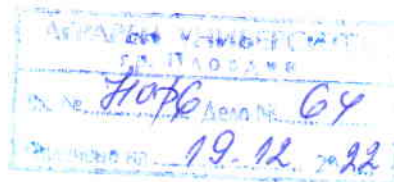


REVIEW



On a dissertation work for obtaining the educational and scientific degree "doctor" in: field of higher education 6. Agricultural sciences and veterinary medicine; professional direction 6.1. Crop production; the scientific specialty "Crop production".

Author of the dissertation: Hristina Atanasova Nedeva

PhD student of independent training at the Department of "Crop production" at the Agricultural University (AU), Plovdiv

Dissertation topic: "Effect of nitrogen fertilization and harvest time on the productivity and quality of green triticale biomass used for energy purposes"

Reviewer: Prof. DSc. Todor Simeonov Kertikov, University of Ruse "A. Kanchev", higher education area 6. Agricultural sciences and veterinary medicine; professional direction 6.1. Crop production; the scientific specialty "Crop production", appointed as a member of the scientific jury by order No. RD-16-1100/27.10.2022 by the Rector of the AU, Plovdiv.

1. Brief introduction of the candidate.

Doctoral student Hristina Atanasova Nedeva was born on 12.05.1977. She graduated from AU, Plovdiv in 2001 and obtained an educational and qualification degree "Master" in the specialty Engineer - agronomist.

During the period 2007-2014, she was an assistant in the JV "OSPZ-Pazardzhik" DP and was engaged in scientific and production activities, consisting in carrying out comparative and demonstration trials. In the period from 03.2014 to 03.2020, she was an agronomist in charge of organic vegetable production at River Garden Ltd. From 2021 to the present moment, the doctoral student is an assistant at the SP "OSPZ-Pazardzhik" DP, where she is engaged in scientific and production activities. Has good computer skills for working with the Windows operating system, skills for working with MS Office (Word, Excel, Power Point), skills for working with various Internet applications. Doctoral student Hristina Nedeva has good social skills, competencies, adequate decision-making when a problem arises and team work.

2. Relevance of the problem.

Triticale is a relatively new grain-forage crop. It was created by interspecific hybridization between wheat (*Triticum*) and rye (*Secale*). Due to its low demand for soil fertility and the influence of climatic factors, the areas for cultivation of this crop have grown significantly in recent decades.

In the current dissertation work, the role and importance of the triticale crop, known not only as a cereal-forage and cereal-bread crop, but also as having an important importance for providing huge amounts of bioenergy mass used as an alternative energy source for production of biofuels. The great potential of the culture in this direction is due to the unique combination of the good qualities of the species from

which it originates, namely - rye and wheat. The culture fits very well in the circular bioeconomy, which is increasingly being imposed recently, where the main share of crop production is the production of raw materials. In this regard, ongoing research on the influence of various agrotechnical factors on the possibility of biofuel production is valuable and timely. The issue of biofuels, as an alternative energy source, is particularly relevant now. The subject under consideration is a dissertationable one. The investigated problem is of interest to modern science and practice.

3. Purpose, tasks, hypotheses and research methods.

The purpose, tasks, hypotheses and research methods in the dissertation work are well developed and clearly formulated.

The aim of the dissertation is to determine the effect of the application of different nitrogen fertilizer rates and harvest phases on the yield and quality of the green mass of triticale intended for biogas production. To achieve the set goal, the following tasks are set for implementation:

1. To study the influence of different rates of nitrogen fertilization and harvesting phases on the growth and development of triticale grown for green mass.
2. To study the influence of different rates of nitrogen fertilization and harvesting phases on physiological parameters of triticale grown for green mass.
3. To study the influence of different rates of nitrogen fertilization and harvesting phases on the structural elements forming the green biomass.
4. To study the influence of different rates of nitrogen fertilization and harvesting phases on the yield of green biomass.
5. To study the influence of different rates of nitrogen fertilization and harvesting phases on the quality of the obtained production intended for biofuel.

The scientific hypothesis, which is relevant at the present time in connection with the search for alternative energy sources, covers the need to conduct experiments with the establishment of different energy carriers - in particular agricultural crops, with different technological solutions of cultivation. Against this background, the scientific research carried out aimed at establishing different nitrogen fertilizer rates and harvesting phases on the yield and quality of triticale green mass intended for biogas production should be considered.

The scientific supervisors have managed to ensure the necessary scientific, methodical and practical level of the research. The experiment was carried out at the Department of "Crop production", AU - Plovdiv during the period 2014-2016. The experiment was carried out using the method of fractional plots in four repetitions with a plot size of 20 m². The same was carried out on a meadow-swamp, slightly saline soil, after a predecessor of rapeseed. The material and methods for the presentation of the dissertation work are correctly selected, well presented; the research conducted is clearly and accurately described and provides an opportunity to obtain objective information.

Factors studied:

- Factor A - triticale varieties: A1 – cv. Musala; A2 – cv. Attila

- Factor B - rates of nitrogen fertilization on background P₁₅ K₁₀: B1 – N₀; B2 – N₁₂; B3 – N₁₆; B4 – N₂₀; B5 – N₂₅
- Factor C - stages of recovery: C1 - graduation; C2 – milky maturity
- Factor D - terms of the year: D1 – 2013/2014; D2 – 2014/2015; D3 – 2015/2016

The traditional technology of growing triticale for the production of biomass has been preserved, complicating the studied factors.

In the course of the experimental activity, the indicators were tracked and reported: Development phases; Structural elements of extraction; Mining of green mass; Chemical composition of the green mass - determined in two phases (grading and milk maturity); Physiological, soil indicators and statistical processing of the experimental data. To establish statistically reliable influences of the studied factors and differences between the tested variants, a variance analysis was applied; Biostat, SPSS for windows, v 9.00; Duncan's Multiple Range Test. The research and statistical analyzes of the obtained results carried out on the main indicators in this way allow to solve the tasks of the research and to achieve the intended goal.

4. Transparency and presentation of the obtained results.

The questions discussed in the separate chapters are in the necessary sequence and logical connection. The obtained results are presented in good scientific style. The scientific work fully complies with the volume and quality of the requirements of the ZRASRB and the Rules for its application in AU - Plovdiv. It contains the necessary attributes for this kind of dissertation. It is written on 169 pages, namely: Introduction (2 pages), Literature review (32 pages), Aim and tasks of the study (1 page), Material and methods (5 pages), Soil-climatic characteristics (7 pages), Results and Discussion (95 pages), Conclusions (3 pages), Contributions (2 pages) and References (19 pages). The dissertation contains 48 tables, 6 figures. Tables and figures are well structured. The list of literary sources is 231 items, of which 80 items in Cyrillic and 151 in Latin. The literary sources are well selected and arranged in a good logical sequence. It can be seen that the doctoral student has the necessary theoretical training, competence and awareness of scientific achievements at home and abroad. The competent presentation of the obtained results and the author's scientific analysis of the nature, state and trends in the field of triticale culture are impressive.

5. Discussion of results and used literature.

The obtained results correspond to the set goal and tasks identified for resolution in the dissertation work. A full soil-climate characterization of the conditions in the region, of the soil of the experimental field of the UOVb of the Department of "Crop production" at AU - Plovdiv, was carried out. Special attention has been paid to the meteorological data during the period of the field experimental activity. The analysis of the obtained results shows that varietal differences have been established in the phenological development of the tested varieties Musala and Atila, under the conditions of the Plovdiv region, grown for green mass.

It can be seen that higher mean values of leaf area and transpiration intensity in

both harvest phases were recorded in cultivar Attila. The rate of net photosynthesis and the content of plastid pigments were higher in Musala variety. As the vegetation progresses, the values of the leaf surface area, the rate of net photosynthesis and the content of plastid pigments in the leaves decrease, and the intensity of transpiration increases. Nitrogen fertilization has a positive effect on physiological parameters. From the conducted experiments, it was found that in terms of yield, a strong varietal differentiation was observed. In the wetter year 2014, higher yields were obtained with the Attila variety, while in the drier years 2015 and 2016 with the Musala variety. Higher yields of green mass are obtained in the milk maturity phase. The variants fertilized with nitrogen N₂₀ stand out with the highest yields - 4548 kg da⁻¹ for the Musala variety and 4490 kg da⁻¹ for the Attila variety. In both cultivars, in all fertilized variants, average yields exceeded the control, indicating that triticale has great potential for inclusion in sustainable energy cropping rotations for biomass production under less favorable growing conditions in both cultivars. The highest effect of fertilization in the grading phase is obtained with the fertilizer variant with 16 kg da⁻¹ nitrogen, and in the milk maturity phase with the fertilizer variant with 20 kg da⁻¹ nitrogen. It is proved that variety Musala has a denser crop and higher productive brotherhood in both harvesting phases. Fertilization with nitrogen fertilizers increased the number of spike-bearing stems formed per unit area in both harvest phases. On average, for the three years of the study, the Musala variety produced 8.9% and the Attila variety 11.6% higher yields during the milk maturity phase. The values of all tested indicators in the variants fertilized with nitrogen fertilizer exceed the control on average, in the stage of classification by 21.3% in the Musala variety and 29.0% in the Attila variety, and in the milk maturity phase - 13.1% and 17.4%.

The content of dry matter in both tested varieties in the milk maturity phase has values close to the optimal (30-35%) for obtaining better quality silage and a larger amount of biogas. The content and yields of dry matter are higher in the milk maturity phase. The highest dry matter content and the highest dry mass yields were obtained with the N₂₀ fertilizer variant. Higher silage yields were reported in the milk maturity phase, from 2788 kg da⁻¹ to 3411 kg da⁻¹ in Musala variety and from 2594 kg da⁻¹ to 3368 kg da⁻¹ in Attila variety. Fertilization with 20 kg da⁻¹ nitrogen has the strongest effect on the amount of silage, where yields reach the highest values. Higher yields of biogas and methane can be obtained in the milk maturity phase in Musala variety. Fertilization with 20 kg da⁻¹ of nitrogen has the strongest effect on the amount of biogas and methane, in which the yields reach the highest values for Musala variety. The Attila variety had a higher crude protein content on average for the period, and the Musala variety had a higher crude fiber and fat content. The yields of biogas and methane in triticale, in addition to the yield of biomass, depend to a great extent on its chemical composition. Crude protein and crude fiber contribute the most to biogas and methane production from triticale. All nitrogen-fertilized variants exceeded the control ones in terms of yield.

6. Contributions of the dissertation work.

The good theoretical and practical training of the doctoral student has enabled her to correctly analyze, summarize and formulate the obtained trends and results, which I accept. 15 numbers of generalized conclusions, five numbers of scientific-theoretical contributions and five numbers of scientific-applied contributions were formulated.

Scientific contributions

1. Varietal differences were found in the phenological development of the tested triticale varieties - Musala and Atila, grown for green mass. The duration and the necessary temperature sum for the interphase periods and their vegetation period under different weather conditions during the years of research for the conditions of the Plovdiv region were determined.

2. The physiological characteristics of the Atila and Musala varieties for green mass and their change under the influence of nitrogen fertilization and harvesting phases were established.

3. Atila variety was found to be superior to Musala variety in nitrogen assimilation efficiency, being more energy efficient, obtaining higher yields with input nitrogen consumption of 1 kg.

4. Theoretically, the yields of silage, biogas and methane were calculated for the chosen variants of the two varieties of triticale, Musala and Atila.

Scientific and applied contributions

1. The genotypic specificity of two modern Bulgarian triticale varieties has been established for the level of nitrogen fertilization and the phases of harvesting for green mass under the conditions of Central South Bulgaria.

2. It was established that in heavy rainfall during the grading period accompanied by strong winds, the Musala variety showed a lower resistance to lodging compared to the Atila variety.

3. It has been proven that the Musala variety is more suitable in terms of yields of green mass in drier years for the region of Central South Bulgaria.

4. A stable tendency to increase yields of green and dry mass is outlined when nitrogen fertilizer rates are applied. The highest yields are obtained when triticale varieties are fertilized with a nitrogen rate of 20 kg da⁻¹. The use of a high nitrogen rate of 24 kg da⁻¹ does not positively affect yields.

5. Under the influence of the changing weather conditions, a varietal response was established regarding the quality of the green mass. The more pronounced effect of nitrogen fertilization on the quality of triticale green mass compared to the influence of the variety is confirmed.

7. Critical Notes and Questions.

Note: The results of the study discussed here are not compared to similar studies.

Question: Besides the published materials on the dissertation work, what is the public domain of the development concerning the practical application?

8. Published articles and citations.

The doctoral student presented three scientific publications related to the dissertation work. One independent and two co-authored issues. She is the first author of all. The same are printed in English. She did not submit a document to cite the articles. The publications are fully sufficient in accordance with the requirements of the ZRASRB and the Rules for its implementation in AU - Plovdiv.

The abstract is 41 pages long. It objectively reflects the structure and content of the dissertation work, including obtained results, conclusions and contributions. No summary in English.

CONCLUSION:

Based on the various research methods learned and applied by the doctoral student, the correctly performed experiments, the generalizations and conclusions made, I believe that the presented dissertation meets the requirements of the ZRASRB and the Rules of the Agricultural University for its application, which gives me reason to evaluate it **POSITIVE**.

I take the liberty of proposing to the honorable Scientific Jury to also vote positively and award the doctoral student Hristina Atanasova Nedeva the educational and scientific degree "**Doctor**" in the scientific specialty "Crop production".

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