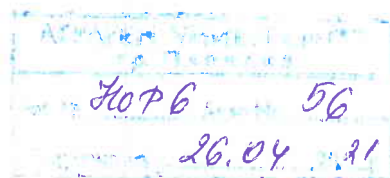


REVIEW



on a dissertation for obtaining the educational and scientific degree "Doctor" in field of higher education – 6. Agricultural sciences and veterinary medicine, professional field – 6.1 Crop sciences, scientific speciality – Crop sciences

Author of the dissertation: Adelina Hristova Garapova
full-time PhD student at the Department of Crop sciences
at the Agricultural University, Plovdiv

Dissertation topic: Agronomic characteristics of express tolerant sunflower hybrids (*Helianthus annuus* L.) depending on the soil's nutrient supply

Reviewer: Assoc. Prof. Dr. Petar Stoyanov Yankov, Department of Plant Production at the Technical University of Varna; field of higher education – 6. Agricultural sciences and veterinary medicine ", professional field – 6.1 Crop sciences, scientific speciality – General agriculture.
appointed from the Rector of the Agricultural university as a member of the Scientific Jury with Order № RD-16-281/15.03.2021.

1. Brief introduction of the candidate.

Adelina Hristova Garapova was born on January 11, 1993. In 2012 she was accepted as a student at the Agricultural University – Plovdiv, majoring in "Decorative Gardening". He graduated in 2017 with a master's degree in "Decorative Plants and Landscape Design". During his studies, he acquired an additional professional qualification - teacher, passed a course in specialized computer training at the Cambridge Center for Foreign Languages and Culture. On March 1, 2018, she was enrolled in a full-time PhD program in the field of Plant Breeding at the Department of Plant Breeding at the Agricultural University, Plovdiv. During her PhD studies, she participated in a seminar organized by Aeres University of Applied Sciences Wageningen and took a training course to learn new pedagogical methods and techniques related to Education for Sustainable Development at Humboldt University of Berlin.

2. Relevance of the problem.

Sunflower is one of the main trench crops grown in Bulgaria. According to FAO data, in the last 10 years, there has been a steady trend of increasing the area and volume of production of this crop in Bulgaria.

From the point of view of the food industry, sunflower mainly produces oil, which is the traditional vegetable fat consumed in our country. From the point of view of agricultural production, it has high plasticity, which allows it to adapt well to different environmental conditions, rationally use the available resources of the environment and achieve sustainable yields, even in years with unfavorable weather conditions. From an economic point of view, the production of sunflower seeds is usually realized at good excavation prices.

For these reasons, according to the soil and climatic conditions of the country, producers strive to obtain higher yields of sunflower, with lower production costs, looking for cost-effective agronomic practices for its cultivation.

In recent decades, there has been widespread chemicalization of conventional agriculture in our country, based on the large supply and use of various mineral fertilizers and plant protection products. Sunflower hybrids have been selectively created and imposed in the production, showing resistance to some of the active substances for weed control registered and applied in modern agricultural production. All this, as well as the changing climatic conditions in recent years, are the reason for farmers to revise the standard application of some agrotechnical practices as a means of using and maintaining effective soil fertility (tillage, fertilization, etc.).

The effect of mineral fertilizers on cereals, used in crop rotations as precursors for spring crops, in particular for sunflower, is a wide-ranging topic that has not been thoroughly studied. In this regard, the topic of the dissertation is relevant, both in theoretical and scientific-applied aspect.

3. Purpose, tasks, hypotheses and research methods.

The main goal of the dissertation was to establish the influence of soil nutrient supply on some biological and economic qualities in express tolerant sunflower hybrids.

Four specific tasks were identified, subordinated to the main objective of the study. These included monitoring the phenological development of selected express-tolerant sunflower hybrids grown in different soil nutrient stocks, establishing the duration of their interphase periods, depending on their genotype and soil regime; analysis of the obtained seed yield from these hybrids and their components; study of the physical properties of the seeds, the fat content in them and their fatty acid composition; establishing correlations between the studied quantitative and qualitative indicators.

For the realization of the set goals and tasks, the methodical part was well planned. A large amount of work has been done, including precisely performed field and laboratory experiments. A large number of indicators were followed, which were analyzed with very well selected statistical analyzes.

Five express tolerant sunflower hybrids have been described, sown at two levels of soil nutrient stock, as a result of residues from previous experience with two backgrounds of triticale mineral fertilizer. Ammonium nitrate was used as a nitrogen fertilizer, triple superphosphate as phosphorus, and potassium chloride as potassium.

Sowing was done manually, with a permanent increase in soil temperature to 10 cm to 8-10 °C, at a density of 5400 to 5800 plants/da, according to the recommendations for the hybrid. After germination, the crop was reduced to the required density.

Weed control was compliant with DuPont™ ExpressSun® technology. Express®50 SG was applied to the 6th leaf of weeds, 2nd-8th leaf of sunflower, in a dose of 4 g/da + Trend™ 0.1% in case of moderate or moderate weeding.

In the individual variants, the occurrence of the phenological phases, the growth and development of the culture, object of the study, was followed. Quantitative and qualitative indicators were reported - seed yield, biological yield, crop yield index, seed yield index, oil yield, weight per 1000 seeds, hectolitre weight, fat content in the seeds, fatty acid composition of the oil. A large volume of chemical analyzes of soil (pH; content of mobile nitrogen, phosphorus and potassium) and plant (determination of crude fat in seeds, the fatty acid composition of the oil) was performed.

The correct methodical formulation of the experiments allowed their precise derivation. The obtained results were statistically processed by a two-way analysis of variance (ANOVA). Correlation analysis was used to calculate the dependencies between the studied traits, and in addition to the correlation coefficient (r), the relationships between the variables were also expressed graphically by correlation scattering and principal component analysis.

4. Visualization and presentation of the obtained results.

The dissertation has a volume of 175 pages. It contains 27 tables, 31 figures and 1 appendix. The cited literature is related to the considered problem and include 268 sources, 57 of which were in Cyrillic and 211 in Latin.

The dissertation contains all generally accepted sections for this type of research: "Content" – 2 pages; "Introduction" – 2 pages; "Literary Review" – 26 pages; "Purpose and tasks" – 1 page; "Material and methods" – 7 pages; "Soil-climatic characteristics" – 7 pages; "Results and discussion" – 96 pages; "Conclusions" – 2 pages; "Contributions" – 2 pages; "Literature" – 28 pages and "Appendix" – 1 page.

The literature review was divided into subsections describing the origin, distribution and application of sunflower; the morphological and biological features of the culture; the growth, development and productivity of sunflower depending on certain abiotic factors; the quality of sunflower seeds and oil depending on some abiotic and agronomic factors; sunflower tolerance to herbicides; the reaction of the crop to the stock of soil and mineral nutrition.

5. Discussion of the results and used literature.

The data obtained from the field experience and the performed laboratory analyzes were presented and analyzed in the section "Results and discussion". The section consists of five subsections, after each of which the doctoral student makes short conclusions.

In the first subsection, examining the influence of soil fertility on the phenological development of the studied express tolerant sunflower hybrids, it was summarized that in the conditions of Plovdiv the average vegetation period of the crop was 152 days. The difference between the earliest and the latest hybrid was 10 days. The longest was the interphase period, end of flowering-ripening (57 days), and the shortest - the 2nd-4th pair of leaves (6.5 days). The stock of soil with macronutrients did not affect the phenological development of sunflower.

The subsection "Biometric Measurements" concluded that on average for the three years of the study, the thesis was confirmed that better soil fertility had a positive effect on plant height. The difference between the two soil stocks averaged over the years of the study and for all hybrids, was 14.6 cm. Better soil nutrient supplies also had a positive effect on the thickness of the stem. On average for all hybrids, the higher content of macronutrients in the soil led to the formation of thicker stems. With better storage, their average diameter was 0.47 cm larger. At higher soil fertility, the studied hybrids form a larger leaf area. The increased content of nutrients in the soil on average led to an increase in the size of the sunflower head by 3.22 cm. The number of seeds in the head changed positively with increasing of soil fertility. In the five hybrids studied, the higher the amount of mineral elements in the soil, the lower the density of the head.

In the third subsection, regarding the productive indicators of the studied express tolerant sunflower hybrids, the doctoral student summarized that higher soil fertility led to increased seed yield. The analysis of the total average values for the biological yield showed that under the conditions of Plovdiv the sunflower plant consisted of 35% stems, 21% leaves, 17% head and 27% seeds. The yield index of the head was also positively affected by increasing the soil's supply of nutrients. On average for the three harvest years, the fat content of the seeds maintained a tendency to decrease with a higher content of macronutrients in the soil and with the five hybrids studied. As a sign related to sunflower productivity, higher soil fertility had a positive effect on oil yield.

In the fourth subsection, the quality indicators of the seeds were considered. On average for the three years studied, the thesis confirmed that the higher content of nutrients in the soil had a positive effect on the mass per 1000 seeds. The effect of soil fertility on the hectoliter mass was ambiguous. The studied hybrids contained on average 15% saturated and 85% unsaturated fatty acids. The supply of soil with nutrients did not have an one-way effect on the ratio of fatty acids in the seeds. During drought, during the formation of seeds, the content of oleic and palmitic acid increased, and the content of stearic and especially linoleic acids decreased.

In the fifth subsection "Correlation between quantitative and qualitative indicators in sunflower", it was concluded that the height of the stem correlated with the other quantitative traits. Stem diameter was a trait positively associated with a strong correlation with head diameter, leaf area, oil yield, stem mass, number of seeds in the head and leaf mass. The leaf area was positively strongly related to the diameter of the head, on average related to the oil yield, the number of seeds in the head, the mass of the leaves. Increasing the leaf area led to a decrease in the density of the head. The diameter of the head correlated on average positively with the oil yield, the number of seeds in the head and the mass of the stem. The number of seeds in the head was strongly related to the oil yield and on average to the mass of seeds in the head. The density of the head was the indicator with the most negative correlations. The mass of the stem was on average positively related

to the mass of the leaves, and the mass of the leaves to the mass of the head and the mass of the seeds.

Increasing the ratio of seeds in the head and the nut in the seed were the two main indicators that increased the fat content in the seeds. The yield index of the head was on average positively related to the harvest index of the seeds and the hectoliter mass. Palmitic acid determined the content of saturated fatty acids to a much greater extent. The content of monounsaturated fatty acids was very strongly negatively related to the total content of polyunsaturated fatty acids, linoleic and stearic acids. The content of polyunsaturated fatty acids was negatively related to the content of oleic and palmitic acids. The content of stearic acid had a positive effect on the content of polyunsaturated fatty acids. The linoleic acid content was very strongly negatively related to oleic acid and moderately negatively related to palmitic acid content. A positive correlation was reported between linoleic and stearic acid content. There was a medium negative correlation between the content of oleic and stearic acids.

Based on the obtained results and their correct analysis, 12 conclusions were formulated, which synthesized the summarized research.

The cited literature, including 268 literature sources, shows the excellent theoretical knowledge of the PhD student on the scientific problem considered in the dissertation.

6. Contributions to the dissertation.

As a result of the good theoretical knowledge and practical work of the doctoral student, of the precisely performed field and laboratory experiments, of the correct interpretation of the obtained results, four contributions with scientific and four with scientific-applied character were formulated.

Scientific contributions

The differences in the phenological development of the express tolerant sunflower hybrids included in the study for the conditions of Plovdiv were established, depending on the specific agrometeorological conditions of the years of the experiment. The influence of soil nutrient supply on stem height and thickness in all tested hybrids was studied.

It has been found that the higher soil fertility had a positive effect on the diameter of the sunflower head and the number of seeds in it, but negatively on the density of the head.

Positive correlations were obtained between seed yield, oil yield, leaf area, number of seeds in the head, a diameter of the head and diameter of the stem, as well as between the fat content and the harvest indices of the head and seeds.

Scientific and applied contributions

Better nutrient supply of the soil had a positive effect on seed yield in all studied sunflower hybrids.

The main contribution to the formation of yield had the relative share of seeds as an organ of the plant.

Higher soil fertility increased the mass of 1000 seeds, did not affect the hectoliter mass and reduced the fat content in the seeds.

The express tolerant hybrids of sunflower contained on average 15% saturated and 85% unsaturated fatty acids.

7. Critical remarks and questions.

Some technical errors were made, but they do not reduce the value of the research work performed.

I have the following questions for the PhD student:

1. Why was ExpressSun® technology chosen in the field experiment?
2. By what criteria were the express tolerant sunflower hybrids chosen in the present study selected?

8. Published articles and citations.

The PhD student Adelina Garapova presented a scientific self-published article in a scientifically Journal, referenced and indexed in Web of Science, related to the PhD thesis. This brings her the required number of points to meet the minimum scientometric requirements for obtaining the educational and scientific degree "**Doctor**" according to the Law for the development of the academic staff. The publication is related to the topic of the dissertation.

No article citations have been submitted because the scientific self-published article was published in 2020.

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

CONCLUSION:

Based on the various research methods, learned and applied from the PhD student, the correctly performed experiments, the summaries and the conclusions made, I consider, that the submitted dissertation meets the requirements of the Law for the Development of the Academic Staff of Republic Bulgaria and the Regulations of the Agricultural University for its application, which gives me a reason to evaluate it **POSITIVE**.

I dare to suggest to the venerable Scientific Jury also to vote positively and award Adelina Hristova Garapova the educational and scientific degree "**Doctor**" in scientific speciality Crop Science.

Date: ..06.04.2022.
Varna

REVIEWER:
(Assoc. Prof. Dr. Petar Yankov)