**Green Mass Yield of Basil (Ocimum basilicum L) Variety Samples under Dry Subtropical Conditions**

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**Abstract.** The article presents the results of evaluating the productivity of 35 purple-leaved and 21 green-leaved basil (Ocimum basilicum L) accessions introduced from various ecological and geographical regions under the dry subtropical conditions of Uzbekistan. The basil accessions were assessed in terms of leaf yield and total green mass yield (leaves, stems, and shoots). The most promising accessions are recommended as initial breeding material for selection programs and for cultivation in household plots and vegetable farms.

**INTRODUCTION**

Plants are a major force that maintains the balance of life on Earth, a fact that is widely recognized. It is well known that humans have long understood the positive influence of plants on human psychology: certain essential oil–bearing vegetable plants, particularly basil (Ocimum basilicum L.), are valued primarily for their rich chemical composition and medicinal properties, serving as remedies for various ailments, while their attractive appearance creates aesthetically pleasing landscapes and contributes to positive emotional well-being.

For this reason, studying basil variety samples in terms of economically valuable traits under dry subtropical conditions is of particular importance. This includes evaluating collections of basil accessions according to their morphological and agronomically important characteristics, identifying promising varieties, determining optimal sowing dates and planting schemes, developing selected elements of seed production technology, and analyzing the biochemical composition of these crops.

Basil is significant in several respects: supplying the food industry with high-quality raw materials (meat processing, wine and liqueur production, canned products, use as a spice, etc.); application in traditional and folk medicine as well as in pharmaceuticals; reducing imports, particularly of dried basil raw materials; and use in perfumery, ornamental horticulture, and other sectors. At the same time, this crop is not yet widely cultivated in sufficient quantities in the Republic. Therefore, its introduction into large-scale production is an urgent task, in which breeding and selection activities play a crucial role [1]

At present, the global demand for the cultivation of essential oil–bearing and spice plants is steadily increasing across agriculture, medicine, and various industrial sectors. Essential oil plants serve as a primary raw material base for the production of a wide range of medicinal products in the perfumery, cosmetics, and pharmaceutical industries. Similarly, basil (*Ocimum basilicum* L.), which is considered highly valuable due to its rich chemical composition, is widely appreciated in many countries around the world. In particular, in European countries such as Germany, France, Italy, Spain, and Greece, basil is highly valued both for essential oil extraction and as a culinary spice.

Currently, the expansion of the existing assortment of vegetable crops can be achieved through the development of new varieties and the introduction of new and underutilized crops. In recent years, both in foreign countries and in our republic, the cultivation of basil—one of the most valuable vegetable crops—has become common practice in vegetable farms, household plots, parks, and even on the balconies of multi-storey residential buildings. Basil is noteworthy for its ornamental appearance, medicinal properties, and its richness in vitamins and mineral substances essential for human health.

In various regions of the country, numerous local basil varieties are cultivated, and consumer demand for this crop continues to increase. The development of new basil varieties that fully meet the requirements for fresh or dried consumption in local markets and for export purposes is therefore one of the most pressing tasks at present [2]

Based on this, during 2023–2025, studies were conducted at the Surkhandarya Scientific Experimental Station of SPE and KITI to evaluate 56 basil (Ocimum basilicum L.) variety accessions introduced from different regions according to economically important traits, including green mass yield, and to develop initial source material for breeding programs. This article presents data on the green mass productivity of purple- and green-leaved basil variety accessions.

**LITERATURE REVIEW**

At present, there are several constraints limiting the expansion of existing vegetable crop species and their assortment. These include insufficient knowledge of the biology of new or underutilized plant varieties and species, inadequate development of cultivation technologies, and a shortage of high-quality seed and planting material. In recent years, global demand for essential oils has increased significantly. Essential oil–bearing plants are widely distributed worldwide, particularly among aromatic plants cultivated in the Mediterranean and tropical regions, where they are highly valued as important components of traditional medical systems. Essential oils are found in almost all plant organs of aromatic species—flowers, unopened flower buds, shoots, leaves, fruits, seeds, and roots. These oils accumulate in secretory cells, cavities, ducts, and epidermal cells [8].

The family *Lamiaceae* (syn. *Labiatae*) is considered one of the richest plant families in terms of essential oil content. It includes more than 252 genera and over 7,000 species. The *Lamiaceae* family is well known for its medicinally important species, which have been used since ancient times, with many of them widely distributed in the Mediterranean region.

Numerous *Lamiaceae* species have a long history of use as culinary spices and in traditional medicine. For example, oregano, rosemary, sage (*Salvia* spp.), and thyme are typical spices in the Mediterranean region, with oregano being especially widely consumed worldwide, such as in pizza seasoning blends. Essential oils derived from *Lamiaceae* species have been used in the treatment of various diseases, including intestinal disorders and bronchitis [9].

Species of the genus *Ocimum* possess considerable medicinal and economic value due to their wide range of secondary metabolites. The importance of this genus is indisputable and is reflected in the traditional medical systems of ancient China and India (Ayurveda). Research on *Ocimum* species has focused on the diversity of chemotypes, as well as on trends, implications, and strategies aimed at improving essential oil quality and yield. To date, the essential oil composition of *Ocimum* species has been analyzed in more than 50 countries worldwide. Asia represents the region with the greatest diversity of chemotypes, followed by Africa, South America, and Europe. *Ocimum basilicum* L. is the most widely distributed and extensively studied species, followed by *O. gratissimum* L., *O. tenuiflorum* L., *O. canum* Sims, *O. americanum*, and *O. kilimandscharicum* Gürke [10; 16-42].

Currently, the level of provision of green and spice vegetables for the population of our country is only 30–34%, which is significantly below the recommended norm (20.4 kg per person per year). Therefore, expanding the range of underutilized vegetable and green plant species, developing varieties with high market and biochemical quality that are resistant to major biotic and abiotic factors, and conducting their scientifically based evaluation and selection are of great importance.

The main stages of breeding include the development of initial material, comprehensive evaluation of new forms and accessions, selection, multiplication, testing, determination of regional adaptability, and introduction into production through seed propagation. The primary direction of breeding is the creation of high-yielding and high-quality varieties and hybrids characterized by uniform ripening, suitability for mechanical harvesting, and resistance to diseases and pests. For new varieties and hybrids, early maturity, high taste and nutritional qualities, and an increased overall yield potential are also of great importance [7].

The species *Ocimum basilicum* L. includes a number of forms that have long been used in the treatment of various diseases. Within this species, *O. basilicum* plays a particularly important role due to its diverse medicinal properties. This plant is cultivated worldwide as an annual or perennial crop, although it originates from the Asian continent. *O. basilicum* is used not only as a culinary spice but also exhibits a range of pharmacological activities related to the prevention or treatment of cardiovascular diseases, diabetes mellitus, menstrual pain, digestive disorders, neurodegenerative diseases, and cancer.

In addition, it is known for its antioxidant, antimicrobial, and larvicidal activities. Chemical constituents such as linalool, eugenol, 1,8-cineole, methyl eugenol, and anthocyanins are among the compounds responsible for these effects. The traditional uses of this plant are consistent with experimental findings; however, research based on its applications remains limited. This review aims to present the pharmaceutical potential of *Ocimum basilicum* [4].

Basil (*Ocimum basilicum* L.) is one of the most popular and beneficial culinary spices worldwide. The essential oil obtained from basil (basil oil) is produced by steam distillation and has traditionally been used in various fields, including culinary applications, aromatherapy, perfumery, medicinal preparations, pesticides, and food preservatives.

This section places particular emphasis on the application of basil essential oil in the food industry, especially its role in enhancing food flavor, extending shelf life (preservation), and its potential in food processing technologies. Moreover, basil oil contributes to the safe and high-quality preservation of food products due to its natural antioxidant and antimicrobial properties [5].

The great Eastern scholar and philosopher Avicenna (Ibn Sina), in *The Canon of Medicine*, described various types of basil, including fibrous, hairy, mountain, sweet, and garden basil. In the Balkan region, basil has been widely used in folk medicine. Since the period of the Ottoman Empire, pharmacists have recommended the internal use of fresh basil leaf juice for purulent inflammation of the middle ear, as well as its external application for non-healing wounds.

For many years, basil (*Ocimum basilicum* L.) was included in the Russian State Pharmacopoeia, while in France it was recognized as a pharmacopoeial raw material and included in the *Pharmacopée Française*. Currently, basil in Russia is cultivated not only as a spice crop but also as an oil-bearing plant and is widely used in the food and cosmetic industries.

At the same time, basil raw material and its essential oil have been extensively studied by researchers, primarily as antibacterial agents. Studies have shown that *Ocimum basilicum* L. essential oil exhibits high antibacterial activity against *Staphylococcus aureus* strains. Furthermore, these studies confirmed the presence of a synergistic effect when basil essential oil is used in combination with antibiotics [6].

African traditional medicine (ATM) has been transmitted orally from generation to generation, with little or no formal documentation. Nevertheless, validated and safe traditional practices and phytopreparations contribute significantly to primary healthcare goals and ensure access to medical services for all populations.

According to the World Health Organization (WHO), traditional herbal medicines serve as the primary—and often the only—source of healthcare for millions of people worldwide. This is due to their accessibility, acceptability, and affordability. As many phytopreparations are relatively inexpensive, they have become particularly attractive to populations in recent years amid rising medical costs and widespread economic challenges [11, 12–13].

**RESERCH METHODS**

The experiments were conducted based on the methodological guidelines entitled *“Features of Agricultural Technology and Breeding of Basil (Ocimum L.)”*, developed by researchers of the Belarusian State Agricultural Academy T. V. Sachivko, V. N. Bosak, and others (1) (BSAA, Gorki, 2015).

Seeds were sown on February 20 under plastic cover into cassette trays filled with a substrate composed of humus (50%), field soil (40%), and a mixture of sawdust and chopped straw (10%). The substrate was placed into cassettes measuring 8 × 8 cm and 10 × 10 cm, irrigated, and 2–3 seeds were sown in each cell at a depth of 0.2–0.3 cm. Initial seedling emergence in most varieties was observed after 7 days, while uniform emergence occurred after 12 days.



**FIGURE 1**. Seedling maintenance process

The seedlings were transplanted to the open field on April 4. The experiment was conducted without replication. The area of each experimental plot was 3.5 m², with 20 plants per plot. The planting scheme was 70 × 25 cm. As standards, the green-leaved variety *Baxt* and the purple-leaved variety *Rozi* were used, and they were placed after every ten tested varieties.

During the growing season, phenological observations, morpho biological characterization of plants, and yield assessments were carried out. Yield determination, namely the assessment of basil productivity for fresh consumption, was performed at the beginning of flower bud formation. During the vegetation period, harvesting was conducted seven times. Plants were cut at a height of 10 cm above the root collar.

**RESEARCH RESULTS**

For green mass production, basil plants are harvested at the budding stage. When determining the green mass yield of basil variety accessions, leaf yield and stem–shoot mass are measured separately. Variety accessions with a lower proportion of stem and shoot mass are considered more promising, since basil leaves are primarily consumed for food purposes.

Among the studied purple-leaved basil accessions—*Bakinskiy dvorik, Ametist, Filosof, Purpurniy korol No. 1, Drag opal, Aromatniy gulyash, Fioletoviy krupnolistniy, Purpurniy korol No. 4, Vostorg, Fioletoviy blesk, Pyat aromatov, Fioletoviy gigant,* and *Aramis*—leaf yield ranged from 2.1 to 3.3 kg/m², which is 116.6–183.3% higher than that of the standard cultivar *Rozi*.

The remaining purple-leaved accessions showed leaf yields equal to or lower than the standard.  
Table 1 shows that total green mass yield (leaves, stems, and shoots) in the accessions *Fioletoviy gigant, Pyat aromatov, Fioletoviy blesk, Vostorg, Purpurniy korol No. 4, Fioletoviy krupnolistniy, Aromatniy gulyash, Drag opal, Filosof No. 1, Purpurniy korol No. 1, Ametist,* and *Qora rayhon* ranged from 3.5 to 5.4 kg/m². The green mass yield of these accessions exceeded the standard by 9.3–68.7%.

Yields close to that of the *Rozi* standard were recorded for *Bakinskiy dvorik, Ferry–Morse, Ararat,* and *Aramis*, amounting to 1.8 kg/m² or 103.1–105.0% of the standard. In other studied accessions, leaf yield was lower than the standard, ranging from 1.4 to 1.7 kg/m².

Overall, stem and shoot mass accounted for 37.7–46.2% of the total green mass. The highest stem and shoot mass was observed in *Sitrusoviy fresh, Pyat aromatov, Fioletoviy gigant, Purpurniy korol No. 4,* and *Fioletoviy krupnolistniy*, comprising 64.0–75.0% of the total green mass. Such accessions cannot be considered promising initial material for breeding. In contrast, accessions with the highest leaf yield—*Purpurniy korol No. 1* and *Vostorg*—had stem and shoot mass accounting for only 60.5–62.5% relative to leaf yield (Table 1).

Among the studied green-leaved basil variety accessions, only **Eastern Bazaar**, **Aromat limona**, and **Vkus koritsi** showed high leaf yields of **3.6–4.2 kg/m²**, which is **16.1–35.4% higher** than that of the standard variety (Table 2). Yields close to the standard **Baxt** variety were observed in **Ovoshnoy gurman gvozdichniy** and **Doerr Samen koritsi**, amounting to **3.1–3.2 kg/m²**, corresponding to **100.0–103.2%** of the standard.

In the remaining studied varieties, leaf yield was lower than the standard and averaged **1.4 kg/m²**.



**FIGURE 2.** Phenological observations and biometric measurements of green-leaved basil variety accessions under field experimental conditions

Overall, the stem and shoot mass accounted for 16.3–20.4% of the total green mass. The highest proportions of stem and shoot mass were observed in the variety samples Tsitrusoviy fresh, Ovoshnoy laym, Feyerverk vkusa, green-leaved Sada basil, and Bazilik zeleniy, where this component constituted 64.0–75.0% of the total green mass.

**TABLE 1**. Green mass yield of purple-leaved basil variety accessions (kg/m²), (2023–2025).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Variety samples** | **Leaf yield (kg/m²)** | **Relative to standard (%)** | **Stem and shoot mass (kg/m²)** | **Total green mass yield (kg/m²)** | **Relative to standard (%)** |
| 1 | Rozi (standard variety) | 1.8 | 100 | 1.4 | 3.2 | 100 |
| 2 | Purple Giant | 3.3 | 183.3 | 2.1 | 5.4 | 168.7 |
| 3 | Five Aromas | 3.3 | 183.3 | 1.9 | 5.2 | 162.5 |
| 4 | Purple Shine | 2.9 | 161.1 | 1.4 | 4.3 | 134.3 |
| 5 | Delight | 2.4 | 133.3 | 1.9 | 4.3 | 134.3 |
| 6 | Purple King No. 4 | 2.3 | 127.7 | 1.8 | 4.1 | 128.1 |
| 7 | Large-Leaved Purple Basil | 2.3 | 127.7 | 1.6 | 3.9 | 121.8 |
| 8 | Aromatic Goulash | 2.5 | 138.8 | 1.3 | 3.8 | 118.7 |
| 9 | Dark Opal | 2.7 | 150.0 | 1.1 | 3.8 | 118.7 |
| 10 | Philosopher No. 1 | 2.6 | 144.4 | 1.1 | 3.7 | 115.6 |
| 11 | Purple King No. 1 | 2.3 | 127.7 | 1.4 | 3.7 | 115.6 |
| 12 | Amethyst | 2.4 | 133.3 | 1.1 | 3.5 | 109.3 |
| 13 | Black Basil | 1.8 | 100.0 | 1.7 | 3.5 | 109.3 |
| 14 | Baku Courtyard | 2.2 | 122.2 | 1.1 | 3.3 | 103.1 |
| 15 | Aramis | 2.1 | 116.6 | 1.2 | 3.3 | 103.1 |
| 16 | Ferry–Morse | 1.9 | 105.5 | 1.4 | 3.3 | 103.1 |
| 17 | Ararat | 2.3 | 127.7 | 0.9 | 3.2 | 100.0 |
| 18 | Ideal Basil | 1.9 | 105.5 | 1.1 | 3.0 | 93.7 |
| 19 | Vegetable Purple Basil No. 1 | 1.9 | 105.5 | 1.0 | 2.9 | 90.6 |
| 20 | Purple King No. 2 | 1.7 | 94.4 | 1.0 | 2.7 | 90.6 |
| 21 | Vz 003 (breeding line) | 1.8 | 100.0 | 1.0 | 2.8 | 87.5 |
| 22 | Basil (Mix of Best Varieties) | 1.8 | 100.0 | 1.0 | 2.8 | 87.5 |
| 23 | Purple King No. 3 | 1.7 | 94.4 | 1.1 | 2.8 | 84.3 |
| 24 | Back to the Roots | 1.8 | 100.0 | 0.8 | 2.6 | 81.2 |
| 25 | Vegetable Purple Basil | 1.7 | 94.4 | 0.9 | 2.6 | 81.2 |
| 26 | Purple Basil | 1.7 | 94.4 | 0.9 | 2.6 | 81.2 |
| 27 | Vegetable Yerevan Purple Basil | 1.6 | 88.8 | 0.9 | 2.5 | 78.1 |
| 28 | Philosopher No. 2 | 1.6 | 88.8 | 0.9 | 2.5 | 78.1 |
| 29 | Velvet Purple Basil | 1.5 | 83.3 | 1.0 | 2.5 | 78.1 |
| 30 | Jon Basil | 1.6 | 88.8 | 0.8 | 2.4 | 75.0 |
| 31 | Sada Basil | 1.7 | 94.4 | 0.6 | 2.3 | 71.8 |
| 32 | Autoregis Hybrid Variety | 1.4 | 77.7 | 0.9 | 2.3 | 71.8 |
| 33 | Qoraqosh | 1.5 | 83.3 | 0.7 | 2.2 | 68.7 |
| 34 | Vegetable Purple Basil No. 2 | 1.4 | 77.7 | 0.8 | 2.2 | 68.7 |
| 35 | Gulchaman | 1.3 | 72.2 | 0.6 | 1.9 | 59.3 |

In the accessions with the highest leaf yield, namely Vostochnyi bazar and Aromat limona, the stem and shoot mass accounted for 60.5–62.5% relative to leaf yield. The highest total green mass yield was also recorded in Vostochnyi bazar and Aromat limona, reaching 5.7–5.9 kg/m², which is 16.3–20.4% higher than that of the standard variety.

**TABLE 2.** Green Mass Yield of Green-Leaved Basil Variety Samples (kg/m²) (2023–2025)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Variety samples** | **Leaf yield (kg/m²)** | **Relative to standard (%)** | **Stem and shoot mass (kg/m²)** | **Total green mass yield (kg/m²)** | **Relative to standard (%)** |
| 1 | Baxt (standard variety) | 3.1 | 100.0 | 1.8 | 4.9 | 100.0 |
| 2 | Eastern Bazaar | 4.2 | 135.4 | 1.7 | 5.9 | 120.4 |
| 3 | Lemon Aroma | 3.7 | 119.3 | 2.0 | 5.7 | 116.3 |
| 4 | Vegetable Basil with Cinnamon Flavor | 3.6 | 116.1 | 1.3 | 4.9 | 100.0 |
| 5 | Gourmet Vegetable Basil with Clove Flavor | 3.1 | 100.0 | 1.7 | 4.8 | 97.9 |
| 6 | Aromatic Green Vegetable Basil | 2.8 | 96.5 | 1.7 | 4.5 | 91.8 |
| 7 | Clove Basil | 2.6 | 83.8 | 1.8 | 4.4 | 89.7 |
| 8 | Genovese Vegetable Basil | 2.5 | 80.6 | 1.8 | 4.3 | 87.7 |
| 9 | Caramel-Flavored Vegetable Basil | 2.4 | 77.4 | 1.9 | 4.3 | 87.7 |
| 10 | Flavor Fireworks | 2.6 | 83.8 | 1.5 | 4.1 | 83.6 |
| 11 | Velvet Vegetable Basil | 2.5 | 90.3 | 1.6 | 4.1 | 83.6 |
| 12 | Lime-Flavored Vegetable Basil | 2.2 | 71.0 | 1.5 | 3.7 | 75.5 |
| 13 | Thai Queen | 2.3 | 74.2 | 1.2 | 3.5 | 71.4 |
| 14 | Citrus Fresh | 2.1 | 67.7 | 1.4 | 3.5 | 71.4 |
| 15 | American Lemon Vegetable Basil | 2.4 | 77.4 | 1.0 | 3.4 | 69.3 |
| 16 | Large-Leaved Green Basil | 2.1 | 67.7 | 1.3 | 3.4 | 69.3 |
| 17 | Dwarf Vegetable Basil | 2.2 | 70.9 | 1.1 | 3.3 | 67.3 |
| 18 | Balcony Miracle | 2.0 | 64.6 | 0.9 | 2.9 | 62.6 |
| 19 | Do‘rr Samen (commercial cultivar) | 3.2 | 103.2 | 1.9 | 5.1 | 59.2 |
| 20 | Charm | 1.9 | 61.3 | 0.9 | 2.8 | 57.2 |
| 21 | Green Basil | 1.4 | 45.2 | 1.2 | 2.6 | 53.1 |

**OVERALL RESULTS**

In general, the mass of stems and shoots accounted for 16.3–20.4% of the total green mass. The highest stem and shoot mass were observed in the variety samples *Tsitrusoviy fresh*, *Ovoshnoy laym*, *Feyerverk vkusa*, green-leaved *Sada basil*, and *Bazilik zeleniy*, where this component constituted 64.0–75.0% of the total green mass.

In the accessions with the highest leaf yield, namely *Vostochnyi bazar* and *Aromat limona*, the stem and shoot mass relative to leaf yield amounted to 60.5-62.5%. These same accessions also exhibited the highest total green mass yield, reaching 5.7-5.9 kg/m², which is 16.3-20.4% higher than the standard variety.

In green-leaved basil varieties, the average leaf mass was 2.6 kg/m², whereas in purple-leaved varieties it was 2.1 kg/m², indicating a substantially higher leaf productivity in green-leaved basil. The average total green mass yield was 3.2 kg/m² in purple-leaved basil varieties and 4.1 kg/m² in green-leaved basil varieties. These data demonstrate that green-leaved basil varieties are characterized by higher leaf and total green mass productivity.

**CONCLUSIONS**

Thus, for the first time in southern Uzbekistan, 56 basil (*Ocimum basilicum* L.) variety accessions of diverse ecological and geographical origin were evaluated according to economically important traits, including green mass yield. As a result, 11 purple-leaved basil accessions with high values of key agronomic traits were identified as promising for basil breeding in the Republic.

Among them, *Fioletoviy gigant*, *Pyat aromatov smes*, *Fioletoviy blesk*, *Vostorg*, *Purpurniy korol No. 4*, *Fioletoviy krupnolistniy*, *Aromatniy gulyash*, *Drag opal*, *Filosof*, *Purpurniy korol No. 1*, and *Ametist* are recommended as initial breeding material and for cultivation in vegetable farms and private household plots.

Of the 21 studied green-leaved basil accessions, only *Vostochnyi bazar* and *Aromat limona* exceeded the standard variety in green mass yield and are therefore considered promising. Such accessions represent valuable initial material for breeding programs aimed at increasing productivity. Leafiness is one of the key agronomic traits that directly determines plant productivity. Accessions belonging to the medium- and high-leafiness groups are regarded as the most valuable and are recommended for use as initial material in breeding programs.

**REFERENCES**

1. **Sachivko T.V., Bosak V.N., Kovalenko N.A., Supichenko G.N.** Features of agrotechnology and breeding of basil (Ocimum basilicum L.): recommendations. Gorki: Belarusian State Agricultural Academy (BSAA), 2015. https://elib.baa.by/jspui/bitstream/123456789/137/1/ecd2065.pdf
2. Aramov M.X., Jumanov D.T., Nurmamatov F.A. Seed Yield of Violet and Green-Leaf Basil Varieties Grown for Seed Production under Dry Subtropical Conditions // Prospects for the Development of Agriculture in Southern Uzbekistan Based on Innovative Technologies: International Scientific and Practical Conference
3. Termizki - 2025, pp. 283-289. https://agroinnovatsiya.uz/index.php/ag/article/view/205/390
4. Singh P., Kalunke R.M., Giri A.P. Towards comprehension of complex chemical evolution and diversification of terpene and phenylpropanoid pathways in *Ocimum* species. *RSC Adv.* 2015;(5):106886–106904
5. Purushothaman B., Prasannasrinivasan R., Suganthi P.,Ranganathan B., Gimbun J., Shanmugam K. A compreh-ensive review on *Ocimum basilicum. J Nat Remedies.* 2018;(18):71–85. <https://doi.org/> 10.18311/JNR/2018/21324
6. Li Q.X., Chang C.L. Basil (*Ocimum basilicum* L.) oils. In: Preedy VR (ed) Essential oils in food preservation, flavor and safety. Academic Press, Cambridge, MA. 2016. https://doi.org/10.1016/B978-0-12-416641-7.
7. Nesterova N. V., Kravchuk K. I., Ermakova V. Yu., Biryukova N. V., Dobrokhotov D. A. Assessment of the content of biologically active substances in fresh and dried raw materials of camphor basil (Ocimum basilicum L.). Voprosy obespecheniya kachestva lekarstvennykh sredstv = Journal of Pharmaceuticals Quality Assurance Issues, 2020, no. 2, pp. 62–68 (in Russian). https://doi.org/10.34907/jpqai.2020.85.74.009
8. Novikova L.N., Novikov B.N. Study of perspective basil varieties as sources in selection on productivity and precocity in the conditions of south Russia. *Vegetable crops of Russia.* 2019;(3):21-24. (In Russ.) https://doi.org/10.18619/2072- 9146-2019-3-21-24
9. Li B., Cantino P.D., Olmstead R.G., Bramley G.L., Xiang C.L., Ma Z.H., Tan Y.H., Zhang D.X. A large-scale chloroplast phylogeny of the Lamiaceae sheds new light on its subfamilial classification*. Sci Rep.* 2016;(6):1–18. https://doi.org/10.1038/srep34343
10. Pandey A.K., Singh P., Tripathi N.N. Chemistry and bioactivities of essential oils of some Ocimum species: an overview. *Asian Pac. J.* *Trop. Biomed.* 2014;(4):682–694. https://doi.org/10.12980/APJTB.4.2014C77
11. Gurav T.P., Dholakia B.B., Giri A.P. A glance at the chemodiversit of *Ocimum* species: Trends, implications, and strategies for the quality and yield improvement of essential oil. *Phytochem Rev.* 2022;21(3):879-913. <https://doi.org/10.1007/s11101-021-09767-z>
12. D. Jumanov J. Nadjiyev, X. Amirov, A. Karimov, Z. Norsaidova. Selection of early ripe eggplant varieties resistant to root-knotnematodes 2024. E3S Web of Conferences 486, 02035. https://doi.org/10.1051/e3sconf/202448602035
13. D.T. Jumanov, J.B. Koziboev, L.A. Izzatullaev. Agricultural technology and cotton yield IOP Conference Series: Earth and Environmental Science, ETESD-2022 (SKOPUS) https://iopscience.iop.org/issue/1755-1315/1112/1
14. Ali H.M., Nguta J.M., Mapenay I.O., Musila F.M., Omambia V.M., Matara D.N. Ethnopharmacological uses, biological activities, chemistry and toxicological aspects of Ocimum americanum var. *americanum* *(Lamiaceae). J Phytopharmacol.* 2021;(10):56–60. <https://doi.org/10.31254/phyto.2021.10111>
15. Toshbekov, O., Urazov, M., Yermatov, S., & Khamraeva, M. 2023). Yeffisient and yesonomisal yenergy use teshnology in the prosessing of domestis soarse wool fiber. In Ye3S Web of Sonferenses (Vol. 461, p. 01068).
16. [https://doi.org/10.1051/e3sconf/202346101068](https://doi.org/10.1051/e3sconf/202346101068 )
17. Jumaniyozov, K., Urozov, M., Toshbekov, O., Salimova, M., Raximova, K., & Khursandova, B. (2025, November). Enhancement of energy-efficient cleaning equipment. In American Institute of Physics Conference Series (Vol. 3331, No. 1, p. 050007). <https://doi.org/10.1063/5.0307149>
18. Sultonova, F., Toshbekov, O., Urozov, M., Boymurova, N., Mustanova, Z., & Boltaeva, I. (2025, November). Enhancing and evaluating the characteristics of specialized workwear for employees in the electric power supply sector. In American Institute of Physics Conference Series (Vol. 3331, No. 1, p. 050006). <https://doi.org/10.1063/5.0306350>
19. Urishev, B., F. Artikbekova, D. Kuvvatov, F. Nosirov, and U. Kuvatov. 2022. “Trajectory of Sediment Deposition at the Bottom of Water Intake Structures of Pumping Stations.” IOP Conference Series: Materials Science and Engineering, 1030(1). https://doi.org/10.1088/1757-899X/1030/1/012137
20. Nosirov, Fakhriddin, Abdurasul Juraev, Ibragim Khamdamov, and Nurmukhammed Kuvatov. 2023. “Economic Calculation of a Photoelectric Station for Degradation Processes.” AIP Conference Proceedings. https://doi.org/10.1063/5.0130642
21. Nosirov, Fakhriddin, Oleg Glovatsky, Bekzod Khamdamov, and Armen Gazaryan. 2023. “Increasing the Stability of the Supply Hydraulic Structures.” AIP Conference Proceedings. https://doi.org/10.1063/5.0218867
22. Urishev, B., and Fakhriddin Nosirov. 2025. “Hydraulic Energy Storage of Wind Power Plants.” Proceedings of the International Conference on Applied Innovation in IT.
23. Mukhammadiev, M., K. Dzhuraev, and Fakhriddin Nosirov. 2025. “Prospects for the Development of the Use of Pumped Storage Power Plants in the Energy System of the Republic of Uzbekistan.” Proceedings of the International Conference on Applied Innovation in IT.
24. Urishev, B., Fakhriddin Nosirov, and N. Ruzikulova. 2023. “Hydraulic Energy Storage of Wind Power Plants.” E3S Web of Conferences, 383. https://doi.org/10.1051/e3sconf/202338304052
25. Urishev, B., S. Eshev, Fakhriddin Nosirov, and U. Kuvatov. 2024. “A Device for Reducing the Siltation of the Front Chamber of the Pumping Station in Irrigation Systems.” E3S Web of Conferences, 274. https://doi.org/10.1051/e3sconf/202127403001
26. Turabdjanov, S., Sh. Dungboyev, Fakhriddin Nosirov, A. Juraev, and I. Karabaev. 2021. “Application of a Two-Axle Synchronous Generator Excitations in Small Hydropower Engineering and Wind Power Plants.” AIP Conference Proceedings. https://doi.org/10.1063/5.0130649
27. Urishev, B., Fakhriddin Nosirov, Obid Nurmatov, S. Amirov, and D. Urishova. 2021. “Local Energy System Based on Thermal, Photovoltaic, Hydroelectric Stations and Energy Storage System.” AIP Conference Proceedings. https://doi.org/10.1063/5.0306446
28. Nurmatov, Obid, Fakhriddin Nosirov, Khusniddin Shamsutdinov, and Dildora Obidjonova. 2025. “Research on Control Systems for Automatic Excitation Regulation Utilizing Fuzzy Logic Methodology.” AIP Conference Proceedings. <https://doi.org/10.1063/5.0306119>
29. Nurmatov O. Large pumping stations as regulators of power systems modes. Rudenko International Conference “Methodological problems in reliability study of large energy systems” (RSES 2020), *E3S Web of Conferences* 216, 01098(2020) [https://doi.org/10.1051/e3sconf/202021601098](%20https://doi.org/10.1051/e3sconf/202021601098)
30. Nurmatov O., Makhmudov T.: Pulatov N. Сontrol of the excitation system of synchronous motors pumping stations //[AIP Conference Proceedings](https://www.scopus.com/sourceid/26916?origin=resultslist), 3152, 040008 (2024) <https://doi.org/10.1063/5.0218781>
31. [Nurmatov](https://pubs.aip.org/search-results?f_AllAuthors=Obid+Nurmatov) O.,  [Nosirov](https://pubs.aip.org/search-results?f_AllAuthors=Fakhriddin+Nosirov) F.,  [Shamsutdinov](https://pubs.aip.org/search-results?f_AllAuthors=Khusniddin+Shamsutdinov) K.,  [Obidjonova](https://pubs.aip.org/search-results?f_AllAuthors=Dildora+Obidjonova) D.Research on control systems for automatic excitation regulation utilizing fuzzy logic methodology. [AIP Conference Proceedings](https://pubs.aip.org/aip/acp) *AIP Conf. Proc.* 3331, 040081 (2025) <https://doi.org/10.1063/5.0306119>
32. Makhmudov T.: Nurmatov O., Ramatov A.N., Site Selection for Solar Photovoltaic Power Plants Using GIS and Remote Sensing Techniques//[AIP Conference Proceedings](https://www.scopus.com/sourceid/26916?origin=resultslist), 3152, 060002 (2024) <https://doi.org/10.1063/5.0218779>
33. Urishev B., Nosirov F., Nurmatov O., Amirov Sh.,Urishova D. Local energy system based on thermal, photovoltaic, hydroelectric stations and energy storage system *AIP Conf. Proc.* 3331, 070015 (2025) <https://doi.org/10.1063/5.0306446>
34. [Rismukhamedov](https://pubs.aip.org/search-results?f_AllAuthors=Dauletbek+Rismukhamedov) D.,  [Shamsutdinov](https://pubs.aip.org/search-results?f_AllAuthors=Khusniddin+Shamsutdinov) K., [Magdiev](https://pubs.aip.org/search-results?f_AllAuthors=Khayotullo+Magdiev) K., [Peysenov](https://pubs.aip.org/search-results?f_AllAuthors=Moldagali+Peysenov) M.,  [Nurmatov](https://pubs.aip.org/search-results?f_AllAuthors=Obid+Nurmatov) O. Construction of pole-switchable windings for two-speed motors of mechanisms with a stress operating mode[AIP Conference Proceedings](https://pubs.aip.org/aip/acp) *AIP Conf. Proc.* 3331, 040059 (2025) <https://doi.org/10.1063/5.0305963>
35. Rabatuly M., Myrzathan S.A., Toshov J.B., Nasimov J., Khamzaev A. Views on drilling effectiveness and sampling estimation for solid ore minerals. Комплексное Использование Минерального Сырья. №1(336), 2026. <https://doi.org/10.31643/2026/6445.01>
36. Toshov J.B., Rabatuly M., Khaydarov Sh., Kenetayeva A.A., Khamzayev A., Usmonov M., Zheldikbayeva A.T. Methods for Analysis and Improvement of Dynamic Loads on the Steel Wire Rope Holding the Boom of Steel Wire Rope Excavators. Kompleksnoe Ispolzovanie Mineralnogo Syra = Complex Use of Mineral Resources 2026; 339(4):87-96 <https://doi.org/10.31643/2026/6445.43>
37. Zokhidov O.U., Khoshimov O.O., Khalilov Sh.Sh. Experimental analysis of microges installation for existing water flows in industrial plants. III International Conference on Improving Energy Efficiency, Environmental Safety and Sustainable Development in Agriculture (EESTE2023), E3S Web of Conferences. Том 463. Страницы 02023. 2023. <https://doi.org/10.1051/e3sconf/202346302023>
38. Zokhidov O.U., Khoshimov O.O., Sunnatov S.Z. Selection of the type and design of special water turbines based on the nominal parameters of Navoi mine metallurgical combine engineering structures. AIP Conf. Proc. 3331, 050022 (2025). <https://doi.org/10.1063/5.0306554>
39. Khamzaev A.A., Mambetsheripova A., Arislanbek N. Thyristor-based control for high-power and high-voltage synchronous electric drives in ball mill operations/E3S Web Conf. Volume 498, 2024/ III International Conference on Actual Problems of the Energy Complex: Mining, Production, Transmission, Processing and Environmental Protection (ICAPE2024) DOI: <https://doi.org/10.1051/e3sconf/202449801011>
40. Toshov B.R., Khamzaev A.A. Development of Technical Solutions for the Improvement of the Smooth Starting Method of High Voltage and Powerful Asynchronous Motors/AIP Conference Proceedings 2552, 040018 (2023); <https://doi.org/10.1063/5.0116131> Volume 2552, Issue 1; 5 January 2023
41. Toshov B.R., Khamzaev A.A., Sadovnikov M.E., Rakhmatov B., Abdurakhmanov U./ Automation measures for mine faninstallations/ SPIE 12986, Third International Scientific and Practical Symposium on Materials Science and Technology (MST-III 2023), 129860R (19 January 2024); doi: 10.1117/12.3017728. Third International Scientific and Practical Symposium on Materials Science and Technology (MST-III 2023), 2023, Dushanbe, Tajikistan.
42. Toshov B.R., Khamzaev A.A., Namozova Sh.R.Development of a circuit for automatic control of an electric ball mill drive. AIP Conference Proceedings 2552, 040017 (2023) Volume 2552, Issue 1; 5 January 2023.
43. [Toirov, O.](https://www.scopus.com/authid/detail.uri?authorId=58029828400), [Pirmatov, N.](https://www.scopus.com/authid/detail.uri?authorId=6506281501), [Khalbutaeva, A.](https://www.scopus.com/authid/detail.uri?authorId=58561258700), [Jumaeva, D.](https://www.scopus.com/authid/detail.uri?authorId=57729949300), [Khamzaev, A.](https://www.scopus.com/authid/detail.uri?authorId=58947489500) Method of calculation of the magnetic induction of the stator winding of a spiritual synchronous motor. E3S Web of ConferencesЭта ссылка отключена., 2023, 401, 04033