

REVIEW

of the official reviewer **Mykola Yanaievych Shevnikov**, doctor of agricultural sciences, professor, professor of the department of plant growing

Poltava State Agrarian university,

for PhD thesis **Jia PeiPei** «Varietal features of development and performance of *Brassica juncea* L. according to growth regulators in terms of the Forest-Steppe of Ukraine», Submitted for a scientific degree of a Doctor of philosophy

Field of study: 20 – Agricultural sciences and food

Specialty 201 – Agronomy

Relevance of the topic and the obtained results. The relevance of the topic of scientific research does not cause objections, primarily because mustard is a valuable agricultural crop of world agriculture. Its cultivation has a favorable effect on the physical and physicochemical properties of soils, water, and nutrient regimes, improves the phytosanitary balance of crop rotation, and increases the yield capacity of other crops. Fulfilling the biological potential of modern varieties of mustard in terms of climate change and significant variability of the weather factor requires the development of regional technologies for its cultivation in terms of certain soil and climatic conditions.

Mustard is a crop of multivector industrial significance due to its diverse uses. The seeds of *Brassica Juncea* L. contain 41–48 % of high-quality oil for technical and food purposes. Modern trends of global climate change and more frequent occurrence of stressful situations determined the urgency of using plant growth regulators to stabilize the development of mustard. It is also worth noting that no study of the mechanism of the growth regulators effect in terms of a controlled environment on the growth and development of mustard plants has been conducted, which makes the research data particularly relevant.

The most significant scientific results obtained by the postgraduate personally. PhD student for the first time for the conditions Left-Bank Forest-Steppe of Ukraine showed that the use of PGR affected the height of plants, the number of branches, the area of the leaf surface, the number of pods, seed yield capacity, and the weight of 1000 seeds of both varieties. This study demonstrated that a combination of seed treatment and foliar spray was effective in promoting mustard growth compared to a single seed treatment or foliar spray. The use of growth regulators increased the average oil content of *Brassica juncea* L. seeds by 1.18-5.61%. A significant effect on the oiliness of seeds in the Prima variety, determined with the help of an infrared analyzer (SupNir 2700, China), was due to the use of Agrinos, Fast Start, and Regoplan.

The scientific novelty of the obtained results. Comprehensive research was *first* conducted to study the influence of growth regulators on the growth and development of *Brassica Juncea* L. in a controlled environment (climate chamber) and field conditions. The antioxidant enzymatic activity and the mechanism of morphological adaptation of roots and shoots of mustard seedlings under artificially created conditions of drought and salinity were *first* investigated.

The dissertation provides theoretical generalizations and a new solution to the scientific issue of stabilizing the impact of stress factors and increasing the performance of *Brassica Juncea* L. The research technology is based on the study

of the combined use of growth regulators for seed treatment and foliar application in terms of the forest steppe of Ukraine.

The practical significance of the obtained results. The technology of growing brown mustard was recommended for production, which ensured a seed yield capacity of 1.77 and 1.91 t/ha, accordingly. The main elements of the research were tested in the production and implemented on the farms of the Sumy and Poltava regions, in particular, at the Elita and Rodina 2017 farming enterprises on a total area of 50 hectares. Their efficiency has been confirmed, namely: net operating profit – 1345 and 4350 UAH/ha; profitability of production – 9.5 and 133 %, accordingly.

The rationale and reliability of the obtained scientific results are determined by the high methodological level of the conducted research, a comprehensive solution to the problem of the technology of growing mustard varieties under the conditions of the Forest-Steppe of Ukraine is presented by combining seed treatment and foliar application of plants, as well as mathematically proven differences in experimental data variants, based on which reliable scientific provisions are formulated, conclusions totaled and recommendations for production are provided. In the dissertation work, the indicators of LSD (least significant difference), the share of the influence of factors, which allowed establishing the regularities of production processes of plants and drawing reliable conclusions about the action and interaction of various factors under these conditions, as well as about the strength and direction of their interrelationship are given. Besides, the developed elements of the mustard cultivation technology in the Left Bank part of the Forest-Steppe of Ukraine have economic and energy validity, which indicates a modern comprehensive approach in the author's research.

The main provisions of the thesis are presented in 15 scientific works, including 2 articles in professional publications of Ukraine; included in the international scientometric citation databases Scopus and WoS – 4; abstracts of reports at international scientific and practical conferences and symposia – 9 (abroad – 2). The materials of the articles and theses reflect the main provisions and conclusions of the dissertation work.

In the introduction, the dissertation justified the relevance of the topic of the work, formulated the goal and objectives of the research, reflected the scientific novelty and practical value of the chosen topic.

In the first section, based on the results of processing and study the world's scientific developments regarding the identification of optimal methods and types of application of growth regulators for yellow mustard plants have been analyzed. Under current climate changes and the emergence of stressful conditions, the combined use of growth regulators for seed treatment and foliar application have been proven to be an important reserve for stabilizing the development and increasing the performance of *Brassica Juncea* L.

In the second section, the soil, climatic and weather conditions of the Eastern Forest Steppe of Ukraine and the places of research are reflected. The program and research methodology are given.

In the third section, adaptive ones were studied the salt adaptive mechanisms of mustard seedlings and roots were studied by determining their growth parameters, biomass, photosynthesis, MDA content, and some key antioxidants. Mustard seedlings were treated with four salt concentrations (0, 50, 100, and 200 mM NaCl). The results of calculations carried out with the help of Epson Perfection V800 Photoscanner (Epson, Inc., LongBeach, CA, USA) showed that the treatment with 200 mM NaCl significantly inhibited the growth of shoots, causing a decrease in leaf area, as well as dry and fresh matter. The inhibitory effect of salt on shoots correlated positively with the decrease in chlorophyll content and performance index and correlated negatively with MDA content in leaves. Increasing salinity has been shown to have a positive effect on root growth. The ratio of the number of lateral roots of the first order and the density of lateral roots were higher than those of the control group by 26.1 %, 28.7 %, and 58.5 % on day 10, accordingly. MDA levels remained unchanged. The coordination of antioxidant enzymes ensures the high efficiency of plants in removing NPK. These results persuade that the antioxidant system is involved in the adaptive regulation of root growth to avoid the deleterious effects of high soil salinity.

Also conducted by the author the laboratory experiment, the brown mustard variety (*Brassica juncea* L.) was used to analyze the response and compensation effects of growth and physiology under drought stress and rehydration at the seedling stage. The seedlings were exposed to different levels of drought stress (0, 10%, 15%, and 20% PEG). Growth parameters, fresh weight, chlorophyll fluorescence, and antioxidant system were measured. The processed results showed that drought stress suppresses the growth of roots and shoots (WinRHIZO 2007, Regent Instruments. Inc., Quebec, Canada) and reduces the performance of the photosystem (a portable fluorometer PEA, Hansatech Instruments Ltd, King'sLynn, UK was used). After rehydration, root length and plant fresh weight increased rapidly, and the performance index (PIABS) was higher compared to the control, indicating a compensatory effect. Chlorophyll content as determined by DualexScientific (Force-A, Orsay, France) decreased significantly under moderate and severe drought stress. However, it increased under mild stress. After rehydration, chlorophyll content under moderate and severe stress did not return to control levels, and there was no significant difference between mild stress and control. During drought stress, the activity of antioxidant enzymes and MDA content in leaves increased significantly. After rehydration, MDA and antioxidant enzyme activity were higher than in the control group, especially under moderate and severe stress. According to the results, mustard is highly adapted to moderate drought stress due to the effective activity of antioxidant enzymes and photosynthesis, as well as its rapid recovery after rehydration.

In the fourth section the results of the field research conducted during 2019-2021 in terms of the Left-Bank Forest-Steppe of Ukraine showed that the use of PGR affected the height of plants, the number of branches, the area of the leaf surface, the number of pods, seed yield capacity, and the weight of 1000 seeds of both varieties. This study demonstrated that a combination of seed treatment and foliar spray was effective in promoting mustard growth compared to a single seed treatment or foliar spray. The seed yield capacity of the Felicia variety (1.78 t/ha)

was significantly higher than that of Prima (1.67 t/ha). The maximum yield capacity for Prima was obtained on the variants of complex application of Fast Start (1.76 t/ha) and Regoplan (1.77 t/ha); for Felicia it was Agrinos (1.89 t/ha) and Antistress (1.91 t/ha). All plant growth regulators increased the average weight of both varieties.

The use of growth regulators increased the average oil content of *Brassica Juncea* L. seeds by 1.18-5.61%. In terms of protein content, no difference was found between the two varieties, as well as methods and types of growth regulators used. According to the results of the correlation analysis, seed yield capacity had positive and close correlations of individual mean values with the number of pods, number of branches, leaf surface area, and seed weight per plant. The weight of 1000 seeds was closely correlated with chlorophyll content and plant height. These results showed that the number of branches, individual plant performance, the number of pods, and the leaf surface area were the main factors that determined the yield with inherent varietal features of the response to the application of plant growth regulators. Oil content correlated negatively with protein.

In the fifth section is the economic and energy assessment of mustard cultivation technology in the conditions of the forest-steppe of Ukraine is given, indicating the best combination of the researched factors and options. Analysis of economic and energy efficiency indicators revealed that the cultivation of yellow mustard (*Brassica juncea* L.) in the Left Bank Forest Steppe of Ukraine is expedient. For gray mustard, the maximum level of profitability (147–151%) and energy efficiency ratio (2.74–2.77) was obtained for the cultivation of the Felicia variety and foliar fertilization with growth regulators Regoplan and Agrinos, respectively.

The conclusions and recommendations for production summarize the results of the research and provide recommendations on the optimal use of the studied elements of the cultivation technology of brown mustard *Brassica juncea* L.

Evaluation of the language and style of the dissertation. The dissertation is written in English clearly and correctly, with the use of many diagrams and photographs that facilitate the perception of experimental data. The presentation of research results in the work is logically connected, and the obtained data are well-argued and accessible for perception. The style of the dissertation fully corresponds to the generally accepted characteristics of productivity and quality indicators of mustard seeds in plant-growing research.

Compliance of the dissertation with the specified specialty and requirements. The dissertation fully corresponds to the field of knowledge 20 “Agrarian sciences and food” specialty 201 “Agronomy”.

Discussion clauses and remarks to the dissertation. Positively evaluating the dissertation work of Jia Pei Pei, emphasizing its important scientific, theoretical, and practical significance, novelty, and relevance of the research, it is necessary to dwell on the following shortcomings, remarks, and comments:

1. The Latin name of brown mustard is *Brassica juncea* L. in writing, not *Brassica Juncea* L. The author has the following variant.

2. The author's statement that the increased salinity of the solution (substrate for germination) has a positive effect on the growth of roots is debatable and requires a deeper study (Table 3.1, 3.2, and Fig. 3.1).

3. An explanation is needed why the chlorophyll content does not have a close correlation with the seed yield capacity of *Brassica juncea* L. (Fig. 4.1).

4. It is advisable to give a broader analysis of the obtained data in tables 3.1, 3.2, and 4.1-4.10, which would contribute to a better presentation and perception of research results.

5. There are single errors in the formatting of the dissertation, in particular, in the transfer of text (pages 67, 88, 145), figure 3.1 (page 107), and tables 5.1, 5.2 (pages 196, 198, 222, 226).

General conclusion. The dissertation work of Jia Pei Pei intitled “Varietal features of development and performance of *Brassica Juncea* L. according to growth regulators in terms of the Forest-Steppe of Ukraine”, which was submitted for defense to the specialized academic council for obtaining the degree of Doctor of Philosophy in the field of knowledge 20 – “Agricultural sciences and food” in the specialty 201 – “Agronomy” in terms of its relevance, scientific and theoretical level, main results of validity, main provisions and results published in professional publications, and novelty of the setting and practical significance meets the requirements of the order of the Ministry of Education and Science of Ukraine No.40 dated January 12, 2017 “On approval of requirements for registration dissertation” and the Decree of the Cabinet of Ministers of Ukraine dated January 12, 2022 No.44 “On approval of the Procedure for awarding the degree of Doctor of Philosophy and cancellation of the decision of the one-time specialized academic council of the higher educational institution, scientific institution on awarding the degree of “Doctor of Philosophy” with amendments made according to the Resolution of the Cabinet of Ministers No.341 dated 03.21.2022. The PhD candidate Jia Pei Pei deserves to be awarded the scientific degree of Doctor of Philosophy in specialty 201 – “Agronomy”.

Official opponent:

Professor of the department of plant growing
Poltava State Agrarian
university, doctor of agricultural sciences,
professor

M. Ya. Shevnikov

