

REVIEWS

АГРАРИЕН УНИВЕРСИТЕТ П. ПЛОВДИВ	
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on dissertation work for obtaining the educational and scientific degree "**doctor**" in: field of higher education Agrarian sciences and veterinary medicine, professional direction 6.1. Crop production, scientific specialty „Crop production”

Author of the thesis: Rumyana Georgieva Georgieva, regular Doctoral student at the Department of Crop Production at the Agricultural University, Plovdiv

Topic of the thesis: "Variety specificity of Triticale (x *Triticosecale* Wittmack) when treated with plant stimulants under different soil nutrition"

Reviewer: Prof. Todor Simeonov Kertikov, DSc - Agricultural Academy: Higher Education Field of Agricultural Sciences and Veterinary Medicine, Professional direction 6.1. Crop Production, Scientific specialty „Crop Production”, appointed as a member of the Scientific Jury with Order No. RD - 16-1125/24.10.2019 from the Rector of Agrarian University.

1. Brief introduction of the applicant.

PhD student Rumyana Georgieva Georgieva was born on February 23, 1988 in Haskovo. In the period 2002 - 2007 she graduated from the language school in Dobrich with intensive study of German and English. She received her Bachelor's Degree in Agricultural Field at the Agricultural University of Plovdiv in 2011, and in 2012 - 2013 she studied at the University of Applied Science and Applied Resources at BOCU - Vienna, where she received a Master's Degree in Plant Protection. In August 2013 she was a trainee at AGES - Food Safety Agency, Vienna, Austria. From 2014 to 2017 she is a Technical Assistant - Agronomist at SGS Bulgaria in Varna. In the period 01.03.2016 - 01.09.2019, after a competition, she is a PhD candidate at the Department of Plant Production. Rumyana Georgieva has fulfilled the tasks included in the individual curriculum and has mastered the modules "Statistical Software in Agrarian Sciences and Practices", AU - Plovdiv, (2016); Databases, AU - Plovdiv, (2018); Training Methodology, AU - Plovdiv, (2018); and Experimental Data Processing, AU - Plovdiv, (2019). She successfully took the doctoral exam. The doctoral student is fluent in German, English and Spanish. In addition, she has good computer skills to work with various software products - (Microsoft Office: Word, Excel, Access, Power Point; Statistical Packages: SPSS 19.0, Internet). She skillfully uses this knowledge when writing and editing her thesis.

2. Relevance of the problem.

Triticale is a relatively new grain-forage crop. It was created along the path of interspecific hybridization between wheat (*Triticum*) and rye (*Secale*). The newly created hybrid fulfilled the breeders' expectations, because attempts to combine the positive qualities of wheat and rye were successful. Due to these qualities, triticale turns out to be a crop that can be successfully grown on acidic and salty soils, as well as those with degraded physical and chemical properties. This favors its intensive cultivation. Due to the advancement and development of genetics, the triticale culture successfully competes with other cereals. The hybrid has a high and stable yield, high grain quality, resistance to lodging, early maturity, resistance to diseases and pests, dry and cold resistance, a large number of grains per spike. Triticale is a good alternative crop compared to other cereals, mainly wheat and barley, for cultivation in anhydrous and semi-anhydrous areas, in

mountainous areas. The great advantage of culture is its high cold resistance. In addition to its high adaptability, the hybrid is characterized by very good productive capabilities. The greatest advantage of triticale, which allows its use for nutrition for both humans and animals, is its high nutritional value. In Bulgaria, data on the impact of the use of plant stimulants on growth and development, productivity, chemical composition and nutritional value of triticale are scarce. In this regard, the studies carried out, incl. the varietal specificity of triticale when treated with plant stimulants under different soil nutrition conditions is valuable and timely. The topic under consideration is dissertable. The problem addressed is of great scientific and practical importance.

3. Purpose, tasks, hypotheses and methods of research.

The objective is well formulated and the objectives cover the objective fully set out in the study, namely: *"To determine the effect of plant stimulants on certain quantitative and qualitative indicators of triticale varieties under different soil nutrition."*

To achieve the objective are placed several tasks related to:

1. To study the growth and phenological development of triticale and determine the accumulation of biomass and the duration of interphase periods depending on the variety, soil nutrition and treatment with plant stimulants.
2. To study the effect of treatment with plant stimulants VitaferAlgi and VitaferGreen on the dynamics of plant growth, grain yield and its components under different soil nutrition.
3. To determine the chemical composition and energy productivity of the grain in the varieties of Kolorit, Musala and Trismart in the conditions of different nutrition of the soil, depending on the effect of the treatment with plant stimulants.
4. Investigate the physical and chemical properties of the grain under different soil nutrition conditions for triticale varieties, depending on the treatment with plant stimulants.

The scientific hypothesis concerns the study of the growth, phenological development and accumulation of biomass in three varieties of triticale - Kolorit, Musala and Trismart and the effect of the treatment with plant stimulants VitaferAlgi and VitaferGreen on the dynamics of plant growth, grain yield, chemical composition and chemical composition under different soil nutrition.

In order to achieve the purpose and objectives of the 2016-2019 study at the UOVB of Agricultural University Plovdiv, a soil subtype of carbonate alluvial-meadow soil was derived from a three-factor field experience. The same is laid out by the method of fractional plots in four times repeatability of variants, with the size of the experimental area of 15 m².

The material and methods of work are properly selected, well presented and accurately described the field studies carried out, namely:

Factor A - Variety (A1 - Kolorit - Standard; A2 - Musala; A3 - Trismart)

Factor B - Fertilizing (B1 - N6P5K2; B2 - N12P10K4)

Factor C - Plant stimulant (C1 - untreated; C2 - VitaferAlgi; C3 - VitaferGreen).

Treatment with the plant stimulant was performed twice (in phases Z31 - 150 ml/da and Z39 - 150 ml/da = 300 ml/da).

It is made complete for the characterization of the tested varieties and applied plant stimulants. The indicators are tracked and reported in accordance with accepted methodological requirements and norms. Reports and observations were made on numerous indicators in field and laboratory studies, namely: phenological development by phases and vegetation period in days; biometric indicators, productivity as biological yield, grain yield, harvest index, dry matter; grain quality in the individual varieties, energy

nutrition of the grain, yields of energy and crude protein, etc. One-factor ANOVA was used to establish statistical and significant differences between the tested variants, and three-way ANOVA (MANOVA) was used to determine the independent influence of the studied factors, and correlation analysis was used to calculate the dependencies between the studied traits. Statistical processing of the results was performed with the products SPSS and "BIOSTAT ©".

The necessary activities have been carried out precisely in strict compliance with the technology of cultivation of the crop. The soil and climatic characteristics of the field experiments and the region are well represented. From the analysis, it is clear that the agro-meteorological conditions during the study period differ from year to year, but in general they differ from those indicated for the multi-year period. The study period is characterized by sufficient rainfall in the second and third years, while in the first period they are extremely scarce. Temperatures are higher than those indicated for the multi-year period. It follows from the above that the meteorological conditions have definitely influenced the results obtained by the years, which provides a full opportunity for the manifestation of the factors studied.

4. Visualization and presentation of the results obtained.

The scientific paper submitted for review is in volume of 175 pages, incl. 53 tables and 9 figures. The dissertation is properly structured and contains all the necessary attributes for this dissertation. It is well balanced, namely: content (2 pages), introduction (2 pages), literature review (31 pages), purpose and objectives (1 page), material and methods (9 pages), soil- climatic characteristics (6 pages), results and discussion (93 pages), conclusions (3 pages), contributions (2 pages) and a list of references (23 pages). Sufficient volume and content of tabular and graphic material is presented. The analysis of the results of the statistical and mathematical processing of the studied features and indicators was carried out. The results obtained in the individual chapters are in the required sequence and logical connection. It has been found that with the use of the plant stimulants VitaferAlgi and VitaferGreen there is a tendency to increase the percentage of the grain in all three varieties. Fertilization rates and treatment with plant stimulants VitaferAlgi and VitaferGreen have no effect on the duration of the growing season. The higher fertilization rate lowers the specific growth force by 13-15% compared to the low fertilization level and increases the yield on average by 41-43,3% for all three varieties, while treatment with the VitaferAlgi and VitaferGreen plant stimulants increases the index by 8-9%. The Trismart variety has the highest overall tillering at the higher fertilization level, while the test weight does not change when fertilized and treated with the VitaferAlgi and VitaferGreen plant stimulants. Yield has a strong correlation with the number of grains per spike ($r = 0.999$), the mass of grains per spike ($r = 0.992$) and the test weight ($r = 0.998$). A higher fertilization rate has proven to increase protein content. The application of VitaferAlgi and VitaferGreen at both fertilizer levels increases BE. The results obtained are presented in a sufficiently high scientific style, scientifically substantiated and analyzed.

5. Discussion of the results and the literature used.

The doctoral student has sufficient knowledge of the treated issue, thorough preparation and precise experimental work. Experimentally, it proves that the higher fertilization rate leads to a 9% increase in biological productivity for the three varieties, and as a result of the treatment with plant stimulants the absolutely dry mass grows by 8% over the untreated variant. For the region, the Musala variety has the lowest duration of vegetative period, average of 109 days and a temperature value of 1927°C, followed by the standard (118 days) and the cv. Trismart (121 days). It is evident that under short-term

negative temperatures, the varieties show good winter hardiness during the first year of the test. The Kolorit and Trismart varieties are resistant to lodging, while in the Musala variety, the higher average height of variants and heavy rainfall during the period of pouring and ripening of the grain lead to the deposition of higher-norm variants. On the other hand, the higher fertilization rate in combination with the VitaferGreen treatment in Musala and Trismart varieties contributes to the most intensive growth, while in the Kolorit cultivar the treatment with VitaferAlgi gives the highest results. Musala variety with average yield of 509.01 kg/da followed by standard (450.12 kg/da) and Trismart variety (415.67 kg/da) was found to be the most productive in the years of the study for the conditions of the Plovdiv region. The positive effect of treatment with plant stimulants VitaferAlgi and VitaferGreen was found. It increases the number of productive tillers per unit area between 3% for low fertilization and 8% for high fertilization, as well as the rate of productive friction. Musala (62 grains) and Trismart (62 grains) are the largest number of grains per spike, followed by the standard with 60 grains per spike. For the Kolorit variety, the high fertilization rate and VitaferAlgi treatment help to form the largest grain mass in the 2.81 g per spike, while the Musala and Trismart varieties give the VitaferGreen treatment a best result of 2.91 g for the first and 2.74 g for the second variety. It has been shown that in the Trismart variety under the conditions of the higher fertilization rate and the treatment with the plant stimulants the 1000 kernel weight decrease and in the other two varieties increase. There is also a well-correlated relationship between plant height and yield ($r = 0.890$). A weaker relationship exists between the yield and the length of the spike ($r = 0.462$), as well as with the 1000 kernel weight ($r = 0.474$). Due to the performed treatments and chemical analyzes, the application of VitaferAlgi was shown to increase the amount of SP by 0.69% and the treatment with VitaferGreen by 1.07%. Trismart variety has the lowest percentage of SP in the grain (9.15%). There is an inverse relationship between the crude protein content and the BEV.

From the submitted bibliographic reference for the used literature, consisting of 248 issues titles (26 in Cyrillic and 222 in Latin) show that the PhD student has a high theoretical background and a high level of awareness of scientific achievements in Bulgaria and abroad. It is noteworthy that the author made a scientific analysis of the nature, condition and trends of the particular study. She skillfully uses good literary knowledge to interpret objectively the scientific and applied results she receives.

6. Contributions to the thesis.

The good theoretical and practical training of the doctoral student has enabled to properly analyze, summarize and formulate the trends and results obtained in 11 summarized conclusions, as well as in 9 scientific and applied scientific contributions, which I accept with minor corrections on my part.

Scientific contributions

1. Variety differences in the phenological development of triticale have been proven and the duration of the interphase periods for each variety has been determined under the different meteorological conditions of the years of experience for the conditions of the Plovdiv region.
2. There are differences in the accumulation of absolutely dry mass in the three varieties of triticale, depending on the levels of fertilizer factor, the treatment with plant stimulants under different meteorological conditions.
3. Maximum in the phenophase tillering and after phenophase stem extension have been established at specific growth rates. The higher fertilization rate leads to a decrease in the specific growth force by 13-15% compared to the low fertilizer level.

4. The growth rate is influenced by the conditions of the year, the soil nutrition regime applied and the treatment with plant stimulants. In conditions of better soil conservation, VG treatment in Musala and Trismart varieties contributes to the most intense growth, while in cv. Kolorit treatment with VA has the highest results.

5. There is a strong correlation of yield with the number of grains per spike ($r = 0.999$), the mass of grains per spike ($r = 0.992$) and the test weight ($r = 0.998$). There is also a well-correlated relationship between plant height and yield ($r = 0.890$). A weaker relationship was demonstrated between the yield and the length of the spike ($r = 0.462$), as well as with 1000 kernel weight ($r = 0.474$).

Scientific and applied contributions

1. There are differences in the average grain yield of the varieties tested, depending on the levels of the tested factors, with Musala being the highest yielding in the Plovdiv region and yielding higher than the standard by 58.89 kg/da.

2. Fertilization is the factor that has the greatest impact on yield, with the indicator increasing under the influence of better soil storage. Second is the variety factor, and the treatment with plant stimulants has the least impact on yield.

3. Better soil conservation and treatment with plant stimulants have a positive effect on the structural elements of production but do not affect the physical performance of the grain.

4. The amount of CP is mostly influenced by the fertilizer factor, with better soil storage proven to increase the amount of protein.

7. Critical notes and questions.

I have no critical notes or questions. In describing the methodical part, factor B (both fertilization levels) are referred to as level C1 and level C2, not B1 and B2 - clearly a technical error.

8. Published articles and citations.

In connection with the dissertation, the doctoral student presented four printed scientific papers in English - two at the scientific conference Proceedings of the IX International Agricultural Symposium "Agrosym 2018" and two in the Journal of Mountain Agriculture on the Balkans, collecting the required 30 points according to the minimum scientometric requirements for obtaining the educational and scientific degree Doctor. The presented scientific papers reflect certain moments and stages of the dissertation research. This gives me reason to believe that the research in the dissertation is mainly the author's personal work. She did not submit a list of citations. The abstract presented objectively reflects the structure and content of the dissertation.

CONCLUSION:

On the basis of the various methods of research, the correctly performed experiments, the summaries made and the conclusions drawn, the dissertation submitted meets the requirements of the ZRASRB and the Regulations of the Agrarian University for its application, which gives me a reason to evaluate it POSITIVE.

I allow myself to offer the venerable Scientific Jury also to vote positively and to award the doctoral student Rumyana Georgieva Georgieva the educational and scientific degree "doctor" in the scientific specialty "Crop Production".

Date: 12.11.2019 r.....
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Reviewer:
(Prof. Todor Kertikov, DSc.)