YIELD PERFORMANCE OF DIFFERENT BASIL (*OCIMUM BASILICUM* L.) VARIETIES

Judit Csabai[1] *– Péter József Béres*[1] *– Felicia Veronica Banciu*[2] *– Anzhela Kolesnyk*[3] *–*

Katalin Irinyiné Oláh[1]

[1] Nyíregyházi Egyetem, Műszaki és Agrártudományi Intézet, Agrártudományi és Környezetgazdálkodási Intézeti Tanszék, 4400 Nyíregyháza, Sóstói u. 31/b., e-mail: csabai.judit@nye.hu
[2]Politehnica" University of Timişoara, Integrated Engineering Research Centre
[3]Uzhhorod National University, 3 Narodna Square, Uzhhorod 88000, Ukraine

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Abstract

Basil (*Ocimum basilicum* L.) is one of the most widely cultivated medicinal and aromatic plants, valued for both fresh consumption and dried herb production. The objective of this study was to compare the yield performance of four basil cultivars ('Genovese', 'Red Rubin', 'Lemon-scented', and 'Cinnamon') under irrigated field conditions in 2025. The experiment was conducted at the Demonstration Garden of the University of Nyíregyháza, Hungary. Seedlings were transplanted in June and cultivated under drip irrigation without foliar fertilization. Three harvests were carried out during the growing season, and both fresh and dry herb yields were determined.

Significant differences were observed among the cultivars. 'Cinnamon' basil achieved the highest dry herb yield per plant (61.49 g plant^{-1}) and the greatest estimated dry yield (8,198 kg ha^{-1}), despite being grown on a smaller experimental area due to poor germination. 'Genovese' also exhibited high productivity, producing an estimated dry yield of 4,672 kg ha^{-1}. In contrast, 'Red Rubin' consistently produced the lowest fresh and dry herb yields. All cultivars showed substantial increases in biomass production between successive harvests, and favourable climatic conditions allowed a successful third harvest, resulting in markedly higher cumulative yields than typically reported for two-harvest production systems.

The results demonstrate considerable differences in yield potential among basil cultivars and indicate that 'Cinnamon' and 'Lemon-scented' basil are particularly suitable for dried herb production under irrigated field conditions, while 'Genovese' represents a reliable high-yielding cultivar for commercial cultivation.

Introduction

Ocimum basilicum L. (basil) is an annual medicinal and culinary herb belonging to the family Lamiaceae (Keskinbaş and Sağlıker, 2026). Owing to its aromatic leaves and high essential oil content, basil is one of the most widely cultivated herb species worldwide and is valued by the food, pharmaceutical and cosmetic industries (Bernáth, 1994; Csupor, 2012; Kissvarga, 2024). The crop originated in tropical regions of Asia and Africa and later spread throughout Europe, where it became an important spice and medicinal plant (Bernáth, 1994; Varban et al., 2014; Allen, 2020; Ivanova et al., 2023).

Basil exhibits considerable genetic diversity, resulting in substantial variation in plant morphology, aroma, growth habit and productivity among cultivars. Depending on the variety, plants generally reach a height of 10–40 cm and develop an erect, branched stem with opposite ovate leaves and terminal inflorescences. These morphological differences influence both biomass production and commercial value (Bernáth & Németh, 2007; Bernáth, 2013).

The aerial parts of basil accumulate essential oils responsible for its characteristic aroma. European basil chemotypes are dominated by methyl chavicol and linalool, whereas African and Asian types differ considerably in their essential oil composition (Bernáth, 1994; Csupor, 2012;

Beldean et al., 2020). Consequently, cultivar selection is important not only for essential oil quality but also for fresh and dry herb production.

Successful basil cultivation depends on appropriate agronomic practices, including soil preparation, planting method, irrigation and harvest timing. Basil requires a well-prepared seedbed and is generally established by direct sowing or transplanting. Although direct sowing is common in commercial production, transplanting is frequently applied to ensure uniform plant establishment (Bernáth, 2013). Irrigation plays a key role in maintaining vegetative growth and maximizing biomass production, particularly under warm and dry conditions (Radácsi, 2014).

Under Hungarian conditions, basil can usually be harvested twice during the growing season. The first harvest is recommended at the beginning of flowering, while the second harvest is carried out after regrowth and before the onset of autumn frost. Proper harvest timing is essential to achieve high herb yield and maintain product quality (Bernáth, 1994; Domnanics, 2023; Valkovszki et al., 2023).

Among the commercially cultivated cultivars, 'Genovese' is the most widely grown green-leaved basil because of its high yield and excellent culinary quality, whereas purple-leaved cultivars, such as 'Red Rubin', are primarily valued for their ornamental appearance and distinctive aroma. Differences in morphological characteristics and growth performance among cultivars justify comparative studies under different cultivation technologies and environmental conditions (Bernáth, 2013; Kissvarga, 2024).

Materials and Methods

The field experiment was conducted in 2025 at the Demonstration Garden of the University of Nyíregyháza, Hungary. Four basil (Ocimum basilicum L.) cultivars were evaluated: 'Genovese', 'Red Rubin', 'Lemon-scented', and 'Cinnamon' basil.

Seeds were sown on 7 April 2025 in 66-cell propagation trays, with one seed placed in each cell. Two trays were prepared for each cultivar, resulting in a total of 528 seedlings. The seedlings were grown under greenhouse conditions with adequate light and regular irrigation until transplanting.

The seedlings were transplanted to the experimental field on 10 June 2025 following the installation of a drip irrigation system (Figure 1). Plants were spaced 50 cm between rows and 15 cm within rows, providing a growing area of 750 cm² per plant. The total experimental area was 25.35 m². Due to poor germination, the 'Cinnamon' cultivar occupied only 4.80 m², whereas the remaining cultivars ('Genovese', 'Red Rubin', and 'Lemon-scented') were each grown on 6.85 m².

Figure 1. Basil seedlings after transplanting.

Source: Photograph by the author.

According to the soil analysis, the experimental site was characterized by the following soil properties: pH 7.29, Arany plasticity index (KA) 31, humus content 2.1%, salt content 0.02% (w/w), exchangeable sodium 2.3% (w/w), nitrate–nitrite nitrogen 19.1 mg kg^{-1}, potassium 183 mg kg^{-1}, phosphorus 339 mg kg^{-1}, sulfate 207.3 mg kg^{-1}, magnesium 68.4 mg kg^{-1}, sodium 32.3 mg kg^{-1}, zinc 11.67 mg kg^{-1}, copper 2.28 mg kg^{-1}, and manganese 28.4 mg kg^{-1} (Csabai et al., 2022).

During the experiment, all plants were supplied with water through a drip irrigation system. In contrast to the previous year's experiment, no foliar fertilizer was applied, allowing the comparison of cultivar performance under irrigated field conditions without additional nutrient treatments.

The first harvest was carried out on 10 July 2025 (Figure 2 and 3), followed by the second harvest on 6 August 2025 (Figure 3). Owing to favourable weather conditions during the autumn, a third harvest was also performed on 16 October 2025. Plants were harvested manually using pruning shears, leaving the lower leaves intact to promote regrowth.

Figure 2. The basil cultivars included in the experiment one week before the first harvest.

Source: Photograph by the author.

Figure 3. The first and second harvests of the basil cultivars in 2025.

Source: Photograph by the author.

Fresh herb yield was measured immediately after each harvest using a digital balance. The harvested material was then dried under covered, naturally ventilated greenhouse conditions for approximately two weeks, after which the dry herb yield was determined. Fresh and dry herb yields from the three harvests were used to evaluate and compare the productivity of the four basil cultivars.

Results

During the first harvest, clear differences were observed among the four basil cultivars (Table 1). 'Red Rubin' produced 2,888 g of fresh biomass and 178 g of dry herb, indicating relatively low dry matter accumulation and suggesting that this cultivar is more suitable for fresh market production. 'Genovese' yielded 3,722 g of fresh biomass and 332 g of dry herb. The 'Lemon-scented' cultivar produced 2,766 g fresh and 418 g dry biomass, while the 'Cinnamon' cultivar yielded 2,474 g fresh biomass and 324 g dry herb. Considering its smaller cultivation area, 'Cinnamon' exhibited the highest productivity per unit area.

Table 1. Fresh and dry herb yield of four basil cultivars at the first harvest (10 July 2025), Demonstration Garden of the University of Nyíregyháza.

Cultivar	**Fresh herb yield (g)**	**Dry herb yield (g)**	**Experimental area (m²)**	**Estimated fresh yield (kg ha⁻¹)**	**Estimated dry yield (kg ha⁻¹)**
Red Rubin	2,888	178	6.85	4,216	259
Genovese	3,722	332	6.85	5,433	485
Lemon-scented	2,766	418	6.85	4,037	610
Cinnamon	2,474	324	4.80	5,154	675

The average dry herb yield per plant also differed considerably among cultivars during the first harvest (Table 2). 'Red Rubin' produced only 1.96 g plant^{-1}, whereas 'Genovese' reached 3.65 g plant^{-1}. Higher values were recorded for the aromatic cultivars, with 4.59 g plant^{-1} for 'Lemon-scented' basil and 5.06 g plant^{-1} for 'Cinnamon' basil.

Table 2. Dry herb yield per plant of the evaluated basil cultivars at the first harvest (10 July 2025).

Cultivar	**Total dry herb yield (g)**	**Number of plants**	**Dry herb yield (g plant⁻¹)**
Red Rubin	178	91	1.96
Genovese	332	91	3.65
Lemon-scented	418	91	4.59
Cinnamon	324	64	5.06

The second harvest resulted in substantially higher dry herb yields for all cultivars (Table 3). Dry biomass increased to 245 g in 'Red Rubin', 786 g in 'Genovese', 778 g in the 'Lemon-scented' cultivar, and 961 g in the 'Cinnamon' cultivar. The corresponding yields per plant were 2.69, 8.64, 8.55, and 15.02 g plant^{-1}, respectively (Table 4). Owing to reduced germination, only 64 plants of the 'Cinnamon' cultivar were available for evaluation; nevertheless, this cultivar achieved the highest individual plant productivity.

Table 3. Fresh and dry herb yield of four basil cultivars at the second harvest (25 August 2025), Demonstration Garden of the University of Nyíregyháza.

Cultivar	Fresh herb yield (g)	Dry herb yield (g)	Experimental area (m²)	Estimated fresh yield (kg ha⁻¹)	Estimated dry yield (kg ha⁻¹)
Red Rubin	1,592	245	6.85	2,324	359
Genovese	6,727	786	6.85	9,820	1,147
Lemon-scented	5,616	778	6.85	8,198	1,135
Cinnamon	6,913	961	4.80	14,402	2,002

Table 4. Dry herb yield per plant of the evaluated basil cultivars at the second harvest (25 August 2025).

Cultivar	Total dry herb yield (g)	Number of plants	Dry herb yield (g plant⁻¹)
Red Rubin	245	91	2.69
Genovese	786	91	8.64
Lemon-scented	778	91	8.55
Cinnamon	961	64	15.02

A further increase in yield was observed during the third harvest (Table 5). Dry herb production reached 579 g for 'Red Rubin', 2,083 g for 'Genovese', 2,165 g for the 'Lemon-scented' cultivar, and 2,650 g for the 'Cinnamon' cultivar. Average yields per plant increased to 6.36, 22.86, 23.80, and 41.41 g plant^{-1}, respectively (Table 6), with 'Cinnamon' showing the highest individual plant performance.

Table 5. Fresh and dry herb yield of four basil cultivars at the third harvest (16 October 2025), Demonstration Garden of the University of Nyíregyháza.

Cultivar	Fresh herb yield (g)	Dry herb yield (g)	Experimental area (m²)	Estimated fresh yield (kg ha⁻¹)	Estimated dry yield (kg ha⁻¹)
Red Rubin	3,685	579	6.85	5,379	845
Genovese	12,726	2,083	6.85	18,578	3,054
Lemon-scented	10,302	2,165	6.85	15,039	3,305
Cinnamon	13,821	2,650	4.80	28,793	5,520

Table 6. Dry herb yield per plant of the evaluated basil cultivars at the third harvest (16 October 2025).

Cultivar	Total dry herb yield (g)	Number of plants	Dry herb yield (g plant⁻¹)
Red Rubin	579	91	6.36
Genovese	2,083	91	22.86
Lemon-scented	2,165	91	23.80
Cinnamon	2,650	64	41.41

Across the three harvests, dry herb yield increased progressively in all cultivars. The cumulative dry yields were 802 g for 'Red Rubin', 3,201 g for 'Genovese', 3,361 g for the 'Lemon-scented' cultivar, and 3,935 g for the 'Cinnamon' cultivar. Although the 'Cinnamon' cultivar was grown on a smaller experimental area because of poor germination, it still produced the highest cumulative dry yield, highlighting its excellent productivity and adaptation to the experimental conditions.

The increase in dry herb yield between the second and third harvests was particularly pronounced. Dry yield increased by 136% in 'Red Rubin', 165% in 'Genovese', 178% in the 'Lemon-scented' cultivar, and 176% in the 'Cinnamon' cultivar. These results indicate that favourable weather conditions and continuous drip irrigation promoted vigorous regrowth after successive harvests, allowing biomass production to increase markedly during the final cutting.

The cumulative dry herb yield per plant reached 10.99 g for 'Red Rubin', 35.15 g for 'Genovese', 36.94 g for the 'Lemon-scented' cultivar, and 61.49 g for the 'Cinnamon' cultivar. While 'Red Rubin' remained the lowest-yielding cultivar, 'Genovese' produced more than twice its yield recorded in the 2024 experiment. The two aromatic cultivars, evaluated for the first time in 2025, showed the highest productivity, with 'Cinnamon' basil achieving the best overall performance.

Extrapolation of the plot yields to a hectare basis (Table 7) indicated estimated fresh herb yields of 7.9–12.5 t ha^{-1} for the cultivars evaluated in 2024 after two harvests. In contrast, the three-harvest system used in 2025 resulted in estimated fresh yields of approximately 11.9 t ha^{-1} for 'Red Rubin' and 27–48 t ha^{-1} for 'Genovese', 'Lemon-scented', and 'Cinnamon' basil. These values considerably exceeded those commonly reported in the literature.

Dry matter production followed a similar trend. In 2024, 'Red Rubin' exhibited a relatively low dry matter ratio (6.7–7.2%), corresponding to 698–897 kg ha^{-1} of dry herb, whereas 'Genovese' reached 12.6–15.0% dry matter and 988–1,876 kg ha^{-1}. In 2025, the estimated dry herb yield increased to 1,462 kg ha^{-1} for 'Red Rubin' and 4,672 kg ha^{-1} for 'Genovese'. The aromatic cultivars showed the highest dry matter content (17–18%) and the greatest estimated dry herb yields (4,906–8,198 kg ha^{-1}), indicating excellent suitability for dried herb production.

Table 7. Summary of fresh and dry herb yield, dry matter content, and fresh-to-dry ratio of the evaluated basil cultivars in 2025.

Cultivar	**Estimated fresh yield (kg ha^{-1})**	**Estimated dry yield (kg ha^{-1})**	**Dry matter (%)**	**Fresh:dry ratio**
Red Rubin	11,919	1,462	12.3	8:1
Genovese	33,831	4,672	13.8	7:1
Lemon-scented	27,274	4,906	18.0	6:1
Cinnamon	48,349	8,198	17.0	6:1

Conclusions

The 2025 field experiment demonstrated significant differences in productivity among the four basil cultivars evaluated under irrigated field conditions. The 'Cinnamon' cultivar achieved the highest dry herb yield per plant and the greatest estimated dry yield per hectare despite being cultivated on a smaller experimental area due to poor germination. 'Genovese' also showed excellent performance, producing high fresh and dry herb yields throughout the growing season. In contrast, 'Red Rubin' consistently exhibited the lowest productivity, indicating that this cultivar is less suitable for high-yield dry herb production under the tested conditions.

The favourable weather conditions in 2025 allowed three successful harvests, resulting in substantially higher cumulative yields than those generally reported for two-harvest production systems. Successive harvests promoted vigorous regrowth in all cultivars, particularly in the aromatic cultivars, which showed the highest dry matter content and the most favourable fresh-to-dry biomass ratio.

Overall, the results indicate that 'Cinnamon' and 'Lemon-scented' basil have considerable potential for commercial dried herb production, while 'Genovese' remains a reliable, high-yielding cultivar suitable for both fresh and dried markets. Further multi-year studies under different environmental conditions are recommended to confirm the stability of cultivar performance and to optimize basil production technologies.

Keywords: *Ocimum basilicum* L.; Genovese; Red Rubin; aromatic basil; dry herb yield; cultivar evaluation; field experiment

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