

COMMON BASIL IN THE REPUBLIC OF MOLDOVA - ACHIEVEMENTS AND PROSPECTS

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Abstract

*The paper indicates the results obtained over 19 years of research on the common basil species (*Ocimum basilicum* L.) as an aromatic and food crop, the description of the cultivars bred and registered in the Catalogue of Plant Varieties of the Republic of Moldova, as well as elaborated technological elements. The data on the morpho-biological parameters and the production of fresh and dried raw material and essential oil in the researched cultivars were obtained after conducting different tests over several years in various scientific institutions. The cultivars of basil were selected according to the requirements of the regional and local market for aromatic herbs. The cultivars created and registered are meant for the food industry, but they have various purposes of use - those with lemon flavor are best suited for hot drinks and refreshing ones, those with savory and "sweet" flavored foliage - for garnishing appetizers and salads, and the cultivars with peppery flavored foliage - for the preparation of meat and fish dishes. Thus, 6 cultivars of aromatic basil have been created and registered, for various uses, suitable for the pedoclimatic conditions of our country and nearby areas, with high productivity of fresh and aromatic raw material.*

Key words: *Ocimum*, cultivar, aromatic herb, raw material.

INTRODUCTION

Currently, the market of aromatic herbs in the Republic of Moldova is partially full of fresh aromatic products, most of them imported and much less - local. Many specimens of imported aromatic herbs are of unknown quality, although they can be grown under the climatic conditions of our region. Currently, it is possible to diversify the assortment and cultivate them, both in open field and in the greenhouse. Many new, less common crops are characterized by high productivity, with growing season that starts earlier or ends later than usual, high content of vitamins, amino acids and mineral salts, being among inter-seasonal vegetables.

Aromatic herbs are an important source of biologically active substances, which have therapeutic effects in the prevention and even treatment of various diseases (Kanmaz et al., 2023). Ethanol and water extracts from the raw material of aromatic plants are widely used, both in folk and evidence-based medicine, in the production of various medicinal preparations.

One of such species would be the common basil (*Ocimum basilicum* L.), which grows as an

annual plant under the climatic conditions of our country, but is a perennial in its native countries - East India and Sri Lanka, South Asia, Africa and the Mediterranean area.

The healing properties of basil have been known for a very long time. In the pyramids of Ancient Egypt, wreaths made of it were found on graves. It is mentioned as a sacred plant in ancient Indian literature written in Sanskrit. In Ancient Greece, it was mentioned in the works of Theophrastus, Hippocrates, Dioscorides and in Ancient Rome, basil was used as a spice, ornamental plant and as feed for animals (Visant et al., 2006). Avicenna recommended using basil in food and for medicinal purposes (Abu Ali ibn Sino, 1996).

It has been cultivated as spicy-aromatic and medicinal plant, which can be used, fresh and dried, as a food spice (Pant & Pandey, 2018), it is also used in the food industry for seasoning meat and canned food, as well as in traditional and folk medicine, pharmaceuticals, perfumery and as an ornamental plant (Sachivko, 2015).

The chemical composition of this species has not been sufficiently studied. According to the specialized literature, the plant is rich in

essential oils (0.02-0.32%), which contain linalool (45.54%), trans- α -bergamotene (7.81%), eugenol (4.55%), hydroxy-2(1H)-pyridine (2.40%), 1,8-cineole (2.31%), epi- α -cadinol (1.973%), α -amorphene (1.563%), α -terpineol (1.46%), 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one (1.44%), cis-linalool oxide (1.21%) (Koshovy et al., 2011). Ferulates, coumarates, basilol, oxynol and basilimoside were also detected in the essential oil (Siddiqui, 2007).

Tannins, glycosides, the vitamins C (3.5-32.4 mg %), P (150 mg %), provitamin A (3-8.7 mg %), proteins, flavonoid aglycones were also identified in the basil herb - salvigenin, nevadensin, cirsiolol, cirsilinolol, eupatorin, apigenin, acacetin, genkwanin, cirsimaritin, ladenein (Grayer, 1996).

Triterpenic acids were identified in the roots - betulinic, oleanolic, ursolic, 3-epimaslinic, alipholic and euscaphic (Marzouk, 2009).

In folk medicine (Taek M., 2018; Süntar, I. 2020), *Ocimum basilicum* L. has been used as an expectorant, anti-inflammatory agent for gastritis, colitis, nephritis (Elansary, 2020). Leaf infusion is used for stomatitis, neurosis, bronchial asthma, loss of appetite and also as an effective lactogenic agent.

Fresh and dried leaves are used in food as an aromatic herb (Andres ton, 2021). Numerous studies have experimentally proven that the essential oil of *O. basilicum* L. has antioxidant effect, which was demonstrated by inhibiting free radical oxidation of linoleic acid (Socolov, 2000). The essential oil, during *in vitro* tests, has shown broad antibacterial activity against the bacterial strains: *Staphylococcus aureus*, *Escherichia coli* and the pathogenic fungi of the genera: *Aspergillus*, *Mucor*, *Fusarium* etc. (Hussain et al., 2008; Joshi, 2014).

The essential oil from the leaves of *O. basilicum* L. has also been proven to have neuroprotective properties, and a series of *in vitro* experiments have shown a cytotoxic effect on a variety of tumors (Al-Ali, 2013). Basil proved to be a natural source of raw materials to be used as an aromatic herb in various branches of the food industry and, last but not least, as a source of biologically active extracts useful for the pharmaceutical and cosmetic industry.

MATERIALS AND METHODS

The expansion of the available assortment of spice-aromatic plants, and common basil in particular, can be done by creating new cultivars, studying their biology and less common cultivation methods, offering the local agricultural producers a source of seeds and planting material in the necessary quantities and of high quality.

The material for research consisted of 34 forms, varieties and cultivars of *O. basilicum* L., included in the working collection, which served as starting material for the breeding process, which lasted 20 years. When creating basil cultivars, much attention was paid to the main morphological and phenological indices, which makes it possible not only to create new cultivars with economically valuable features, but also to use these indices in the identification of cultivars, which is included in the requirements of the State Variety Testing.

An important criterion for the selection of economically valuable basil populations is the biochemical approach to the study of intraspecific polymorphism and, primarily, the essential oil content. The data on the quantitative chemical composition of the essential oil, as well as the organoleptic evaluation of the basil plant mass, make it possible to use these indicators to create cultivars with desired characteristics for consumption, such as aroma, taste, high or low essential oil content, leaf structure, color.

The basic method in the breeding process, in the beginning, was the repeated individual selections in the initial population and then selections among the obtained offspring. The selections were made from a very large number of descendants, which were obtained from isolated and individually pollinated floral "spikes".

Some aspects regarding the seeds were also included in the breeding works, such as the volume of seeds obtained and their quality. Such indicators as the long-term maintenance of germination capacity and growth energy, the weight of 1000 seeds were analyzed. Experiments were conducted in the laboratory and in the field. Under laboratory conditions, the germination capacity and growth energy were

determined using generally accepted methods (GOST 12038-84.).

RESULTS AND DISCUSSIONS

Following the plant breeding activities (2004-2011), three cultivars of basil were selected and registered in the State Register, for the purpose of using the raw material as fresh and processed aromatic herb (Figure 1). Among the chosen cultivars, there were 'Lămâiță' with soft foliage, lemon flavor, optimal for making hot drinks like "forest" tea, refreshing and with numerous health benefits. Another selected cultivar was the one called 'Frunză Verde' - with large and sweet leaves meant to be used for preparing salads, seasoning fresh dishes, vegetables and cheeses. Another registered cultivar was the one named 'Purpuriu', which is ideal to be used as a fresh herb to decorate meat dishes. The essential oil content in the fresh mass of the above-mentioned cultivars varies from 0.1 to 0.6%, but has an excellent taste and pleasant aroma.



Figure 1. The first basil cultivars registered in 2005

Later, to improve and enrich the initial material, various classical breeding methods and sources of different origin were used. By using the demasculinization of flowers before flowering and then - controlled pollination, under the insulator, a large variety of forms with special characteristics were obtained. Based on this material, group and individual selections were performed and their ability to recombine was determined.

Following these selections made in stages, stable forms were obtained, with various phenotypic and genotypic characters, with high performance indices, which after multiple tests in various nurseries, evolved into two new cultivars: 'Crețișor' and 'Opal-mini' (Figure 2). The first cultivar differs from the others in the shape and color of the foliage - green, large, ruffled leaves, with a pleasant sweet taste,

suitable to be used fresh in salads, with cheeses and as a garnish for vegetables. The second cultivar has opal-purple foliage with green shades, best suited for fish, lamb dishes etc.

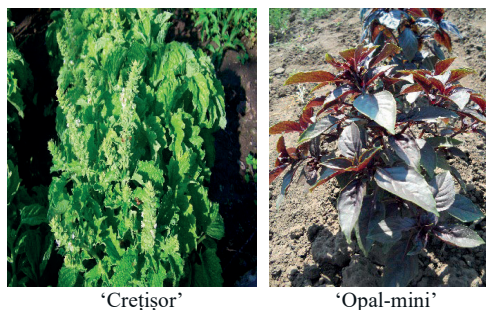


Figure 2. Basil cultivars registered in 2013

The data of the specialized literature, bring more and more evidence to support the claim that that anthocyanin, which are contained in the forms of basil with purple foliage, exhibit pharmacological activities such as: antioxidant, radical scavenger (Lila, 2004), anti-inflammatory and antioxidant (H. Wang et al., 2004) antitumor (Hou, 2010), fungicidal and antibacterial (Norton F.A., 1999). Therefore, in order to be in trend with the breeders in this field, the research aimed at obtaining cultivars with purple leaf color and high content of anthocyanins was continued.

In the breeding process, by applying the same methods described above, we obtained a new cultivar of basil 'Picant de grădină', with a high percentage of anthocyanins, but also with a pleasant clove aroma (Figure 3).



Figure 3. Basilic cultivars

The cultivar has been submitted for Comparative Contest Crop Testing (TCCC) to the State Commission for the Registration of Plant

Varieties as well as for obtaining an invention patent.

During the growing seasons, morphometric measurements of the quantitative parameters of the plants were made, such as their height, the stems and leaves ratio, the useful mass ratio, the duration of the growing season until harvest. The height of the plants of the cultivar 'Lămâiță' was 45-47 cm, the cultivars with purple foliage 35-42 cm and the cultivars 'Frunză verde' and 'Crețisor' reached basically the same height of 63-68 cm, these being the averages for four years.

At the first harvest of the basil raw material, the growing season lasted for 39 days (Table 1) for the cultivar 'Lămâiță', which was the earliest to vegetate. For the cultivars with purple leaves, the duration of the growing season was as follows: 'Purpuriu' - 40, 'Opal-mini' - 41 and 'Picant de Grădină' - 38 days, being practically equal. For the cultivar 'Frunză verde', the growing season until the first harvest lasted 52 days, and for 'Crețisor' - 55 days. The quantitative parameters were measured at harvest and then recalculated in %. The best-performing cultivars according to this parameter, which refers to inflorescences and leaves, are the cultivars with sweet leaves, of green color, which are best suited for salads, such as 'Frunză verde' and 'Crețisor', where the percentage of useful mass reached 61 and 60 %. Among the cultivars with purple leaves, the most valuable was 'Picant de grădină', which had 58% useful mass, the others having 53 ('Purpuriu') and 55% ('Opal-mini'). The cultivar 'Lămâiță' had the lowest percentage of useful mass - 51%. The raw material can be harvested several times per season - two or even three times, depending on the conditions and amount of rainfall in that year. In the years 2023, 2022 and 2020, two and three harvests were carried out, but in 2021 - only one.

Table 1. The share of quantitative parameters in *O. basilicum* L. cultivars, 2020-2023

Cultivar	The share of quantitative parameters in plants, %				Growing season, days
	stems	inflorescences	leaves	useful mass	
Lămâiță	43	8	49	51	39
Frunză verde	39	10	51	61	52
Purpuriu	47	11	42	53	40
Crețisor	40	9	51	60	55
Opal-mini	45	8	47	55	41
Picant de grădină	42	8	50	58	38

Every second harvest is done in 27-30 days, according to the averages of the last four years. The third harvest is done even faster – in only 15-20 days and depends entirely on the sum of the positive temperatures, which are recorded in the mild autumns, and on the amount of moisture that comes from rainfall or irrigations.

The lowest production of fresh raw material (Table 2) was obtained from the cultivar 'Lemon', only 4.3 t/ha, and dry matter - 1.2 t/ha. A little higher productivity, according to the amount of fresh and dry raw material, was achieved by the cultivars 'Crețisor' - 6.6 t/ha and 'Frunză verde' - 6.3 t/ha, which are meant to be used fresh. The new cultivar 'Picant de grădină' is the leader in terms of fresh raw material productivity - 11.6 t/ha, which surpasses the control with which it competed in tests – 'Opal mini' - 9.1 t/ha. The amount of essential oil is not too high, varying from 5.6 kg/ha in the cultivar 'Lămâiță', to 9.4 kg/ha in the cultivar 'Crețisor', but it is within the limits of the standards. For these cultivars, not the amount of oil is the most important, but its aroma, the finesse of the taste and the texture of foliage.

Table 2. The raw material and essential oil production, on average for four years

Tested cultivars	Raw material productivity, t/ha		Essential oil	
	fresh	dry	content, % dry matter	kg/ha
Lămâiță	4.3	1.2	0.6	5.6
Frunză verde	6.3	2.4	0.8	9.1
Purpuriu	9.7	1.6	0.4	4.6
Crețisor	6.6	2.6	0.7	9.4
Opal-mini	9.1	1.7	0.5	7.6
Picant de grădină	11.6	2.6	1.1	12.2
DL ₀₅	0.94	0.23	-	-

In addition to the fact that the production of fresh mass, dry matter and the amount of essential oil were studied, research was also conducted on the seeds of the created cultivars, because the common basil propagates only by seedlings obtained from seeds. The propagation and maintenance of these cultivars is quite peculiar and complicated, because they require isolated land sectors and irrigation at least 3-5 times during the growing season. Basil plants need more time to produce seeds than to produce fresh plant mass. These indices were determined during the Comparative Contest Crop Testing, when the cultivars were submitted for

registration in the Catalogue of Plant Varieties of the Republic of Moldova, in the years 2004-2011, 2013, being updated in the reference years as well. Thus, the duration of the growing season in the years 2020-2024 depended to a large extent on the weather conditions of the year, especially on temperature, as basil is a heat and light-loving species.

The amount and frequency of rainfall are equally important, but the 3-5 irrigations that we usually apply during the growing season are essential for the production of seeds. The period from transplanting the seedlings to seed ripening, in the cultivar 'Lămâiță', lasted 100 days in 2020 and up to 108 days in 2022 (Table 3). The cultivars 'Frunză verde' and 'Crețșor' were practically at the same level, being characterized by the longest duration of the growing season - 123-126 days. The cultivars with purple leaves had the shortest growing season of 103 and 109 days and the longest – of 123 days, with a difference between them of 1-3 days.

Table 3. The duration of the growing season in the cultivars of *O. basilicum* L. until seed ripening, 2020-2024

Years of testing, Cultivars	2020	2021	2022	2023
Lămâiță	100	103	108	101
Frunză verde	123	120	124	116
Purpuriu	112	118	122	106
Crețșor	125	117	126	119
Opal- mini	111	113	120	103
Picant de grădină	109	112	123	103

The quality of the seeds largely depends on the conditions under which they grew and developed, as well as how they have been stored. The seeds of *O. basilicum* L. keep their germination capacity for 5-7 years, after which they need to be replaced. The cultivar 'Lămâiță' has the smallest seeds with a weight of 1000 seeds of 0.5-0.8 g (Table 4), but this did not negatively influence the germination capacity (76-80%). The seeds of the cultivars 'Frunză verde' and 'Crețșor' have the largest seeds, the weight of 1000 seeds being of 1.1-1.5 g and 1.0-1.6 g, respectively, with fairly good germination of 64-68 and 63-68%. The seeds of the cultivars with purple foliage have average values of 0.8-0.9 g and germination capacity up to 84%. Seed growth energy is assessed 3-5 days after soaking the seeds in water and placing them in the

germination cabinet. We have observed that the faster and the higher the growth energy, the faster the seeds germinate in the seedling trays.

Table 4. Seed indices (min., max.) in the cultivars of *O. basilicum* L.

Cultivar	Germination capacity,%		Growth energy,%		Weight of 1000 seeds, g	
	min	max	min	max	min	max
Lămâiță	76	80	55	58	0.5	0.8
Frunză verde	64	68	47	50	1.1	1.5
Purpuriu	73	76	44	47	0.8	1.1
Crețșor	63	78	46	49	1.0	1.6
Opal- mini	70	74	44	46	0.9	1.1
Picant de grădină	80	84	55	58	0.8	1.1

The seeds germinate at the same time, the number of seedlings in a cell of the tray being visible and easily controlled by removing the unnecessary ones, without any major damage, before the root system is formed.

Treating basil seeds with 0.5% potassium permanganate $KMnO_4$ solution for five minutes increased the germination capacity and growth energy by 2-5%.

CONCLUSIONS

The use of classic breeding methods in the selection process makes it possible to create new, high-performance cultivars of *O. basilicum* L. suitable to be used in the food, pharmaceutical industry etc.

The rapid implementation of the created cultivars of aromatic herbs in the pharmaceutical, food and wine industries contributes to the use of raw materials, local labor, obtaining organic products, diversifying and improving crop rotation schemes to provide environmental benefits, contributing to the sustainable development of modern agricultural production.

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