fertilization have a positive effect on the dry matter of the seeds and the fat content, as the amount of proteins and carbohydrates varies within narrow limits.

The effect of the fertilization regime on the storage of carrot seeds was monitored, and on the basis of the obtained results the doctoral student determined the appropriate norms and terms of fertilization.

As a result of the economic assessment of the complex influence of the tested factors, expressed in higher economic efficiency and conditional profit, as well as higher productivity and seed quality give the doctoral student to recommend double fertilization with $N_9P_9K_{10}$ and one-time fertilization with $N_9P_9K_{20}$ at carrot seed production.

The applied statistical methods for processing the results have allowed the doctoral student to make reliable conclusions that are well-founded and consistent with the results of the study. The results of the study provide basic and additional information on the method of cultivation, terms and norms of fertilization of carrots for seed production, in the conditions of Southern Bulgaria, which can be used as a starting point for future research.

6. Contributions to the dissertation.

Based on the conducted research, the obtained data and their analysis and as a result of the presented conclusions in the dissertation, a total of 9 contributions are indicated, divided into two groups, which I accept in full.

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Scientific contributions

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.

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.

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.

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 umbelaters in a umbels with the number of flowers and the diameter of the umbel.

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

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.

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.

It is proved that the carrot seed storage has been improve most strongly as a result of a once application of N5P19K20 as well as twice fertilization with $N_9P_9K_{20}$ and $N_9P_{19}K_{20}$.

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. Gritical notes and questions

I have the following notes and recommendations for the PhD student:

1. Section "Material and methods" - it is correct to describe that the soil samples were taken at a depth of 0-30 cm.
2. The units of measurement kg.da-1 and kg/da should be uniform.
3. A technical error has been made, as calcium and magnesium are given as trace elements.
4. Figures 18, 19, 20 and 20, which show regression dependences, it is correct that the values in the ordinate are uniform in order to have comparability between the two fertilization regimes. In the legend, fertilizer rates are given per hectare, probably borrowed from an article.
5. When compiling the tables for greater clarity, it is necessary for the fertilization variants to be written as a legend and not presented only as a

numbering.

In connection with the dissertation I have several questions:

1. How are the fertilization variants selected for compiling the regression equations - fig. 13, 14, 15 and 16?

2. How is the stronger positive effect on seed quality explained in a single fertilization with N9P9K20?

3. Which variant of fertilization from the ones mentioned in conclusion 15 would you use in seed production of carrots?

The critical remarks and recommendations made in no way diminish the merits of the dissertation and do not affect my overall high appreciation for the research conducted by the PhD student.

8. Published articles and citations.

The main part of the results and contributions of the dissertation are presented in 4 scientific articles, two published in the Proceedings of the Union of Scientists - Plovdiv branch, one in an international journal and one in an indexed scientific journal. Three of the publications are independent, and in one the dictator is the first author. The total number of points (53.3) of the presented publications cover and exceed the required (30) of scientometric requirements for obtaining the educational and scientific degree "Doctor".

Reference to the citations of the published scientific articles is not presented, which is not included in the requirements.

The autoreferat is shaped and structured correctly and objectively reflects the results obtained and the achieved scientific and scientific-applied contributions.

CONCLUSION:

The dissertation of **Alexander Trayanov** shows that he has in-depth knowledge and professional skills related to the scientific field of Plant Breeding, which give him reason to conduct research in important problems for agricultural science. The presented work contains significant scientific results, representing an original contribution and a real contribution to the practice.

Based on the learned and applied by the PhD student, different research methods, correctly performed experiments, summaries and conclusions, I believe that the dissertation meets the requirements ofthe Application of the Act for the development of Academic Staff in the Republic of Bulgaria and the Rules of the Agricultural University for its application, which gives me a reason to rate a **POSITIVE.**

I allow myself to suggest to the esteemed 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 r.
Plovdiv

REVIEWER: .....
((Prof. Dr. Hriska Boteva)