



## REVIEW

of doctoral dissertation for awarding the educational and scientific degree of “Doctor” in area of higher education: 6. Agrarian sciences and veterinary medicine; professional field: 6.1. Horticulture, scientific specialty Horticulture.

**Author of the doctoral dissertation:** Yordan Rangelov Yordanov - a self-study doctoral student at the Department of Horticulture, Agricultural University of Plovdiv

**Topic of the doctoral dissertation:** STUDY ON MAIN ELEMENTS OF THE TECHNOLOGY FOR *TRITICUM MONOCOCCUM* L., *TRITICUM DICOCCUM* Sch. AND *TRITICUM SPELTA* L. IN THE CONDITIONS OF ORGANIC FARMING

**Reviewer:** Reviewer: Prof. Dr. Dragomir Gospodinov Valchev, Institute of Agriculture in Karnobat, area of higher education: 6. Agrarian sciences and veterinary medicine; professional field: 6.1. Horticulture; scientific specialty 04.01.05. Selection and seed production of cultivated plants, appointed as a member of the scientific jury with Order No RD 16-149/ 28.02.2022 by the Rector of the Agricultural University.

### 1. Short introduction of the candidate

Yordan Rangelov Yordanov was born on 2 August 1972 in Pazardzhik. In 2012 he graduated from the Agricultural University of Plovdiv with a master's degree in Agribusiness. In 2018 he enrolled in doctoral studies as a self-study doctoral student at the Department of Horticulture, scientific specialty Horticulture.

### 2. Relevance of the problem

Today primitive wheat (single-grain einkorn, two-grain einkorn and spelt) is a major product of organic farming due to the growing interest of producers in low-investment crops and of consumers in environmentally-friendly and healthy lifestyles. The common forms in Bulgaria are not demanding to heat and are very drought-resistant and cold-resistant, which makes them very suitable for growing in changing climatic conditions. They can also develop at higher altitudes between 700 and 1300 meters, where the cultivation of modern wheat is unthinkable. Primitive wheat is characterized by high resistance to fungal diseases, they are undemanding to the applied agricultural techniques.

The increased interest in these crops in Bulgaria requires the resumption of activities in this direction. The optimization of basic technological elements (sowing and fertilization density) is a step in the right direction.

In this regard, the topic is extremely dissertable and is of interest to science and practice.

### **3. Aim, tasks, hypotheses and research methods**

The aim of the study is well defined - to optimize main elements of the technology - sowing and fertilization density - in three ancient types of wheat - *Triticum monococcum* L., *Triticum dicoccum* Sch. and *Triticum spelta* L., under organic farming conditions. To achieve this goal, several tasks were set related to the comparative characteristics of the phenological development of the three types of wheat in the vegetation years: tracking the dependencies between the duration of interphase periods and the vegetation period with the tested factors, tracking the dynamics of growth, tillering and productivity of formed plant density and establishing the effect of different sowing and fertilization densities on them, characterizing the photosynthetic activity of the three types of wheat and analyzing their dependence on the tested factors, establishing the effect of sowing and fertilization density on the productivity of *Triticum monococcum* L., *Triticum dicoccum* Sch. and *Triticum spelta* L., establishing correlations between yield and spike components, establishing the elements of productivity and their relative influence on yield in the tested factors - year, type, sowing and fertilization density, studying the physical qualities of grain in the tested factors of the study, studying the biochemical composition and content of some macro- and microelements in the grain of the three wheat species. The scientific hypothesis regards the selection and investigation of genetically diverse and suitable for our conditions breeding material, which will provide an answer to the requirements of these crops for sowing and fertilization density in organic farming.

Yordan Yordanov managed to ensure the necessary methodological level of research. The material and methods of work were properly selected and allow to obtain objective information.

### **4. Visualization and presentation of the obtained results**

The results from the study are presented on 171 pages, organized into 10 sections and include a total of 86 tables, 12 figures, 11 pictures and literature list. In terms of composition the dissertation is correctly and logically organized and follows the traditional structure: Introduction (3 pages), Literature Review (31 pages), Aim and Tasks (1 page), Material and Methods (9 pages), Agrotechnics in the Experiment (2 pages), Agroclimatic Conditions (6 pages), Results and Discussion (95 pages), Conclusions (4 pages), Applied Science Contributions (1

page), Literature (17 pages). The tables are well structured and competently visualize the statistical and mathematical processed results from the study by all included traits

## **5. Discussion of results and used literature**

A detailed literature review was done, including 204 authors, of which 16 in Cyrillic and 188 in Latin scripts. Thematically, it corresponds to the problems the dissertation works on. The literature review shows that Yordan Yordanov is very well informed about the achievements in this field in Bulgaria and abroad. This allows him accurately and objectively to interpret the results obtained over the years of the study.

Comprehensive soil and agroclimatic characterization was conducted for the region where the experimental work was performed - the Agroecological Center – Demonstration center for organic farming – Plovdiv.

The main section, Results and Discussion, presents extensive experimental material obtained from conducted field and vegetation research and laboratory analyses.

On the basis of the obtained results the doctoral student establishes that:

The increase of the sowing rates was proven to develop more plants per sq.m., with density of 366 to 588 plants in double-grained einkorn, 332 to 484 plants in spelt and 335 to 538 plants in single-grained einkorn. Out of the three species, *Tr. dicoccum* Sch. showed best growth, followed by *Tr. monococcum* L. and *Tr. spelta* L., with significant differences between them.

The applied soil and foliar fertilization improves to some extent the photosynthetic activity of spelt, single-grained and two-grained einkorn plants. The effect of fertilization is manifested by increasing the content of the photosynthetic pigment chlorophyll and improving the parameters of chlorophyll fluorescence. The observed positive changes in leaf gas exchange in spelt and single-grained einkorn were not found in two-grained einkorn. This may be due to the different photosynthetic sensitivity of the studied species to the applied preparations.

Yordan Yordanov established that the effect of the year is decisive for the formation of productive crop density. Within the period of the experiment the conditions in 2019/2020 and 2020/2021 were proven more favorable, when the crops formed 812 and 793 productive stems/sq.m., respectively. The largest number of spikes per sq.m. developed in *Triticum monococcum* L. (941 pcs./sq.m.), followed by *Triticum dicoccum* Sch. (761 pcs./sq.m), and *Triticum spelta* L. (495 pcs./sq.m.). Most spikes develop at the highest sowing rate, but between 700 and 900 pls/sq.m. the differences were not proven. Soil fertilizer and to a lower extent foliar fertilizer have a more significant effect than the variants with different fertilization.

The doctoral student found that the grain yield of the three tested species is most strongly affected by the agro-meteorological conditions of the years. The highest yield was obtained in the second year (2019/2020) - 328.3 kg/da, which is



54.8% higher than the first (most unfavorable year). Out of the three species, *Triticum spelta* L. has the highest productive potential -290.6 kg/da grain yield, followed by *Triticum monococcum* L. -266 kg/da and *Triticum dicoccum* Sch. - 226.8 kg/da. The differences between the three species were statistically proven.

*Triticum dicoccum* Sch. realizes its best productive potential at a sowing density of 900 pls/sq.m. and the difference with the lowest sowing rate is 19.1%. Soil fertilization with Italtolina leads to an increase in yield by 11%. Of all the observed correlations, the strongest is between yield and productive crop density ( $R = 0.759^{**}$ ). The relation between yield and grain mass per spike was also proven, but it was much weaker ( $R = 0.278^{**}$ ).

In *Triticum spelta* L., the optimum density for maximum yield is 700 pls/sq.m. Fertilization with soil fertilizer Italtolina was proven to increase yield by 18.8%. The yield is in a proven average positive correlation with the number of sprouted plants ( $R = 0.503^{**}$ ) and formed productive stems ( $R = 0.410^{**}$ ).

Yield in *Triticum monococcum* L. is not affected by sowing density. Soil fertilizer Italtolina leads to a slight increase in grain productivity (6.3%). The yield is in proven average positive correlations with the productive tillering and the productive stems ( $R = 0.422^{**}$  and  $R = 0.371^{**}$ ).

On the basis of the results of the pot trial, the doctoral student found that soil fertilizer Italtolina and foliar fertilizer Naturamin - WSP improve the photosynthetic activity of spelt plants, single-grained einkorn and two-grained einkorn. Their positive effect is manifested by improving the leaf gas exchange, increasing the content of the photosynthetic pigment chlorophyll and improving the parameters of chlorophyll fluorescence. Soil fertilization with Italtolina has a more pronounced effect on the physiological status of plants.

## **6. Contributions of the doctoral dissertation**

On the basis of the conducted experimental work and obtained results Yordan Yordanov draws the following conclusions:

### **Applied science contributions**

1. For the first time in a complex multifactorial experiment was established the effect of increased sowing and fertilization rates on local forms of the three ancient grain species - *Triticum dicoccum* Sch., *Triticum spelta* L. and *Triticum monococcum* L.

2. The effect of increasing the sowing rate from 500 to 900 pls/sq.m., in combination with two fertilizer products - soil fertilizer Italtolina and foliar fertilizer Naturamin was established for the growth, development and formation of productivity of local forms of two-grained einkorn, spelt and single-grained einkorn, in the conditions of organic farming.

3. Specific conclusions and recommendations were made for the individual species related to the sowing and fertilization rates, on the basis of their comparative assessment in the experiment, analysis of variance and the established correlations.

4. A set of physiological parameters showed that the applied soil and foliar fertilization improves the photosynthetic activity of spelt, single-grained and two-grained einkorn plants.

5. A comparative assessment was conducted on the physical, biochemical qualities and mineral composition of the grain (naked and covered) in the conditions of the tested factors and organic system of farming.

### **7. Critical notes and questions**

Some mistakes and inaccuracies have been made in the dissertation:

- In the entirety of the dissertation the sequence of experiments with the three wheat species is different from the one indicated in the title and the introduction - one-grain einkorn, two-grain einkorn and spelt.

- There are typographical errors on page 152 - conclusions 9 and 12, etc.

I have the following questions:

- Is the drought resistance and cold resistance of the studied accessions of single-grained einkorn, two-grained einkorn and spelt sufficient for the conditions of Bulgaria?

- Which of the studied primitive wheats has a future in Bulgaria?

- Which of the studied accessions can be used for direct implementation in practice?

These critical notes in no way diminish the contributions of the dissertation, but aim to improve the future work of Yordan Yordanov.

### **8. Published articles and citations.**

Yordan Yordanov presented two scientific publications related to the dissertation. They are published in the *Journal of Mountain Agriculture on the Balkans*. The doctoral student is the first author of both articles. No document was submitted on cited articles.

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

### **CONCLUSION:**

On the basis of the various methods of research learned and applied by the doctoral student, the correctly performed experiments, the summaries and conclusions made, I consider that the presented dissertation meets the requirements of the Development of Academic Staff in the Republic of Bulgaria Act and the regulations of the Agricultural University for its application, which gives me reason

to evaluate it **FAVOURABLY**.

I allow myself to suggest that the honourable Scientific Jury also vote favourably and award Yordan Yordanov the educational and scientific degree of “Doctor” in scientific specialty Horticulture.

**Date:** 4.04.2022  
Karnobat

**REVIEWER:**

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