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PHYSIOLOGICAL STATE OF *Brassica carinata* PLANTS DEPENDING ON THE GENOTYPE CHARACTERISTICS AND PHASE OF PLANT DEVELOPMENT IN THE CONDITIONS OF KYIV

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Summary. The results of non-destructive assessment of the physiological state of 17 samples of *Brassica carinata* plants are highlighted. As a result of studies of the content of chlorophyll, flavanols and the nitrogen-flavanol index using a multi-pigment meter MPM-100 (ADC BioScientific Ltd, UK) during the growing season (in particular, during the phase of budding, flowering, fruiting and seed maturation), important results were obtained that allowed us to identify the dependence physiological processes from genotypic features and determine groups of plant resistance to environmental conditions.

Keywords: *Brassica carinata* A. Braun, genotype, resistance, physiological state.

Introduction

In today's conditions, both on a regional and global scale, an important scientific question is the search for mechanisms of resistance of living organisms to biotic and abiotic factors of the environment. Plants, which are one of the most important components in ensuring the vital activity of biological systems on Earth, require significant attention and interaction of a wide range of specialists (botanists, physiologists, geneticists, ecologists, biochemists, biotechnologists, breeders), which will contribute to the effective preservation and enrichment of phytodiversity.

The Brassicaceae family is one of the most widespread groups of plants, representatives of which have been cultivated for a long time and still have important economic and economic importance [10, 16]. Among the variety of well-known and widely used crops of this family, *Brassica carinata* A. Braun deserves special attention as a highly productive oil-rich, valuable food, medicinal, fodder, meat, etc. crop [4, 7, 8, 13-15]. Considering its origin (mountainous regions of Africa) and distribution (outside of Africa, in Asia, Southern Europe, Australia, North America, Canada), this culture presents great prospects for realizing its genetic and biological potential in terms of resistance to abiotic and biotic stress factors and providing high productivity [12, 17]. *Brassica carinata* today is mainly cultivated and processed in the USA to meet the needs of its own domestic market [6].

The effectiveness of the introduction of new introducers into a wide culture depends on the creation of competitive varieties with a high level of productivity, manufacturability, product quality, adaptability, based on the correct selection of source material, the basis of which should be genetic resources.

Brassica carinata A. Braun – Ethiopian mustard is a new oil plant for Ukraine, which is undergoing complex introduction, selection-genetic and physiological-biochemical research on the basis of the M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine (together with the Institute of Food Biotechnology and Genomics of the National Academy of Sciences of Ukraine) [3]. A collection of *Brassica carinata* genotypes of various origins was created, which includes 17 taxa.

Brassica carinata in the conditions of Ukraine has shown great yield potential and stability and can be a promising oil crop with the use of appropriate molecular genetic and biotechnological methods to create valuable genotypes and varieties with specified quantitative and qualitative oil characteristics.

Taking into account the high adaptive and productive potential of *Brassica carinata* plants and taking into account the needs of the domestic energy and food market, there is a need to involve a wide range of genotypes of these plants in comprehensive introduction studies in the conditions of Ukraine for introduction into industrial culture and expansion of the domestic raw material base of oil plants.

Materials and methods

Research in the open ground was carried out at the experimental sites of cultural flora department of the M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine. The territory of the introduction sites is represented by gray forest-soled soils. The depth of the plow layer is 20–22 cm. The content of humus in the soil is 3.26%, pH is 6.7, nitrogen content is 98 mg/kg, phosphorus is 373 mg/kg, potassium is 66 mg/kg of soil.

17 samples of *Brassica carinata* plants were involved in the study, which during the growing season (in particular, in the phase of budding, flowering and fruiting) underwent a non-destructive assessment of above-ground phytomass for the content of chlorophyll, flavanols and nitrogen-flavanol index NFI using a multi-pigment meter MPM-100 (ADC BioScientific Ltd, UK) on developed plant leaves. The leaves of the medial part of the adaxial surface of the plant were selected for measurement, and when the fluorescent detector was installed, the leaves with the area covering its working part were selected to obtain readings.

Statistical processing of the received data was carried out using the Microsoft Excel 2010 program (the "Data Analysis" package). Minimum, maximum, average values, standard deviation, coefficient of variation were used to express the obtained data.

Results and discussions

The analysis of physiologically active compounds of different genotypes of *Brassica carinata* plants revealed certain regularities in the dynamics of their accumulation during the growing season (Fig. 1). Oscillation in chlorophyll (ChlM) are mainly associated with the acquisition of genetic resistance of plants to exposure to ultraviolet radiation [5]. It was found that in almost all the studied samples, the level of chlorophyll in the leaves increases from budding to flowering and decreases to the fruiting phase. The high content of chlorophyll indicates the optimized operation of photosystem II, which in turn should have a positive effect on the productive performance of plants. With the help of statistical data processing, groups of plants were selected regarding the resistance of the photosynthetic apparatus to environmental conditions: highly resistant – BC NPF-1, BC NPF-2, BC NPF-4, BC NPF-6, BC NPF-7, BC SCF-9, BC SCF-10, BC SCF-11, BC SCF-12; resistant – BC NPF-3, BC NPF-5, BC NPF-8, BC SCF-13, BC SCF-14, BC SCF-15, BC SCF-16; BC SCF-17.

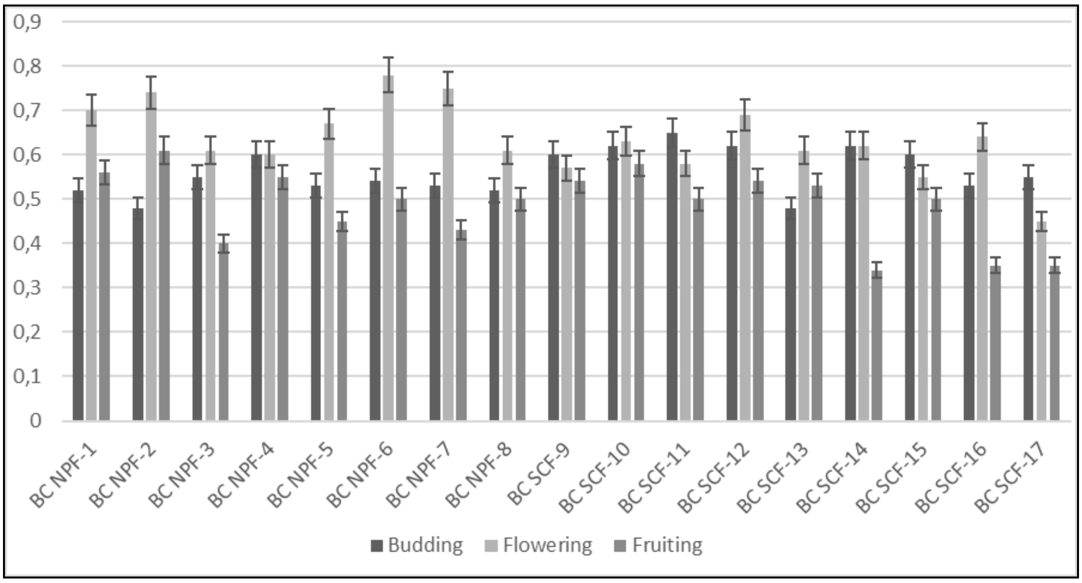

Figure 1. Dynamics of chlorophyll accumulation in leaves of different genotypes of *Brassica carinata* plants depending on the developmental phase (n = 10)

It is known that with an increase in the level of chlorophyll, there is a decrease in the level of another component of the optimized work of photosystem II – flavonol [1, 9, 11]. In our study, we generally observed a decrease in the level of flavonol in the leaves of plants of all genotypes depending on the developmental phase (Fig. 2).

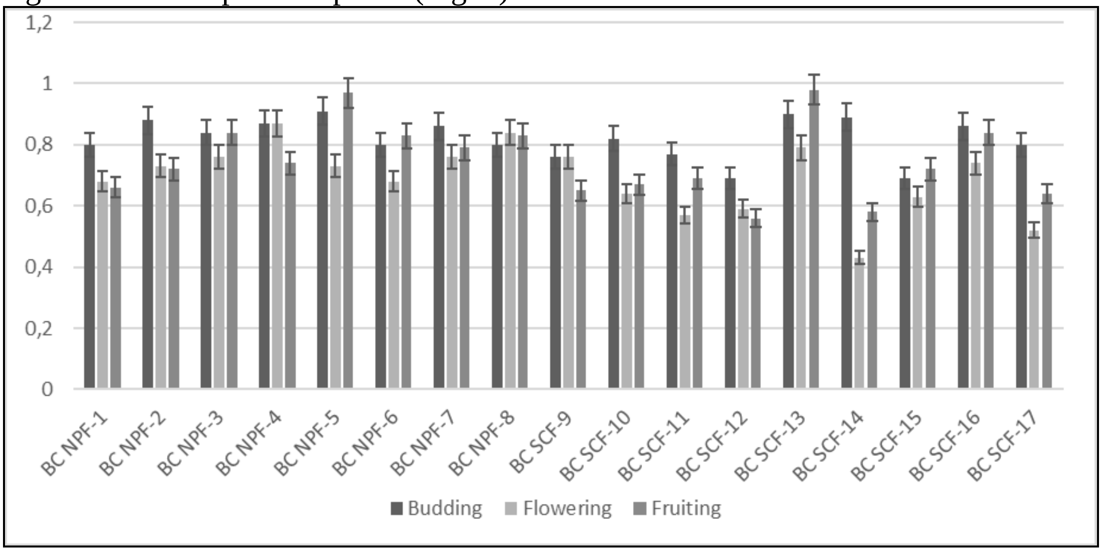

Figure 2. Dynamics of flavonol accumulation in leaves of different genotypes of *Brassica carinata* plants depending on the developmental phase (n = 10)

But it is worth noting that the content of flavonols in the leaves of the studied mustard genotypes did not always decrease in direct proportion with the increase in chlorophyll and vice versa. Statistical data processing made it possible to isolate genotypes with the most optimal operation of photosystem II – BC NPF-1, BC NPF-6, BC SCF-9, BC SCF-10, BC SCF-11, BC SCF-12.

According to Aliet al., another important indicator of the optimal operation of photosystem II is the nitrogen-flavanol index (NFI), because its relatively high level in the leaves during the growing season ensures the balance of physiological processes, which in turn prevents the abortive nature of plant flowers, the formation of full-fledged fruit and seeds [2]. In our study, the nitrogen-flavanol index varied depending on the genotype and developmental phase (Fig. 3).

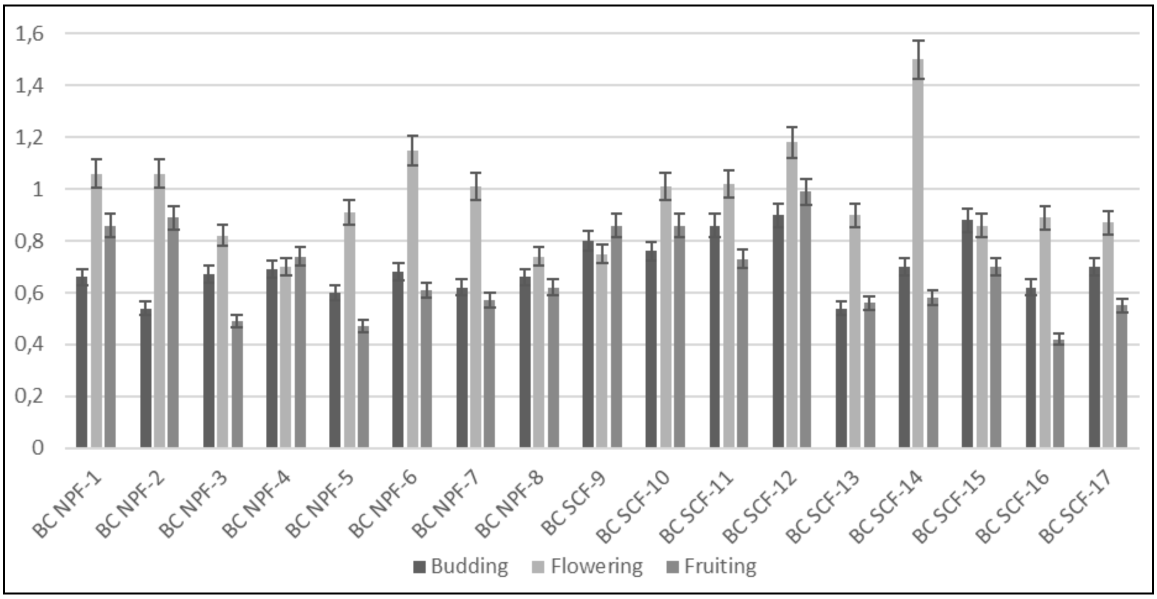

Figure 3. Nitrogen-flavanol index in leaves of different genotypes of *Brassica carinata* plants depending on the developmental phase (n = 10)

As a result of statistical processing, two groups of plant resistance were identified: highly resistant – BC NPF-1, BC NPF-2, BC NPF-4, BC NPF-6, BC NPF-7, BC SCF-9, BC SCF-10, BC SCF-11, BC SCF-12; resistant – BC NPF-3, BC NPF-5, BC NPF-8, BC SCF-13, BC SCF-14, BC SCF-15, BC SCF-16; BC SCF-17.

The obtained results make it possible to assess the physiological state of plants depending on genotypic features and the period of their development and to determine the most resistant samples.

Conclusions

Therefore, a non-destructive evaluation of the leaves of 17 genotypes of *Brassica carinata* plants was carried out in order to assess their physiological state depending on the phase of plant development and genotypic characteristics.

Screening of chlorophyll, flavanols and nitrogen-flavanol index made it possible to find out the work of photosystem II of the studied genotypes and to divide them into two resistance groups – highly resistant and resistant. Among the 9 highly resistant samples, it is worth highlighting BC SCF-12, which according to all indicators during the development period showed the best state of physiological processes and the highest content of physiologically active compounds. Regarding the rest of the samples, it should be pointed out the imbalance of substances is a temporary phenomenon, since after further breeding and genetic studies, the fixation of the physiological mechanisms of resistance at the genetic level will be achieved. This will make it possible to select plant genotypes with increased resistance to biotic and abiotic factors, which will contribute to the improvement of the process of acclimatization and selection and the selection of highly adaptive and productive genotypes for introduction into culture and diverse use.

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