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FLOWER AND FLOWERING PECULIARITIES OF SOME *SALVIA* SPECIES CULTIVATED IN ROMANIA

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Abstract

This study addresses the morphological peculiarities of the flower and flowering in several Salvia species, a genus of significant biological, ornamental, and utilitarian importance. The genus Salvia belongs to the family Lamiaceae, which represents a plant group with remarkable morphological diversity, characterized by its bilabiate flowers and the unique staminal lever mechanism, adapted to various specific modes of pollination. The morphological and functional analysis of the flower in the Salvia species under investigation (Salvia officinalis, Salvia splendens, Salvia farinacea, and Salvia coccinea, cultivated in Romania) aims to identify specific traits by relating them to the general floral plan of the genus Salvia and, respectively, the family to which it belongs, Lamiaceae. This paper integrates data from both Romanian and international specialized literature, which will subsequently be complemented by original experimental results. These results focus on the elements of the floral structure (bracts, calyx, corolla, androecium, gynoecium, fruit) and the phenology of flowering.

Key words: *Lamiaceae, Salvia, flower, androecium, ornamental.*

INTRODUCTION

The importance of flowers in contemporary society is undeniable, as they represent a constant presence in everyday human life, both in public and private spaces, and occupy a special place in the arts - painting, poetry, and music. In some countries, the appreciation of flowers is reflected in their elevation to the status of national symbols, such as the chrysanthemum in Japan, the tulip in the Netherlands, and the rose in the United States of America (Toma Fl., 2009).

The diversity of floral morphology and function can be explained as an adaptation of plants to pollinators and to different reproductive strategies (Han-Wen Xiao et al., 2023).

The family *Lamiaceae*, belonging to the angiosperms (*Magnoliophyta*), is distinguished by the morphological and functional coherence of its flowers, which represent a classical model for studying evolutionary adaptations associated with entomophilous pollination.

Among the representative genera of the family *Lamiaceae*, *Salvia* holds a central position due to its high species diversity and the morphological innovations that have contributed to the adaptive radiation of the group (Claßen-Bockhoff, 2007; Walker & Sytsma, 2007).

The present study aims to provide a comparative characterization of floral structure and the flowering process in four representative species of the genus *Salvia* cultivated under field conditions, namely *Salvia officinalis*, *Salvia splendens*, *Salvia farinacea*, and *Salvia coccinea*.

Salvia species are widely used in the design of flower beds, roundabouts, and floral patches, and are also cultivated as potted plants and in planters for balconies and terraces (Toma Fl., 2003).

Owing to their drought tolerance, *Salvia* plants may represent ideal ornamental species for use in arid and semi-arid areas, particularly within the context of xeriscaping - a landscaping or gardening approach that reduces or eliminates the need for irrigation. Native plant species are especially suitable for xeriscaping, as they exhibit low water requirements, excellent adaptability to local soil and climatic conditions, high ornamental value, and contribute to the preservation of landscape character. Furthermore, *Salvia* species may also prove valuable for use on urban green roofs (Papafotiou et al., 2021).

Through the analysis and synthesis of data from the specialized literature, combined with the integration of original results obtained from experimental research, this study seeks to highlight the morpho-functional traits that support the adaptability of *Salvia* flowers to environmental factors specific to south-eastern Romania. This perspective contributes to a better understanding of the relationships between floral structure, pollination ecology, and ornamental value, while also providing arguments for the use of the genus *Salvia* in the improvement and diversification of ornamental and medicinal crops.

Floral Structure in *Lamiaceae*

The flower, as a functional unit of sexual reproduction, balances the reproductive requirements of the species by achieving a compromise between pollen presentation as a floral attractant and pollen economy for successful reproduction (Claßen-Bockhoff, 2007).

A complete flower is composed of the following elements: pedicel, receptacle, floral envelope (perianth), androecium, and gynoecium (Săvulescu, 2009).

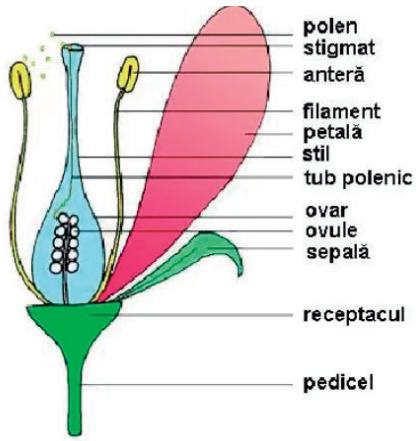

Figure 1. Morphology of a Complete Flower, according to Săvulescu, 2009
Source:https://www.scribd.com/doc/236016038/Elena-Savulescu-Botanica-Morfologia-I#page=90

The family *Lamiaceae*, also known as *Labiatae*, represents one of the largest and most extensively studied families of dicotyledons, many of whose members are recognized for their medicinal, aromatic, and ornamental importance. The floral architecture of *Lamiaceae* has been regarded by several authors (Claßen-Bockhoff, 2007; Rather et al., 2018) as a representative example of the evolutionary adaptation of floral morphology to specialized entomophilous pollination.

This family, comprising over 7,000 species and approximately 230 genera (Harley et al., 2004), includes predominantly aromatic, herbaceous plants, and more rarely woody forms represented by shrubs and subshrubs, characterized by quadrangular stems and opposite leaves lacking stipules. The inflorescences are typically verticillate, a diagnostic feature of the family; the flowers are zygomorphic, hermaphroditic, and arranged in cymose inflorescences. The calyx is gamosepalous, frequently bilabiate, while the corolla is gamopetalous, bilabiate, and associated with a double perianth. The androecium is didynamous, consisting of four stamens - two with longer filaments and two with shorter filaments - inserted on the corolla tube. The gynoecium is bicarpellate and syncarpous, with a superior ovary, and the fruit is a schizocarpic mericarp, typically a tetrachene. Members of the family are characterized by the presence of glandular hairs that secrete essential oils (Toma, 2003; Pădure, 2006; Ciocârlan, 2009; Georgescu, 2014).

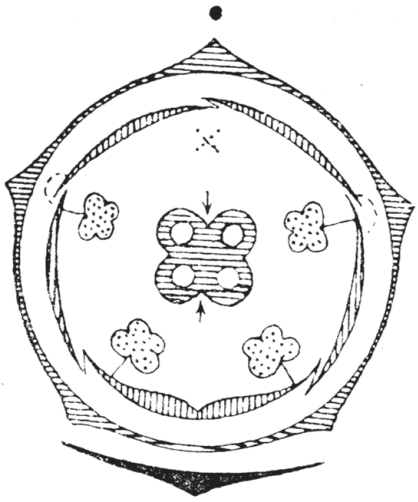

Figure 2. Floral Morphology in *Lamiaceae* (ex.: *Lamium*). Public domain, after Strasburger et al., 1900
Source:https://commons.wikimedia.org/wiki/File%3ALamium_flowerdiagram.png?utm

The corolla is gamopetalous and bilabiate, organized into a concave upper lip (formed by two fused petals) and a trilobed lower lip (formed by three connate petals), a fundamental morphological adaptation for guiding pollinators (Claßen-Bockhoff, 2007).
The androecium typically consists of four didynamous stamens (two longer and two shorter), inserted on the corolla; however, in numerous genera, a reduction in stamen number to two functional stamens is observed, a phenomenon interpreted as an evolutionary innovation (Walker & Sytsma, 2007).
The gynoecium is bicarpellate and syncarpous, but appears four-lobed due to the formation of four false ovary locules. The gynobasic style and bifid stigma are diagnostic features of the family (Pădure, 2006).
At the base of the ovary there is a well-developed annular nectary, described by Konarska et al. (2022) as a secretory tissue rich in epithelial cells containing sugar-filled vacuoles.
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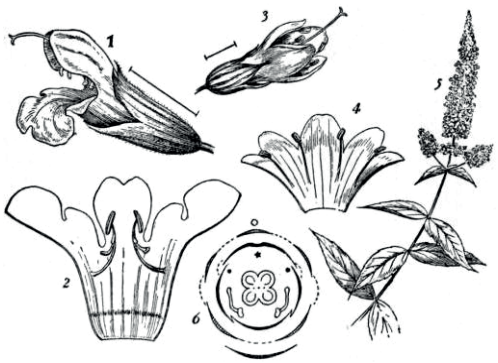

Figure 3. Floral diagram and floral details in *Salvia officinalis* (Encyclopaedia Britannica, 1911, public domain)
Source:https://commons.wikimedia.org/wiki/File%3AEB1911_-_Labiatae_-_Fig._2.%E2%80%941%2C_Flower_of_Sage_%28Salvia_officinalis%29.jpg?utm

Particular Features of the Flower in the Genus *Salvia*

Belonging to the family *Lamiaceae*, the genus *Salvia* comprises over 700 annual and perennial species, herbaceous or suffrutescent, characterized by hollow, quadrangular stems, and originating from warm and temperate regions of the world (Toma Fl., 2009).
In the following figure, a schematic longitudinal section of a "typical" *Salvia* flower is presented, illustrating the functioning of the staminal lever mechanism (Reith et al., 2006).

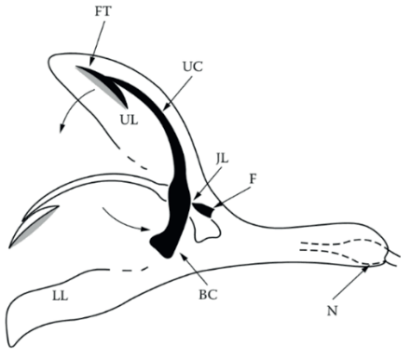

Figure 4. Schematic longitudinal section of a "typical" *Salvia* flower showing the functioning of the staminal lever mechanism. For clarity, the style and second stamen are omitted. Black: staminal lever arm in unreleased position, white: in released position. UL: upper lip of the flower, LL: lower lip of the flower, F: filament, JL: jointlike ligament, UC: upper part of the elongated connective with the fertile theca (FT), BC: basal, sterile part of the connective, N: nectar glands. (Modified from Speck, T. et al., in Deep Morphology: Toward a Renaissance of Morphology in Plant Systematics, T. Stuessey, T., F. Hörandl, F., and Mayer, V., Eds., Koeltz, Königstein, 2003, p. 241)
Source:http://www.anthonyherrel.fr/publications/Herrel%20et%20al%202006%20Ecology%20&%20Biomechanics.pdf

The androecium, composed of two fertile stamens, employs a mobile connective that functions as a lever. Upon contact with an insect, the connective arm rotates the anther, depositing pollen onto the dorsal surface of the pollinator (Claßen-Bockhoff et al., 2004). In subsequent flowers, the stigma collects pollen from the same body region, ensuring efficient nototribic pollination (Walker & Sytsma, 2007).
The gynoecium is four-lobed, with a gynobasic style and a bifid stigma. The annular nectary located at the base of the ovary secretes nectar rich in sugars and volatile oils (Konarska et al., 2022), which attract pollinators.
Corolla shape and size vary among species: *Salvia officinalis* and *Salvia nemorosa* exhibit violet corollas with short tubes, adapted to bee pollination, whereas *Salvia splendens* has a red corolla and *Salvia coccinea* presents a pinkish-

milky tubular corolla, both adapted to bird pollination (Kriebel et al., 2020).
The genus *Salvia* includes species that possess only two stamens, each with a single fertile theca (Georgescu, 2014).
With regard to the *Salvia* species that constitute the subject of the present research, the specialized literature has identified several approaches addressing the aspects of interest, as follows:

Salvia splendens
The plant is native to Brazil, where it is perennial and locally used as a medicinal and culinary plant. It does not tolerate freezing temperatures but can be grown as an annual in colder climates (Clebsch et al., 2003). Under the climatic conditions of Romania, it is cultivated as an annual species, flowering from June until late autumn, when the first frosts occur (Toma Fl., 2009).
Salvia splendens is an attractive and valuable ornamental plant, widely used in flower beds and frequently employed for decorating parks and urban green spaces. It is suitable for borders, rock gardens, and container cultivation. The species flowers profusely and is well adapted for large-scale plantings in public areas. It effectively fills empty spaces and is often used in combination with other summer flowers. It displays a particularly striking appearance when associated with blue lobelia, purple-flowered ornamental sunflower cultivars, or yellow marigolds. *Salvia splendens* grows best on sandy-loam, fertile soils that are well cultivated and moderately moist (Błażewicz-Woźniak et al., 2012).
The plant is branched from the base and exhibits a pyramidal growth habit, reaching heights of 25-50 cm. The stem and shoots are intensely green, with violet to dark purplish hues at the base. Leaves are petiolate, oval to elliptic, with crenate margins and an acuminate apex, arranged oppositely along the stem. The flowers are bilabiate, predominantly red in colour, and arranged in terminal spiciform racemes. The flowers persist for a relatively short period; however, after their abscission, the decorative effect is maintained by the persistent, cup-shaped calyx, divided apically into three teeth and coloured in vivid shades of red, pink, white, or violet. Flowering occurs from June until late autumn, coinciding with the onset of frost (Toma Fl., 2009).



Figure 5. *Salvia splendens* (SCARLET SAGE) botanical illustration (Favourite flowers of garden and greenhouse /by Edward Step, public domain) Source:https://commons.wikimedia.org/wiki /File:Favourite_flowers_of_garden_and_greenhouse_ (10593932836).jpg

Salvia splendens, characterized by a bright red calyx and corolla, is cultivated as an ornamental plant (Munteanu et al., 2007; Munteanu et al., 2016).

Salvia officinalis
Also known locally as *jaleș* or *garden sage*, is a perennial subshrub or shrub native to the eastern Mediterranean region, characterized by a lignified rhizome that is branched within the soil and bears numerous roots. The stem reaches 30-80 cm in height, is strongly branched, lignified at the base, and quadrangular in its upper portion. The plant has a characteristic aroma, while the leaves exhibit a bitter, aromatic taste. *Salvia officinalis* is cultivated as an ornamental, aromatic, and medicinal plant (Muntean, 1990; Munteanu et al., 2007; Georgescu, 2014).
It is a perennial subshrub with a well-developed, highly branched root system, extending both vertically and horizontally, a feature that confers

increased resistance to water deficit. The stem is covered with fine, greyish-white, appressed hairs; the leaves are elongate-ovate to lanceolate, with prominent reticulate venation on the abaxial surface. The flowers are blue-violet in colour and are arranged in verticillasters with a spiciform appearance. Flowering occurs in June-July. The fruits are dark brown to blackish tetrachenes, ovoid in shape, grouped in fours at the base of the calyx (Luchian, 2017).



Figure 6. *Salvia officinalis* (JALEŞ) - botanical illustration (List of Koehler Images /by Walther Otto Műller, public domein)
Source:https://commons.wikimedia.org/wiki/File:Salvia_officinalis_-_K%C3%B6hler%E2%80%93s_Medizinal-Pflanzen-126.jpg

Salvia coccinea

The plant grows as a compact shrub, reaching a height of 60-70 cm, and is entirely covered with small, grey hairs. The leaves are ovate-cordate, dark green on the adaxial surface and greyish-green on the abaxial surface. The flowers are small, bright red in colour, and arranged in spaced verticillasters forming terminal spikes. The calyx is green, cup-shaped, and divided apically into three short teeth. Flowering occurs from July until late autumn (Toma Fl., 2009).
This species is an excellent ornamental plant for public green areas and private gardens and exhibits moderate tolerance to salinity (Grzeszczuk et al., 2018).



Figure 7. *Salvia coccinea* Buchoz – herbarium (T. F. Cheeseman/Place of creation-Cook Islands. Collection Auckland War Memorial Museum Tamaki Paega Hira)
Source:https://commons.wikimedia.org/wiki/File:Salvia_coccinea_Buchoz_(AM_AK94432).jpg

Salvia farinacea



Figure 8. *Salvia farinacea* – botanical illustration (PLATE 119 ADDISONIA,
The New York Botanikal Garden - 1918)
Source:https://commons.wikimedia.org/wiki/File:Addisonia__colored_illustrations_and_popular_descriptions_of_plants_(1916-(1964))_(16771647711).jpg

Salvia farinacea reaches a height of 50-60 cm and is strongly branched from the base. The

leaves are ovate-lanceolate and borne on long petioles. Both the flowers and the calyx are small, arranged in verticillasters within terminal spiciform inflorescences, and are covered with a thin, farinose, waxy layer. The flowers, like the calyx, are coloured in various shades of white, blue, or violet. Flowering occurs from July until late autumn, extending into October–November (Toma Fl., 2009).

According to the description provided by George V. Nash in *Addisonia – Colored Illustrations and Popular Descriptions of Plants*, vol. 3 (1918), *Salvia farinacea* is a perennial species whose self-sown seeds germinate readily in spring, producing an abundance of seedlings that require vigorous thinning.

MATERIALS AND METHODS

The research was conducted on four species of the genus *Salvia*. Considering, on the one hand, the high species diversity within the genus *Salvia* and, on the other hand, the specific characteristics of its members, the study was designed so that the selected species would cover as much as possible of the existing range with respect to the duration of the biological cycle, namely annual, biennial, and perennial plants (Toma Fl., 2009).

Accordingly, perennial and annual species were selected for the present study, as follows:

– *Salvia officinalis* - a perennial plant with underground organs resistant to low temperatures, capable of flowering and fruiting every year (Draghia L., 2011). Also referred to as perennial (*vivacious*) plants, these species have a biological cycle extending over several years and are characterized by the presence of a dormancy period induced by adverse environmental conditions in their area of origin (Toma Fl., 2009).

– *Salvia splendens, Salvia coccinea, and Salvia farinacea* – annual plants in which the entire biological cycle is completed within a single growing season (Draghia L., 2011). These species are characterized by rapid growth and highly decorative inflorescences. In particular, *Salvia splendens* is well recognized for its prominent role in ornamental plantings, flowering continuously throughout the summer and until late autumn (Toma Fl., 2009).

The experimental field was established in Brănești, Romania, located in the south-eastern region of the country. Soil preparation included ploughing to a depth of 25-30 cm, followed by the preparation of planting plots.

The species were cultivated in plots with an area of 1.2 m² (1.2 m in length × 1.0 m in width), with a spacing of 0.5 m between rows and between plants within the row. The plots were arranged linearly, forming a Latin rectangle design, with each variant replicated three times and arranged in a randomized layout.

To ensure planting material, seeds were procured from certified suppliers of planting material, namely *Salvia splendens* cv. Blaze of Fire, *Salvia farinacea* cv. Blue Victoria, *Salvia coccinea* cv. Summer Jewel Pink, and *Salvia officinalis*.

Seed germination was carried out in the greenhouses of the Faculty of Horticulture within the University of Agronomic Sciences and Veterinary Medicine of Bucharest. Seedlings were transplanted approximately three weeks after emergence; at the same time, the apical growth tip was pinched in order to promote improved plant branching. Transplanting into the open field was performed in May, after the risk of late frosts had passed.

Within the field maintenance technology applied to the experimental plot, particular attention was given to irrigation, given its major importance for plant growth and development. Immediately after transplanting, individual watering of the seedlings was carried out. Subsequently, irrigation during the growing season was performed by furrows, as required, taking into account plant water requirements in relation to their phenological stage, environmental factors, and the period of the year (Toma Fl., 2009).

In addition, maintenance of the experimental field involved weed control and soil loosening; for this purpose, specific practices such as hoeing and manual weeding were applied whenever necessary.

Plant material was collected at the full flowering stage and consisted of a sample of 10 flowers from each studied species, harvested from the experimental field under similar conditions of light exposure, moisture, and soil characteristics.

Morphological analyses focused on the identification of the distinctive characteristics of the flower (calyx, corolla, androecium, gynoecium, fruit), the inflorescence, and the flowering period. Standard macro and microscopic description methods were employed, with morphological observations and measurements performed in millimetres (mm), as well as microphotographs taken using a light microscope. Flower dissections were carried out manually using a blade and forceps.

RESULTS

Salvia splendens

The inflorescence of *Salvia splendens* is a pyramidal spike composed of 15-22 intensely red flowers.

The bracts are modified leaves, intensely red in colour, positioned at the base of the floral peduncle. They have an average length of 7.5 mm, with entire margins and an acuminate apex. The epidermis contains anthocyanin pigments responsible for the intense coloration, conferring a decorative appearance that persists even after corolla wilting.



Figure 9. Inflorescence and flower in *Salvia splendens*
Source: original

The *calyx* is tubular, intensely red in colour, with an average length of 19 mm and a basal diameter of 4-5 mm. It is composed of five fused sepals ending in acute lobes. Its role is to protect the corolla and internal organs during the bud stage, and after fertilization it remains attached to the peduncle, enclosing the fruit.

The *corolla* has an average length of 37.3 mm and is formed of connate petals arranged in a tubular, bilabiate structure. The upper lip, measuring approximately 37.2 mm in length, is curved and covers the androecium and gynoecium, while the lower lip is about 30.2 mm long, trilobed, and serves as a landing platform for pollinators. The intense red coloration is due to anthocyanin accumulation, and the elongated tubular shape represents an adaptation to entomophilous pollination.

Tabel 1. Morphometric data (biometric-morphological) *Salvia splendens*

Floral elements	M.S. (mm)	R.V. (mm)	Morphological observations
Bracts	7,5	7-8	Intensely red in color, oval in shape, and prominent at the base of the peduncle
Sepal calyx	19	18-20	Tubular, persistent, dark red, composed of five fused sepals
Corolla – petals upper lip (labium superius) lower lip (labium inferius)	37,2	36-39	Tubular, bilabiate, intensely red, with a curved upper lip
Androecium – stamens – filament	17	16-18	Two fertile stamens, with red filaments and transversely oriented anthers
Androecium – stamens – anthers	3	3	The anthers are basifixed, with distinct thecae
Gynoecium – style and stigma	31,2	29-32	Style filiform; stigma bifid
Gynoecium – ovary	4	4	Superior, tetralocular ovary
Fruit (nutlets)	2	2	Four small, oval, black, glossy nutlets

M.S. - Medium size;
R.V. - Range of variation.

The *androecium* consists of two fertile stamens positioned beneath the upper lip of the corolla. The filaments are slender, red in colour, with an average length of 17 mm, and bear transversely oriented anthers. This structure forms a lever-like mechanism characteristic of the genus *Salvia.*

The *gynoecium* is bicarpellate, bearing a filiform style with an average length of 31.2 mm and an ovary approximately 4 mm in diameter, divided into four locules, each containing a single ovule.

The stigma is bifid and slightly exceeds the corolla. The position and length of the style facilitate effective contact between the stigma and pollinators.
The *fruit* is a tetranutlet, composed of four small, oval, black nutlets with an average size of 2 mm. At maturity, the nutlets are released through the opening of the calyx.
Flowering period - following transplanting and pinching performed to stimulate branching, the first flowers appeared approximately four weeks later, with flowering progressing dynamically from the base towards the apex of the inflorescence. Peak flowering occurs during July-September, when average temperatures of 27-30°C are favourable for blooming. Under open-field cultivation conditions in the lowland area of south-eastern Romania, *Salvia splendens* exhibits an extended flowering period.

Salvia officinalis

Salvia officinalis exhibits a terminal inflorescence (at the apex of the stem), composed of flowers arranged in verticillasters (2–6 flowers per whorl), protected by bracts. The flowers have a bilabiate corolla of blue-violet colour and are arranged so as to form a spike or raceme at the end of the stem.



Figure 10. Inflorescence and flower in *Salvia officinalis*
Source: original

The *bracts* are modified leaves, greenish in colour, positioned at the base of the floral peduncle. They have an average length of 11 mm, an ovate to lanceolate shape, with an acute apex, green with slightly violaceous tinges at the base, and are prominent at the peduncle base.
The *calyx* is tubular, green in colour, with an average length of 9 mm, slightly pubescent, and a basal diameter of 4-5 mm. It is formed of fused sepals terminating in acute lobes. Its function is to protect the corolla and internal organs at the bud stage, and after fertilization it remains attached to the peduncle, enclosing the fruit.
The *corolla* has an average length of 24 mm and is composed of connate petals arranged in a tubular, bilabiate structure of bluish-lilac colour, with a velvety texture. The upper lip is narrow, slightly arched, approximately 24 mm long, covering the androecium and gynoecium, while the lower lip is about 25 mm long, trilobed, with a larger median lobe serving as a landing platform for pollinators.

Tabel 2. Morphometric data (biometric-morphological)
Salvia officinalis

Floral elements	M.S. (mm)	R.V. (mm)	Morphological observations
Bracts	11	10-12	Ovate to lanceolate in shape, with an acute apex, green in colour with slightly violaceous tinges at the base, and prominent at the base of the peduncle.
Sepal calyx	9	8-10	Tubular, persistent, greenish in colour.
Corolla – petals upper lip (labium superius) lower lip (labium inferius)	24	23-25	Tubular at the base, bilabiate, bluish-lilac in colour, with a concave upper lip and a trilobed lower lip bearing a larger median lobe.
Androecium – stamens – filament	20	19-21	Two fertile stamens, with white to violet filaments, finely pubescent, and transversely oriented anthers.
Androecium – stamens – anthers	2	2	Golden-yellow in colour.
Gynoecium – style and stigma	25	24-26	Style filiform; stigma bilobed
Gynoecium – ovary	4	4	Ovary tetralobed in shape, greenish in colour.
Fruit (nutlets)	2	2	Four small, oval, black, glossy nutlets

M.S. - Medium size;
R.V. - Range of variation.

The *androecium* consists of two fertile stamens located beneath the upper lip of the corolla, modified into a staminal lever mechanism

characteristic of the genus *Salvia officinalis*. When an insect enters the corolla to collect nectar, it touches the lower arm of the stamen, causing the fertile theca to be lowered onto the insect. Pollen is deposited on the back of the pollinator and subsequently transferred to the next flower. The filaments are slender, lilac in colour, with an average length of 20 mm, and bear transversely oriented anthers.

The *gynoecium* (*pistil*) is bicarpellate, bearing a filiform style with an average length of 25 mm, slightly exceeding the corolla, and an ovary approximately 4 mm in diameter, divided into four locules, each containing a single ovule. The stigma is bifid and protrudes beyond the corolla. The position and length of the style facilitate effective contact between the stigma and pollinators.

The *fruit* is a tetranutlet, composed of four small, oval, black nutlets with an average size of 2 mm. At maturity, the nutlets dry and are released through the opening of the calyx.

The *flowering period* occurs in the second year after planting; following pinching performed to stimulate branching, the first flowers appear from May to July, opening progressively from the base towards the apex of the inflorescence. The intense violet coloration of the corolla combined with the silvery-green foliage confers a pleasant ornamental effect, making the species suitable for borders, planters, and mixed green spaces.

Salvia coccinea



Figure 11. Inflorescence and flower in *Salvia coccinea*
Source: original

Salvia coccinea cv. Summer Jewel Pink is a compact plant characterized by an elongated, lax spiciform inflorescence, with tubular flowers grouped in terminal racemes measuring 15-25 cm in length. The flowers are approximately 2-3 cm long and exhibit a white to pink coloration, with a bilabiate corolla in which the upper lip is relatively straight and the lower lip is more open.

The flower is zygomorphic and hermaphroditic, borne on a pedicel attached to the inflorescence axis at the level of a small green bract. Flowering extends from early summer until autumn. The flowers are attractive to butterflies, bees, hummingbirds, and other pollinators.

The *bracts* are modified leaves, green in colour, positioned at the base of the floral peduncle. They have an average length of 2.5 mm and an acuminate apex.

Tabel 3. Morphometric data (biometric-morphological) *Salvia coccinea* cv. Summer Jewel Pink

Floral elements	M.S. (mm)	R.V. (mm)	Morphological observations
Bracts	2.4	2-3	Intensely green in colour, oval in shape, and prominent at the base of the peduncle
Sepal calyx	9	8 – 10	Tubular, persistent, green in colour, tridentate
Corolla – petals upper lip (labium superius) lower lip (labium inferius)	24	23-25	Tubular, bilabiate, milky-pink in colour, with a narrow upper lip
Androecium – stamens – filament	30.8	30-32	Two fertile stamens, with white to pink filaments and transversely oriented anthers
Androecium – stamens – anthers	2	2	Whitish or slightly yellowish in colour.
Gynoecium – style and stigma	31.2	30 -33	Style filiform; stigma bifid
Gynoecium – ovary	4	4	Superior, tetralocular ovary
Fruit (nutlets)	2	2	Four small, oval, black, glossy nutlets

M.S. - Medium size;
R.V. - Range of variation.

The *calyx* is tubular, green in colour, with an average length of 9 mm, slightly pubescent, and a basal diameter of 4-5 mm. It is composed of

fused sepals terminating in acute lobes. Its function is to protect the corolla and internal organs at the bud stage, and after fertilization it remains attached to the peduncle, enclosing the fruit.

The *corolla* has an average length of 24 mm and is formed of connate petals arranged in a tubular, bilabiate structure of milky-pink colour, with a velvety texture. The upper lip is narrow, slightly arched, measuring approximately 24.2 mm in length and covering the androecium and gynoecium, while the lower lip is about 23 mm long, trilobed, and serves as a landing platform for pollinators.

The *androecium* consists of two fertile stamens positioned beneath the upper lip of the corolla, modified into a staminal lever mechanism characteristic of the genus *Salvia*. When an insect enters the corolla to collect nectar, it contacts the lower arm of the stamen, triggering the downward movement of the fertile theca onto the insect. Pollen is deposited on the dorsal surface of the pollinator and subsequently transferred to the next flower. The *filaments* are slender, pink in colour, with an average length of 31 mm, slightly protruding from the corolla tube, and bear transversely oriented anthers.

The *gynoecium* (*pistil*) is bicarpellate, bearing a filiform style with an average length of 31 mm, slightly exceeding the corolla, and an ovary approximately 4 mm in diameter, divided into four locules, each containing a single ovule. The stigma is bifid and protrudes beyond the corolla. The position and length of the style facilitate effective contact between the stigma and pollinators.

The *fruit* is a tetranutlet, composed of four small, oval, black nutlets with an average size of 2 mm. At maturity, the nutlets are released through the opening of the calyx.

The *flowering* period extends from May to October following transplanting and pinching performed to stimulate branching. Flowering is abundant and prolonged, progressing from the base towards the apex of the inflorescence. The pastel pink coloration of the corolla combined with the intense green foliage confers a pleasant ornamental effect, making the species suitable for borders, planters, and mixed green spaces. Pruning is required to stimulate continuous flowering, which may extend from spring until the first frost.

Salvia farinacea

The plant bears flowers arranged in elongated, spiciform inflorescences with an average length of 22 cm, organized in verticillasters along the floral axis. The flowers are hermaphroditic, zygomorphic, and bilabiate.

The *bracts* measure approximately 3 mm in length, are greenish-grey with bluish tinges at the base, elliptic, thin, caducous, and slightly farinose (with a whitish, powdery appearance). They have a protective role and fall after flowering.

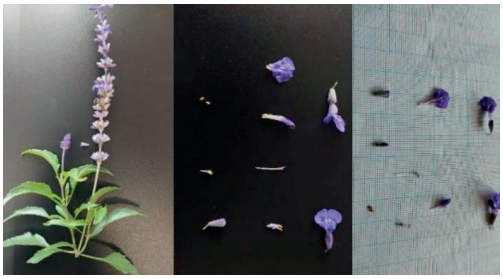

Figure 12. Inflorescence and flower in *Salvia farinacea* cv. Blue Victoria
Source: original

The *calyx* is tubular, with an average length of 8 mm, persistent, blue-violet in colour, and covered with greyish-white hairs, giving it a farinose (powdery) appearance. It bears short, unequal teeth and remains decorative even after corolla abscission, displaying a greyish-bluish colour.

The *corolla* has an average length of 16 mm; it is tubular, narrow at the base and widening towards the upper part, bilabiate, and of an intense blue colour. The upper lip is concave, forming a hood that covers the androecium, while the lower lip is trilobed, with a large, flat median lobe. The corolla has a velvety texture, and the corolla tube displays nectar guide markings.

The *androecium* consists of two fertile stamens positioned beneath the upper lip of the corolla, modified into a staminal lever mechanism characteristic of the genus *Salvia*. When an insect enters the corolla to collect nectar, it contacts the lower arm of the stamen, triggering the downward movement of the fertile theca onto the insect. Pollen is deposited on the dorsal surface of the pollinator and subsequently transferred to the next flower. The stamens have short filaments, with an average length of 3 mm,

and an elongated, articulated connective measuring 6-8 mm, which functions as a staminal lever.

Tabel 4. Morphometric data (biometric-morphological) *Salvia farinacea* cv. Blue Victoria

Floral elements	M.S. (mm)	R.V. (mm)	Morphological observations
Bracts	3	2-4	Greenish-grey in colour with bluish tinges at the base, elliptic, thin, caducous, and slightly farinose (with a bluish powdery appearance); protective in function and falling after flowering.
Sepal calyx	8	7-9	Tubular, persistent, blue-violet in colour, covered with greyish-white hairs (farinose), with short, unequal teeth; remaining decorative after corolla abscission, displaying a greyish-blue colour.
Corolla – petals upper lip (labium superius) lower lip (labium inferius)	16	15-17	Tubular, narrow at the base and widening towards the upper part, bilabiate, of intense blue colour; the upper lip is concave, forming a hood that covers the androecium, while the lower lip is trilobed, with a large, flat median lobe. The corolla has a velvety texture, and the corolla tube exhibits nectar guide markings.
Androecium – stamens – filament	3	3-5	Two fertile stamens, with short filaments and an elongated connective measuring 6–8 mm in length.
Androecium – stamens – anthers	2	2	Stamens glabrous, bluish to pale violet in colour.
Gynoecium – style and stigma	13	12-14	Style filiform; stigma bifid, with slightly curved lobes.
Gynoecium – ovary	4	4	Superior, tetralocular ovary
Fruit (nutlets)	1	1	Four small, oval, black, glossy nutlets

M.S. - Medium size;
R.V. - Range of variation.

The *gynoecium* (*pistil*) is bicarpellate with fused carpels, bearing a filiform style with an average length of 13 mm, slightly exceeding the corolla, and an ovary approximately 4 mm in diameter, divided into four locules, each containing a single ovule. The stigma is bifid.
The *fruit* is a tetranutlet, composed of four small, oval, black nutlets with an average size of 2 mm. At maturity, the nutlets are released through the opening of the calyx.
The *flowering period* extends from June to October, with flowering lasting approximately five months. Flowers open progressively from the base towards the apex of the inflorescence, ensuring continuous blooming. Removal of senescent inflorescences is required to promote re-flowering. The high spike density, large inflorescence size, extended flowering duration, intense blue coloration with violet tinges, and good field performance confer a pleasant ornamental effect, making the species suitable for borders and mixed green spaces.

DISCUSSIONS

The analysis of the morphological results of the inflorescences of the six *Salvia* species included in this study highlights, on the one hand, their structural and chromatic diversity and, on the other hand, their adaptive strategies, while also emphasizing their ornamental value.
With regard to shared characteristics, it was found that all species included in the study exhibit spiciform inflorescences composed of flowers arranged in verticillasters along the entire length of the floral axis.
The distinguishing elements that highlight the differences among species are related to the length of the floral axis, the number of floral verticillasters, and flower density, as follows:
– *Salvia splendens* cv. Blaze of Fire develops a pyramidal spiciform inflorescence composed of 15–22 intensely red flowers, with an extended flowering period from July until the first frost, which confers exceptional ornamental value.
– *Salvia officinalis* exhibits a terminal inflorescence (at the stem apex), consisting of flowers grouped in verticillasters (2-6 flowers per tier) and protected by bracts. The flowers have a bilabiate, blue-violet corolla and are arranged to form a spike or raceme at the end of the stem. Flowering occurs in the second year

after planting, from May to July, progressing from the base towards the apex of the inflorescence. The intense violet coloration of the corolla combined with the silvery-green foliage confers a pleasant ornamental effect, making the species suitable for borders, planters, and mixed green spaces.

– *Salvia coccinea* cv. Summer Jewel Pink is a compact plant with an elongated, lax spiciform inflorescence, bearing tubular flowers grouped in terminal racemes measuring 20-22 cm in length. The flowers are approximately 2-3 cm long, white to pink in colour, and bilabiate, with a straighter upper lip and a more open lower lip. The pastel pink corolla and the intensely green foliage provide a pleasant ornamental appearance, making the species suitable for borders, planters, and mixed green spaces. It exhibits a prolonged flowering period from May until the first frost.

– *Salvia farinacea* cv. Blue Victoria bears flowers arranged in elongated spiciform inflorescences with an average length of 22 cm, organized in verticillasters along the floral axis. Flowers open progressively from the base towards the apex of the inflorescence, ensuring continuous flowering. Blooming extends from June until the first frost. The high spike density, inflorescence size, long flowering duration, intense blue coloration with violet tinges, and good field performance confer high ornamental value, making the species suitable for borders and mixed green spaces.

CONCLUSIONS

The species investigated in this study demonstrate, on the one hand, morphological unity at the genus level, and on the other hand, pronounced diversity in inflorescence structure and floral coloration.

At the same time, the size and shape of the bracts, calyx, and corolla represent key elements in species identification and in the assessment of their ornamental value.

The staminal lever mechanism of the androecium is evolutionarily conserved, confirming the taxonomic affiliation with the genus *Salvia* and the efficiency of entomophilous pollination.

The gynoecium, through its tetralobed ovary and the formation of four nutlets, consistently preserves the fruit type characteristic of the family *Lamiaceae*.

Based on the observed features, it can be concluded that each species exhibits valuable ornamental traits adaptable to various types of landscape design. The combinations of colors, textures, and forms provide diverse possibilities for use in public green spaces, as well as in private gardens and thematic landscape arrangements.

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