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RESULTS OF BREEDING LEGUMINOUS CROPS FOR DROUGHT RESISTANCE

РЕЗУЛЬТАТИ СЕЛЕКЦІЇ ЗЕРНОБОБОВИХ КУЛЬТУР НА СТІЙКІСТЬ ДО ПОСУХИ

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Leguminous crops play a crucial role in providing the human population of our planet with quality food. Food products made from them are an important component of ration in developing countries. Such factors as population growth, an increase in the area of agricultural land under crops

associated with the production of biofuels and animal feed, a reduction in irrigated land, global warming in the future will lead to a certain tension with the food to the human population. One of the ways to mitigate this problem is to significantly increase the use of plant products for nutrition, the most valuable and affordable of which are obtained from leguminous crops.

The Plant Breeding and Genetics Institute conducts intensive breeding work with three leguminous crops – soybean, pea and chickpea. Soybean breeding began in 1979 and during this time 32 varieties were bred. To date, there are 13 varieties in the state register. An important advantage of our varieties is the increased level of drought resistance and high protein content in seeds. The presence of dry periods annually during plant growth makes it possible to identify better adapted genotypes under natural conditions without the use of special devices and artificial climate. Although under very dry conditions, the yield potential of the newly created varieties is not fully released, however, when grown under a favorable agro-climatic background, they are not inferior in productivity to the best domestic and foreign varieties.

Grain yield of several varieties can be analyzed in different zones of Ukraine. The yield of Taverna and Serenada varieties released in 2021 in state trials (ST) averaged 2.25 and 2.23 t/ha, respectively, which is more than 7 times higher than their yield in the competitive trials (CT). The new varieties Odesytka and Zmina, which were released in 2023, showed an average yield of 2.58 and 2.75 t/ha in ST, and 0.88 and 0.97 t/ha, respectively, in CT, which is 34.1 and 35.3% smaller. At the same time, the maximum yield of Odesytka variety was 3.57 t/ha in 2020 in Polissia, and Zmina variety showed a maximum yield of 4.63 t/ha in 2021 in the Forest-Steppe.

To create the source material, we practice double crosses and step hybridization, in which we involve the best forms of competitive variety testing. To increase the amount of hybrid material, along with artificial crossing, natural hybridization was used using lines with gene sterility of pollen. At the same time, the number of hybrid plants increases by about 6 times [1, p.16].

The current stage of our program is the gradual accumulation of positive small genes that affect the level of drought resistance. We use for hybridization the previously obtained constant lines, which are characterized by an increased level of adaptability, and recently created varieties. In addition, every year in the environmental test we study a significant set of new domestic or foreign varieties. We annually maintain and study a working collection of soybean in the amount of about 1000 forms. This makes it possible to select valuable material for hybridization on a broad genetic basis. The main criteria for the selection of cultivar samples for

inclusion in the crossing program are yield, drought resistance, biochemical parameters, and seed size. Especially high requirements for the biochemical composition of seeds apply to varieties for food use, which must have a protein content of 42% and above, a minimum content of trypsin inhibitors, and reduced lipoxygenase activity. Varieties created according to this scheme are able to productivity of 4.0 t/ha under optimal conditions, at the same time they are characterized by a high level of drought resistance [2, p. 63]. In new varieties, the protein content reaches 42–43%, oil – 23–24%.

The main task of pea breeding is to create varieties with short height and an optimal leaf apparatus, which are resistant to lodging, respond positively to an intensive agricultural background and are better adapted to local conditions. The leafless varieties Svit, Bilyi Angel, Darunok Stepu and Prystan created at our institute are characterized by a height of 60-75 cm, the yield of which reaches 3-4.5 t/ha. For the arid conditions of the Steppe zone of Ukraine, the genotypes with a height of 75-85 cm are required. Varieties of this type Cruise, Veleten', Cozachock are recommended for the Steppe, Forest-Steppe and Polissia. They have proven themselves well in different zones of Ukraine with yields from 2.0 to 4.8 t/ha [3, p. 37].

A promising direction for the creation of new pea varieties is the use in breeding of the "chameleon" form (af, tak genes), which has a low tendency to lodging and a larger photoassimilating surface than leafless genotypes, and sources of determinant of the "lupinoid type" (det, fas) – plants with an apically elongated peduncle, which contains up to 11 flowers on short pedicels.

In our breeding program, samples of the world collection of various ecological, geographical and genetic origins are of great importance. After a detailed study, they are used to breed new varieties by direct selection or as components of crossing. The paired crosses were widely used at the initial stages of our breeding programme. But they did not always provide the necessary gene recombinations, so complex step crosses are often used. With an increase in the number of new hybrid varieties, their pedigree is becoming more and more complex. With the introduction of recessive genes of multiflowering, non-shedding, short-stemmed into the genotypes of high-yielding varieties, the use of saturation crosses schemes gives a good effect.

A significant reduction in the impact of adverse environmental factors can be achieved by winter sowing of specially created winter-hardy varieties that are able to tolerate low temperatures during the winter period. Our research claims that plants of such varieties as Enduro, Balltrap and Moroz are not damaged by temperatures down to -15^0C without snow cover and tolerate -25^0C in the presence of a layer of snow on the surface of the field.

Chickpea breeding began in 1995 in our institute. It is based on collection material obtained from the International Research Institute of the Semi-Arid Tropics (ICRISAT, Patancheru, India) and the Center for Plant Genetic Resources of Ukraine (Kharkiv). Over the past period, more than 3 thousand collection forms have been analyzed for economically valuable traits and 12 varieties have been created. The accumulated long-term information allows us to form the main indicators of the model of a highly adaptive variety for the arid zones of our country. The varieties bred at our institute are characterized by a semi-determinate type of growth, increased intensity of initial plant growth, especially when there is a sufficient amount of moisture in the soil. Under such conditions, there is a rapid increase in above-ground mass, which reduces evaporation from the soil surface and contributes to increased competition with weeds. It is desirable that the plants are pubescent, since the presence of a dense cover of stems and leaves effectively reflects the sun's rays, which reduces water loss for transpiration.

New varieties of our breeding are distinguished by a strong thick stem, a compact bush, leaves close to the erectoid type, short internodes, 2–3 branches of the first order and 3–4 of the second. One of the important factors in increasing productivity is the creation of varieties that form two flowers in a node, from which two beans are developed. Our research suggests that the two-legume trait is controlled by a single recessive gene.

Particular attention should be paid to the size of the seeds. Domestic and international markets require large seeds (weight of 1000 seeds more than 400 g) of the kabuli type. The inheritance of this trait is quite complex, as a rule, the mass of the seed is controlled by a significant number of genes. Of the 12 varieties we bred, 7 are large-seeded of the Kabuli type.

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