THE SELECTION AND EVALUATION OF PROMISING FORMS OF *SESAMUM INDICUM* L.

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Abstract

Sesame (*Sesamum indicum* L.) is a "historic" species recognized as an oleaginous and medicinal plant since over 5000 years ago. The works on its acclimatization started with 5 seed samples from India and 6 from Bulgaria, all of which were included in the breeding process. The seed material obtained after crossings was subjected to "negative selection", choosing the forms with the shortest growing season and high productivity under the climatic conditions of our region. After six years of selection, a form that corresponded to the initial requirements was obtained. The comparative crops tests (CCT) conducted over several years confirmed the superiority of the selected form by high productivity of 1.2-1.5 t/ha and oil content of 55.4%, making it possible to register it in the National Register as a cultivar with the name 'Deliciu', which is still used by Moldovan farmers. The breeding has continued, in order to obtain cultivars with capsules that ripen simultaneously and do not open before harvesting, another cultivar, which is undergoing CCT testing, was chosen by the method of repeated selections. The new cultivar reaches a height of about 125-127 cm, which contributes to the facilitation of mechanized harvesting, with a production potential of 1.4-1.8 t/ha, the content of fatty oil 60.3% and the duration of the growing season of 132-138 days. Thus, as a result of the selection, the sesame crop was included in the agricultural production as a source of aromatic plant oil, and the seeds being a food additive with high content of Ca, Fe, Zn, Mg, P, Cu vitamins and minerals.

Key words: breeding process, cultivar, productivity, *Sesamum indicum*

Sesame (*Sesamum indicum* L.) is a species with the oldest cultivation history in the world, recognized as an oleaginous and medicinal plant since over 5000 years ago (Bedigian D. *et al* 1986). The plant is native to Africa, but has been cultivated for a long time in India, Middle Eastern countries, America (Moazzami A. *et al* 2009). The name of the species derives from the Greek word "sesamon" meaning "fat" or "oil". In India, it is recognized as a sacred plant, in Hindu rituals the oil obtained from sesame seeds is used during prayers in temples. A Hindu legend says that black sesame seeds were given by the god Maha Vishnu to his consort as a symbol of immortality (Shah N.S., 2016). The global area cultivated with sesame exceeds 7.8 million hectares and increases annually due to its expansion the north, in countries not specific for its cultivation. Annual world production is about 7.9 million tons of sesame seeds (FAOSTAT, 2018). The biggest producers are India, China, Tanzania, Sudan, Nigeria, Mexico, Turkey, Venezuela *(Latest Report Update. 2022) etc.*

In the last 20 years, sesame has been studied multilaterally and has consolidated its position due to its rich chemical composition and beneficial effect on human health. Sesame seeds contain up to 65% fatty oil (Das R., Bhattacharjee C., 2015), proteins, vitamins B, D, E, F, phytosterols, esters, alcohols, carbohydrates, dietary fibre, sugars, minerals such as Ca, Fe, Mg, P, Cu, Zn (Amoo S.O, Venter S.L., 2017). Whole (unhulled) sesame seeds have special antioxidant properties thanks to sesamin, which lowers blood cholesterol levels, prevents premature aging of cells and tissues, improves the condition of nails and hair, and is also beneficial in the prevention of various diseases (Erasmus U., 1993). They also contain a large amount of calcium, which helps strengthening the bone and joint tissue. They contribute to the normalization of metabolic processes in the body, maintain vitality, strengthen the immune and muscular systems, have a beneficial effect on vision and the condition of blood vessels (Mateljan G., 2007).

From a technological point of view, the proteins extracted from sesame seeds have exceptional functional characteristics such as foaming and emulsifying properties, oil and water retention capacity and solubility (Sibt- e-Abbas M. *et al* 2020). Sesame seeds and oil are used in various food recipes, as coating or sprinkled on

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cookies and bread, the seed paste is used in various products such as desserts, including sweet cookies, salads and sauces, sesame paste – tahini, halva halva (Elleuch M. *et al* 2011).

Our concerns regarding the cultivation of sesame are related to the fact that the seeds are imported into the Republic of Moldova in quite large quantities. According to the data provided by the National Bureau of Statistics regarding the import of sesame seeds, in the Republic of Moldova, during the period 2016-2021, 1,180 thousand tons of sesame seeds were imported at a cost of over 2 million US dollars. Sesame plants have already adapted to the local pedo-climatic conditions, they develop well, and produce seeds that are able to ripe. Besides, new cultivars have been bred, with fairly good productive capacities, which could be easily cultivated locally.

MATERIALS AND METHODS

The carried out research on the introduction of this species allowed us to find that the species is able to grow and form stable productions of mature seeds under the pedoclimatic conditions of our region. Five initial seed samples were brought from India, and the plants derived from them demonstrated the need for the same growth conditions as in the country of origin, especially temperature. Another 6 sesame samples used as starting material were purchased in Bulgaria, being adapted to growth conditions closer to our country's. All samples were included in the breeding process, being crossed with each other.

All the material resulting from the crosses was sown to evaluate the most important character "the length of the growing season" as well as plant productivity indices. At the first stage, a "negative" selection was carried out according to the character "the length of the growing season ", that is, all forms that needed 145 days or more to reach maturity were rejected.

An important characteristic for *Sesamum indicum* is the period from sowing the seeds to the complete emergence of the seedlings. There were years when the germination under laboratory conditions was 100% and the germination in the field was 3-4%, although all other conditions have been met, such as soil moisture and temperature at least 25 °C. Therefore, those forms that were characterized by difficult emergence were also rejected, being unsuitable for cultivation as new forms or cultivars.

RESULTS AND DISCUSSIONS

During 6 years of selection, a form was chosen that met the initial requirements for a cultivar, and the tests continued during five years in various trials, allowing us to highlight and register it in the State Catalogue – the cultivar 'Deliciu'. This was the first cultivar registered in our region; it was a success, being a novelty then, and it is still used by Moldovan farmers to this day.

This cultivar differs from its ancestors, with which it was compared during tests, in such characteristics: annual herbaceous plant, heat-loving. The average height of the plants was 1.0-1.7 m. The number of branches on the main stem – 3-5 pcs. The root system is a taproot with a large number of lateral roots, growing into the soil to a depth of one meter. The stem is erect, with elongated, pubescent leaves. The flowers are large, tubular, pink, located in the axils of the leaves. The duration of the flowering stage of plants is up to 25 days, and a flower is open for only one day, when self-pollination takes place. The fruits formed after fertilization are cylindrical-tetrahedral capsules (up to 340 pieces per plant), about 4-5 cm in length. In a capsule, there are about 80-90 seeds, the weight of a seed is on average 2.1-2.3 g.

According to multi-year data, the average seed yield was 1.2-1.5 t/ha, and the oil content was 55.4%. The duration of the growing season was 135-140 days. This cultivar ripens unevenly over a fairly long period. On the same plant one can see, at the same time, the lower capsules split open with the seeds scattering, blooming flowers at the top of the plant and only the 10-12 pairs of capsules in the middle of the stem that are sufficiently mature and suitable for harvesting. The given cultivar had several disadvantages, but it was the first and, unfortunately, the last officially registered in the State Register.

Every year, the research on sesame, like the other seed-producing species, started with the assessment of the germination capacity, growth energy and the weight of seeds that a plant produces. The obtained results are reflected in (*table 1*).

Sesame seeds germinate very quickly, even on the second day, the energy of germination is 92-95%. The germination is practically completed in 3-4 days, with values of 99.4 for the control and 99.9% for the new cultivar (*figure 1*). The weight of a thousand seeds was 2.3-2.4 g in both tested cultivars.

Figure 1 **Sesame seeds germinating on the second day**

From a mature plant, 32.2 to 33.0 g of dry seeds were collected; the harvesting was done in three rounds to avoid losses, but despite all the effort, some of the seeds were lost.

The methods of individual harvesting of seeds from those plants, which reached the flowering period faster and ripened earlier, were also applied, which is valid for both tested cultivars. For the following tests, we also collected only the capsules from the central stem, from its middle part, where the seeds were better developed, with well-defined shapes and even colour.

The other seeds that the plant produces are harvested and stored together and, when passing through the seed sorting machine, they constitute the majority of the batch of seeds representing the second fraction, which are of good quality, but have a slightly lower weight of a thousand seeds than those from the individual selections.

Table1

Quantitative indices to assess the quality of *Sesamum indicum* seeds, averaged over two years

Tested cultivar	Germination capacity %	Growth energy %	Weight 1000 seeds, g
S. indicum, control	99.4±0.2	92±0.72	2.3±0.6
S. indicum, new cultivar	99.9±0.1	95±0.8	2.4±0.7

During two growing seasons, several morphological and biological indices were assessed (*figure 2*). The average values per two years of testing of the new cultivar for characters such as plant height, were 1999.5 for the control cultivar and 1996.5 cm for the new cultivar. The number of branches per plant was practically the same in both cultivars and was equal to 4.7 and 4.75 in the new cultivar.

Another important characteristic is the number of capsules per plant, which constitutes an element of the production. Thus, the number of capsules/plants was 240.5 pcs. for the control and 256 pcs. for the new cultivar.

The weight of the seeds per plant was 32.2 g in the control and 33.0 g in the new cultivar.

The duration of the growing season from the emergence of the seedlings to the harvesting of the seeds was quite long – 132 and 138 days, for the first and second year, for both cultivars that are harvested simultaneously. At this moment the new cultivar has 30% more ripe capsules than the control.

Figure 2 **Testing the new cultivar in CCT**

Table 2

Morphological indices of *Sesamum indicum,* averaged over two years

Tested cultivar	Plant height, cm	Number of branches per plant	Number of capsules per plant	Weight of seeds per plant, g
S. indicum control	1999.5 ±4.8	4.71 ±0.58	240.5 ±17.9	32.2 ±1.1
S. indicum new cultivar	1996.5 ±3.9	4.75 ±0.55	256.1 ±16.9	33.0 ±0.9

Weather conditions influence both the emergence of plants and the other stages of development and the characteristics of the plant. Sesame, being a short-day plant, develops much better under the conditions of positive temperatures during the growing season, favouring the formation of a higher productivity (*table 3*), namely, 1.285 in the control and 1.405 t/ha in the new cultivar.

Table 3

Seed production of *Sesamum indicum* cultivars, averaged over two years

Tested cultivar	Average seed production, t/ha repetitions				Average t/ha
	1	2	3	4	
S. indicum control	1.336	1.235	1.338	1.233	1.285
S. indicum new cultivar	1.402	1.390	1.407	1.424	1.405
DI_{05}					0.28

Some individual plants are able to produce a seed yield of up to 45-55 g/plant, and the potential yield per 1 ha would be 1.5-1.8 t/ha, with an oil content of 60.3%.

CONCLUSIONS

The research on the introduction and implementation of sesame in the Republic of Moldova was carried out to familiarize the local producers with well-known and well-forgotten species, which are promising and can bring high profits during a single growing season.

Sesame seeds have multiple uses, but they are imported at high costs and usually are not of the best quality, however, they can be easily produced locally, of good quality, even under conditions of organic farming, benefiting from significant added value.

The high productivity of the cultivars (1.2-1.4 t/ha) created as a result of the breeding research shows that the creation of industrial plantations od sesame is beneficial and opens new opportunities for the agricultural sector in the Republic of Moldova. This crop can be included in both small and large crop rotations, it can be cultivated both by farmers and agricultural households that use modern agricultural techniques, as well as by small land owners who do not possess special equipment for cultivation.

Sesame seeds are widely used by bakeries and there would be no problem with selling the production, which is currently considered a risk, because of the geopolitical situation in the area.

Plant residues, left after harvesting, also can be useful, being used for the production of solid fuel materials (pellets, briquettes) that have a fairly good combustion efficiency, equal to that of soft wood.

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