

**Name of the project:** Num.14870651 «Production early maturing soybean material with high productive and adaptive potential using molecular breeding methods for conditions of Northern Kazakhstan»

**Relevance:** Soybean is a new, previously uncultivated and promising crop for Northern Kazakhstan. The culture is difficult to cultivate in Kazakhstan due to the climatic features of our country, however, it is in demand and promises farmers high profitability. However, due to climatic conditions, the choice of soybean varieties or hybrids in Kazakhstan, unlike other regions, is small, it is necessary to use precocious and ultra-ripe varieties. In dynamics, there is an increase in the area under soybeans from 24.9 thousand hectares to 227.8 thousand hectares in 2021. On average, the yield of soybeans in Kazakhstan is 20-21 kg /ha, but the highest indicators are characteristic of the Almaty region (irrigation farming zone). In other regions of Kazakhstan, the yield of soybeans does not exceed 10 kg/ha. In Kazakhstan, the main growing regions are Almaty and East Kazakhstan regions.

When creating soybean varieties for the conditions of Northern Kazakhstan, it is necessary to take into account many factors, in particular, an insufficient amount of temperatures during the growth period and a long daylight day, since soybean is a short-day plant. Soybean varieties with weak photoperiodic sensitivity can bloom relatively early and form seeds in long daylight conditions.

For the northern region, 1-2 varieties of non-district selection are allowed, for which there is no seed production. This is the problem of cultivating a highly profitable crop in the conditions of the north of Kazakhstan: the lack of varieties and, accordingly, the lack of seed production by culture. For the full implementation of this culture, it is necessary to create varieties adapted to the conditions of the north of Kazakhstan, taking into account the terms of vegetation of plants and the photoperiodic reaction of the plant to the length of daylight.

Precocity is the most important indicator for agricultural plants in the conditions of Northern Kazakhstan. Using the methods of molecular biology, it will be possible to obtain the raw material of soybeans in order to create new highly productive and precocious varieties for specific conditions. The project provides for the use of traditional and molecular breeding methods, including DNA marker methods, which makes it possible to simplify, accelerate and reduce the cost of the breeding process when creating new varieties for 3-5 years. Also, molecular markers in plant breeding make it possible to assess the genetic diversity of the soybean source material and classify breeding forms and traits.

**Goal:** study and create new precocious forms of soybeans using traditional methods of breeding and molecular analysis for the conditions of Northern Kazakhstan.

**Project objectives:**

1. Study of the source material of soybeans according to the main economically valuable characteristics and determination of their breeding significance, identification of valuable initial forms of soybeans with high values of morphobiological, morphophysiological and economically valuable characteristics, to include them in the breeding process to create varieties with high adaptive ability. Identification of soybean genotypes based on molecular genetic polymorphism in the conditions of Northern Kazakhstan;

2. To create a new soybean source material by classical selection and evaluation based on molecular analysis using DNA markers associated with precocity. Selection of sources and donors of precocity and productivity based on field research and molecular analysis.

1. Generation and accelerated reproduction of the obtained soybean hybrids in greenhouse conditions;

2. Hybridological analysis of soybeans according to the main economic and valuable characteristics in the conditions of Northern Kazakhstan;

5. Molecular analysis for precocity and field assessment for the productivity of generations F3 F4 and the selection of precocious forms for further passage of the links of the breeding process.

### **Expected results**

1. A comprehensive assessment of the source material of soybeans of various origins according to the main economic and valuable characteristics. Selection of genotypes for further use in practical breeding. Documentation of soybean samples;

2. Optimization of protocols for the development of DNA markers associated with precocity and molecular analysis of the soybean source material with subsequent selection of highly productive and adaptive lines will be carried out;

3. Selection of precocious soybean samples to include them in the breeding process. Hybridization of selected parental soybean forms, obtaining F1 generation hybrids;

4. Generation and production of hybrid grains of F2 generations. Hybridological analysis of A3 and A4 generation hybrids according to the main economically valuable characteristics and field assessment on the productivity of A3 A4 generations and selection of precocious forms.

5. Publication of at least 2 (two) articles and (or) reviews in peer-reviewed scientific publications indexed in the Science Citation Index Expanded of the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 35 (thirty-five).

6. Publication of 2 articles in a peer-reviewed foreign or domestic publication recommended by COXON, indicating the identification number and name of the project, as part of its financing.

### **Members of the research group:**

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**Information for potential users:** the direction of breeding and seed production of agricultural crops

**The results of the study:** The study of a new source material of soybeans according to the main economically valuable characteristics was carried out, valuable initial forms of soybeans were identified. Ивушка, Suiyang 1, СК Элана, Beidou 26, Heihe 43, Heihe 58, Beidou 56 varieties were the best in terms of the complex of elements of productivity, yield and grain quality, breeding lines 7-21-2, 28-21-1, 31-21-1, 46-21-1, 92-21-1, 100-21-1, 122-21-1 etc., varieties were marked by precocity and yield. According to the height of the attachment of the lower bean, the degree of correlation was  $r = 0.51$ , the number of beans on the plant  $r = 0.74$ , the size of the seeds and their number were characterized by a high positive relationship. The

conducted analysis of variance showed a high confidence score and a lower deviation rate in the experiment. A molecular analysis of the soy source material using DNA markers, as well as the selection of genes controlling precocity, was carried out. Primers for the soybean SEP3 gene have been selected (Genbank number XM\_006579370). Work has been carried out on the amplification of full-size sequences of SEP3 genes of soybeans of different varieties using selected primers. On primers 22GmSEP3aNachS1 and 2GmSEP3aKonA1 with DNA of different varieties, PCR products of the expected size (about 735 bp) were obtained, which were then sequenced on ThermoFisherScientific. Work has been carried out on the creation of a new source material, reproduction and evaluation of breeding material in breeding nurseries. According to the results of the hybridological analysis, 2 combinations of crosses were identified.