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EVALUATION OF NEW HYBRIDS OF *SALVIA SCLAREA* L., WITH HIGH ESSENTIAL OIL CONTENT

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Abstract. The importance of the species *Salvia sclarea* L., its multiple uses, have stimulated genetic and breeding work to create new hybrids with high essential oil content, resistant to drought, frost and wintering. The biological material used is 33 F_2 hybrids, simple, triple, double, stepped, complex, in the first, and second year of vegetation. The evaluated hybrids are distinguished by high height, long, compact inflorescences, due to the large number of branches (40 – 52) of the first (12.6 – 17.8) and second (22.4 – 35.6) order of the inflorescence. Determination of the essential oil content has shown that 72.7% of the evaluated hybrids have accumulated an essential oil content greater than 1,000%. In the first year of vegetation, the oil content recorded values ranging from 0.924 – 1.992%, and in the second year, 0.745 – 1.761%. 8 F_2 hybrids with very high essential oil content of 1.409–1.761% were selected. The simple hybrid [AP115-11 S_4 x AP 112-11 S_4]F_2 was highlighted for this character, with 1.587% in the first year and 1.761% essential oil recalculated to dry matter, in the second year of vegetation.

***Keywords*: *essential oil, hybrid, the quantitative characters, Salvia sclarea* L.**

INTRODUCTION

Cultivation of the species *Salvia sclarea* L., (Sage) for the production of essential oil is of indisputable importance. Sage oil is highly appreciated in the perfumery industry [2], being highly appreciated for its excellent aroma and quality as a fixative of aromas [5]. Like other essential oils, clary sage oil can be used in medicinal practice as an antiseptic [5; 8]. The oil of this species has been studied in particular for its antioxidant, antibacterial, analgesic, anti-inflammatory action and qualities [8; 9]. The beneficial action of sage oil in the treatment of diabetes mellitus [10] is attested. Good results have been recorded in Moldova in the treatment of osteoarthritis and arterial hypertension [11]. Sage oil is also used in the manufacture of beer instead of hops, as well as in the production of soft drinks. In the production of liqueurs, scherlai oil is part of the "vanilla cream", and in winemaking it is used

to make vermouth and muscat-type wines [14].

The importance of the *S. sclarea* L. species, the multiple uses of the essential oil, has stimulated a series of genetic and breeding research, which aim to create new, more productive genotypes, resistant to drought, frost and wintering, adapted to the pedoclimatic conditions of the Republic of Moldova. Breeding work on the *S. sclarea* L. species has resulted in the creation and evaluation of over 550 genotypes.

MATERIALS AND METHODS

The biological material used in the research is 33 F_2 hybrids, including 13 – simple, 4 – triple, 2 – double, 5 – step and 9 – complex, in the first and second year of vegetation (2023-2024). Sowing was carried out in the second decade of November, 2022. Cultivation technology – usual for sherlai [6, 14].

During the vegetation period, phenological estimates were made and the phases of plant development were determined. In the first year, the vegetation period begins with the emergence of seedlings, in the second year, from full regeneration, followed by the formation of a leaf rosette, the appearance of internodes, budding, the beginning of flowering, mass flowering, technical ripening of seeds. The evaluation of the hybrids was carried out by studying the morphological characters: plant height, inflorescence length, number of first and second degree branches of the inflorescence [6, 15].

The essential oil content was determined by hydrodistillation in Ginsberg apparatus and recalculated to dry matter to avoid errors caused by the difference in humidity (development phase) of the analyzed samples from each genotype [12].

The statistical interpretation of the obtained experimental data was carried out according to the methods in force [13].

RESULTS AND DISCUSSIONS

Genetic and breeding work on *S. sclarea* L. has resulted in the creation of hybrids of various types with valuable quantitative traits and high essential oil content. The appreciation of the species, by evaluating the initial breeding material used to create hybrids and performance varieties, aims to obtain new genotypes with high essential oil content, supported by valuable quantitative traits [3]. The second generation (F_2) hybrid genotypes evaluated and described in this work are distinguished by quantitative traits that directly influence productivity: plant height, inflorescence length, number of inflorescence branches and essential oil content. Simple, triple, double, stepped and complex hybrids of *S. sclarea* L., bloom in the first and second year of vegetation, respectively, are distinguished by high height (103.2 – 136.2 cm), very long inflorescences (65.0 – 70.0 cm), compact, due to the

large number of branches (40.0 – 52.0) of the first order (12.6 – 17.8), and, respectively, of the second order (22.4 – 35.6). As a result of the evaluation of quantitative characters in F_2 hybrids, it was demonstrated that they possess excessive variability. The height of the plants ranged from 103.2 cm to 136.2 cm, depending on the genotype. Plants taller than 124 cm formed the triple hybrid [AP 26-11 S_4 x (M-69 487-82 S_3 x Rubin 115 b 77)F_{11}]F_2 (124.2 cm) and the stepped hybrid [(0-32 S_3 x 0-41 S_5)F_{11} x (0-42 x Rubin)F_1 x S-786)F_9]F_2 (124.5 cm) (Figure 1, n. 16, 24). In the genotype [M-69 489 S_{12} x [(S-1122 60 S_{10} x (M-69 10 S_4 x L-15)F_9)]F_5]F_2 this index constituted 128.9 cm, two other step hybrids [(0-57 S_5 x 0-20 S_5)F_{11} x (0-42 x Rubin)F_1 x S-786)F_9]F_2 and [(S-1122 528 S_3 x H-453)F_1 x S-1122 390 S_4)F_{11} x AP 11-11 S_4]F_2 were practically at the same level and the plant height was 130.4 (Figure 1, n. 20, 25, 21). The highest index for the "plant height" trait was attested to the simple hybrid [AP 115-11 S_4 x AP 112-11 S_4]F_2 – 136.2 cm (Figure 1, n. 10).

Another quantitative character, which influences productivity, "inflorescence length", varied from 52.0 to 69.9cm in different hybrids (Figure 1). With vigorous inflorescences, two simple hybrids [NC 60-11 S_4 x AP 115-11 S_4]F_2 (65.9 cm), [AP 115-11 S_4 x AP 112-11 S_4]F_2 (68.9 cm), a trilinear hybrid [AP 26-11 S_4 x (M-69 487-82 S_3 x Rubin 115 b 77)F_{11}]F_2 (66.6 cm), as well as four stepwise hybrid combinations – [AP 70-11 S_4 x (0-42 x Rubin)F_1 x S-786)B_7]F_2 (65.0 cm), [M-69 489 S_{12} x [(S-1122 60 S_{10} x (M-69 10 S_4 x L-15)F_9)]F_5]F_2 (65.2 cm), [(0-57 S_5 x 0-20 S_5)F_{11} x (0-42 x Rubin)F_1 x S-786)F_9]F_2 (68.3 cm) and [(S-1122 528 S_3 x H-453)F_1 x S-1122 390 S_4)F_{11} x AP 11-11 S_4]F_2, (69.9 cm) (Figure 1, n. 9, 10, 16, 26, 20, 25, 21).

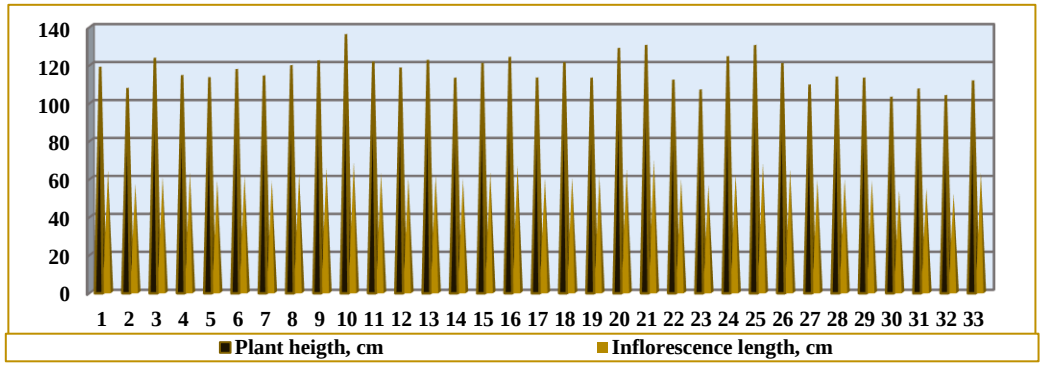


Figure 1. Quantitative characteristics of the plant in the F_2 hybrids of *S sclarea* L.

Vigorous inflorescences with a large number of branches are important characters for sage. Both the first and second degree branching of the inflorescence

influence the production of raw material and the essential oil content, because the oil glands in *S. sclarea* L. are exogenous, located on the epidermis of the inflorescence branches and the conger eel sepals of the flowers [3]. Thus, the number of first-degree branches of the inflorescence in the evaluated hybrids varied from 12.6 in the complex hybrid [M-69 655 S_9 x (M-69 429-82 S_3 x 0-40 S_5)F_7]F_6] x [(S-3 x H_2S_3)F_2 x 0-32 S_3)F_8 x NC 11-11 S_2]F_2]F_2, to 17.8 branches in the simple hybrid [NC 60-11 S_4 x AP 115-11 S_4]F_2 (Figure 2, n. 32, 9). The inflorescences of the evaluated hybrids formed a number of second-degree branches, which ranged from 22.4 to 35.6, indices recorded by the simple hybrids [AP 32-11 S_4 x AP 26-11 S_4]F_2 and [NC 77-11 S_4 x V-24-86 844 S_{12}]F_2 (Figure 2, n. 12, 4). The simple hybrid [NC 60-11 S_4 x AP 115-11 S_4]F_2 and the complex hybrid [M-69 655 S_9 x (M-69 429-82 S_3 x 0-40 S_5)F_7]F_6 x [NC 34 -11S_2 x (S-1122 528 S_3 x S.s.Tien-Shan/sud))F_6]F_2]F_2 stood out with a very high number in the character "number of branches" of degree I and II of the inflorescence, which in sum constituted 49.0 and 49.2 branches respectively (Figure 2, n. 9, 31). Exceptional in this character were the stepped hybrid combination [(0-32 S_3 x 0-41 S_5)F_{11} x (0-42 x Rubin)F_1 x S-786)F_9]F_2 and the simple hybrid [NC 77-11 S_4 x V-24-86 844 S_{12}]F_2, with (16.4-34.6) 51 and (16.6-35.6) 52.2 branches, respectively (Figure 2, n. 24, 4).

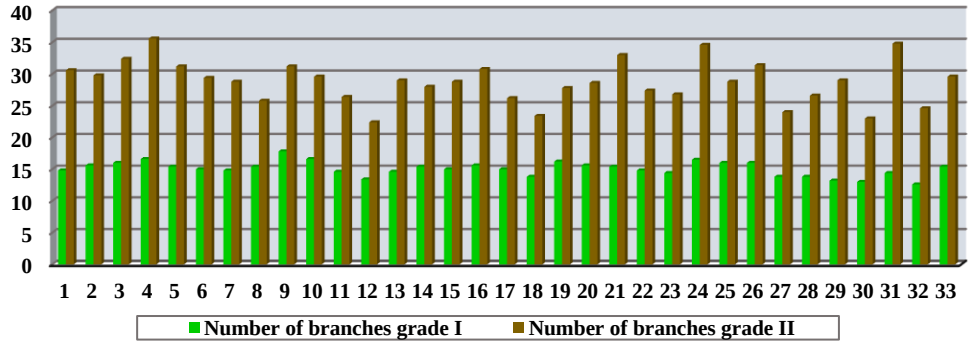


Figure 2. Number of first and second degree branches of the inflorescence in the F_2 hybrids of *Salvia Sclarea*

One of the priority objectives of *S. sclarea* L. is the creation of varieties, hybrids of different types, with high content of essential oil of superior quality [6]. The characteristics of the inflorescence, as well as the large number of branches of the first and second order, always ensure the accumulation of a high content of essential oil. The determination of the essential oil content, recalculated to the dry matter, demonstrated that some hybrids synthesized and accumulated a more modest essential oil content, of 0.745 – 0.997%, but the vast majority of them accumulated an essential oil content higher than 1,000%. Thus, in the first year of

vegetation, the essential oil content in the evaluated hybrids recorded values ranging between 0.924 – 1.992% (dry matter), and in the second year, 0.745 – 1.761% (dry matter) in different hybrids. As a result of the evaluation of F_2 hybrids of *S. sclarea* L., it was demonstrated that 8 genotypes with very high essential oil content were identified in the second year of vegetation. Thus, the simple hybrid [NC 77-11 S_4 x AP 89-11 S_4]F_2, the trilinear hybrid (0-57 S_5 x 0-20 S_5)F_{11} x AP 115-11 S_4]F_2 and the complex hybrid [(M-69 655 S_9 x (S-1122 528 S_3 x (Rubin x S-786) F_1 x (0-33 S_3 x L-15)F_7)]F_6 x [M-69 655 S_9 x (K-36 x0-41)F_2 x 0-19)B_5]F_5]F_2, accumulated 1,409; 1,440 and 1,443% essential oil recalculated to dry matter, respectively (Figure 3. n. 5, 17, 29). The simple hybrid [AP 113-11 S_4 x M-69 489 S_{14}]F_2 as well as the triple hybrid combination were at a level and the essential oil content constituted 1.483% (dry matter) (Figure 3. n. 3, 14). We note that very high oil content was attested to 2 simple hybrids [NC 60-11 S_4 x AP 115-11 S_4]F_2 and [AP 26-11 S_4 x AP 115-11 S_4]F_2 and this important index constituted 1.548 and 1.665% (dry matter) respectively (Figure 3. n. 9, 2). Exceptional in this character was the hybrid [AP 115-11 S_4 x AP 112-11 S_4]F_2, with a content of 1,587% in the first year and 1,761% essential oil recalculated to dry matter, in the second year of vegetation (Figure 3. n. 10).

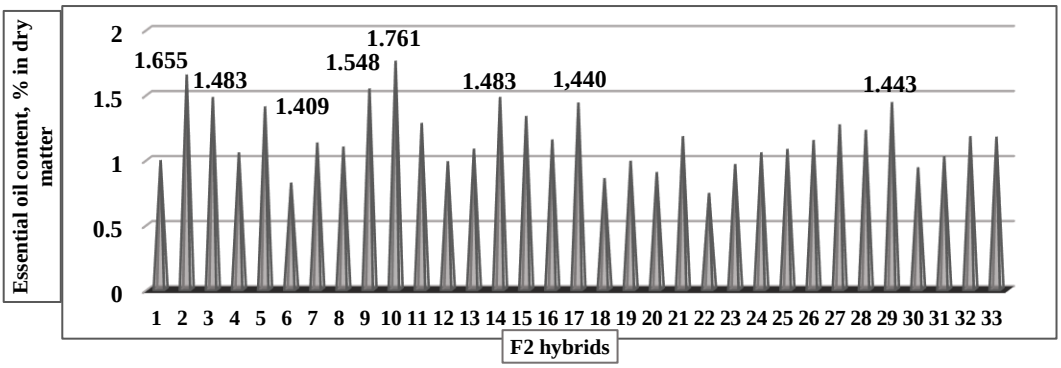


Figure 3. Essential oil content in F_2 hybrids of *Salvia Sclarea* in the 2nd year of vegetation

As a result of the research, it was found that 72.7% of the F_2 hybrids accumulated essential oil greater than 1.0% (dry matter), and in 24.2% of the genotypes evaluated, the essential oil content was very high and amounted to 1.4 – 1.7% (dry matter).

CONCLUSIONS

33 simple, triple, double, stepped and complex F_2 hybrids of *S. sclarea* L. were evaluated. The evaluated hybrids possess valuable quantitative characters:

high height (103.2 – 136.2 cm), very long inflorescences (65 – 69 cm), compact, due to the large number of branches (40 – 52) of the first order (12.6 – 17.8), and, respectively, of the second order (22.4 – 35.6).

For the character "inflorescence length", the step hybrids [(0-57 S_5 x 0-20 S_5)F_{11} x (0-42 x Rubin)F_1 x S-786)F_9]F_2 (68.3 cm) and [(S-1122 528 S_3 x H-453)F_1 x S-1122 390 S_4)F_{11} x AP 11-11 S_4]F_2, (69.9 cm) were highlighted. The highest number of I and II degree branches of the inflorescence was demonstrated by the step hybrid combination [(0-32 S_3 x 0-41 S_5) F11 x (0-42 x Rubin) F_1 x S-786)F_9]F_2 (51) and the simple hybrid [NC 77-11 S_4 x V-24-86 844 S_{12}]F_2 (52.2).

It was found that 72.7% of the evaluated hybrids accumulated essential oil greater than 1.0% (dry matter). As a result of the evaluation, 8 hybrids with very high essential oil content were selected: 1,409 – 1,761% (dry matter). The simple hybrid [AP 115-11 S_4 x AP 112-11 S_4]F_2 was highlighted, with 1,587% in the first year of vegetation and 1,761% essential oil recalculated to dry matter, in the second year of vegetation.

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