

## The use of genetic resources in rose breeding and creation of new rose cultivars through hybridization and selection

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### Abstract

Despite the existence of more than 37,000 different varieties of roses worldwide, there remains a significant interest and high relevance in rose breeding. The rose is the most beloved flower in the world, commonly named the “queen of flowers”. In addition to its remarkable ornamental significance, the rose possesses various ecological, environmental, landscaping, food, pharmaceutical and medicinal, cosmetic, and industrial attributes, thereby contributing to its overall socio-economic value. The current study investigated the results of rose breeding in a horticulture research center in the northwest of Romania, with over 70 years of experience. The main method used to generate variability for the selection of new genotypes was artificial hybridization. After 1970, an average of 15-20 crossings per year were carried out, in different parental formulas or types of crosses, with approximately 1,000-2,000 flowers pollinated per parental combination. Thousands of F1 hybrids were obtained annually (approximately 10,000-12,000 hybrids per year, per hybrid combination), and dozens of elites were selected, grafted, and promoted as clonal selections in comparative trials. The success rate in obtaining new varieties through hybridization was 5.1% from total hybrid combinations, 0.72% from total hybrids, and 1.6% from total clonal selections. Of the total new *Rosa* varieties, hybrid teas represent 11.9%, floribundas 64.2%, shrubs 16.6%, and others 7.1%. Thus, 38 new cultivars suitable for open field cultivation were obtained, showing different habits, decorative value, flowering behavior, flower color, fragrance, resistance to frost or major diseases, and intended use. The exploration of new research directions aimed at harnessing the potential of roses, the region, as well as the socio-economic requirements; interest was undertaken to enhance and beauty degraded or landslide-prone lands, but also to introduce damascene roses, valued within the oil perfume and cosmetics industry.

**Keywords:** breeding; cross-pollination; germplasm; new cultivars; selection; traits; variability

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## Introduction

As is the case with the most well-known, widespread and cultivated species on the planet, there is also an extremely diverse assortment of roses. This ensures that it is possible to use the cultivars that are most suitable for the conditions that are present in one specific environment and culture, suitable for the interests and desires that are pursued (Zlesak, 2007; Datta, 2018). Nevertheless, the progression of society and the new requirements of producers, users and the market, specifically farmers, nurseries, economic agents involved in industrial exploitation and marketing, beneficiaries, and buyers of biological material and flowers, impose new expectations (Bhattacharjee and Banerji, 2010). All persons and structures involved in the cultivation and marketing of roses become increasingly demanding, enforcing the continuation and development of breeding works, as well as the acquisition of new cultivars that must become increasingly valuable (De Vries and Dubois, 1996; Leus *et al.*, 2018). These requirements are necessary due to changes in the market and consumer preferences, as well as an adaptation to the impact of climate change. Additionally, modifications in plants' response to new stress factors, both abiotic and biotic, have led to increased intensity of attacks or aggressiveness of new pathogens or insect pests.

The desire to enhance the aesthetic appeal and create a more pleasant and beautiful environment drives the pursuit of a wider range of diverse varieties and hybrids. The variations in plant appearance include differences in flower size, color, appearance, fragrance intensity and delicacy, bush height and shape, leaf color, and length of growing season (Leus *et al.*, 2018). The aim is to cater to the needs of parks, greenhouses, interiors and other settings, whether they require seasonal or continuous flowering. Consequently, the breeder's responsibility is to generate and proliferate diverse and novel plant varieties (Smulders *et al.*, 2019). However, breeding is a highly challenging endeavour that demands not just extensive expertise, but also a refined sense of aesthetics.

Roses, in general, are plants that thrive in light and heat, and they can completely reward the grower who provides appropriate conditions for the full expression of their biological and ornamental potential (Božanić Tanjga *et al.*, 2022). Nevertheless, roses can thrive even in a world that is "imperfect" because they are extremely undemanding and adapt to various conditions. The fact that many of the hardy roses that are cultivated are old garden roses that belong to one of the several classes that were developed prior to the introduction of the first hybrid tea in 1867, provides an explanation for the knowledge of the response of these plants to the environment in which they thrive. These varieties were cultivated before the introduction of modern culture technologies, and their resistance was a native one. Other groups, however, are represented by 'modern' roses, which already have a considerable age and are quite widespread and well-known.

The historical events of the last two centuries have influenced the behaviour of roses in their natural environment, as well as their susceptibility to stressors. Conversely, the cultivation of roses dates back to minimum three thousand years ago. Although roses were one of the earliest plants cultivated for decorative purposes and their aesthetic impact on humans has been well-documented in ancient writings, the breeding of roses made significant progress following Linnaeus' studies on plant biology. This led to the initiation of artificial hybridization programs in the mid-1700s (Krussman, 1981; Druitt, 2004). By the end of the 18th century, the number of rose varieties had increased significantly. This growth was also because some European countries increasingly expanded their territories and trade borders, and economic competition also contributed to the opening of China to trade. The large number of wild rose species and garden varieties or hybrids from China contributed to the extent of rose improvement and the diversity of new creations in Europe in the early 1800s. These roses were adapted to a warm climate with long dormancy and flowering cycles constantly repeated, factors that increased the possibility of reproduction and survival. After Chinese roses were crossed with cold-hardy, single-flowering European varieties in a single 'wave' (flowering stage), roses with 'repeated' flowering spread everywhere and diversified into varieties with different degrees of tolerance to cold or heat, of different types according to habitus, class, group, flowers, fragrance combinations etc. (Druitt, 2004). The process of improving and diversifying the assortment continued, so that thousands and thousands of rose

varieties were obtained, some of excellent quality, many being perpetuated until current times, others being lost from different causes.

Presently, there are more than 30,000 rose cultivars, enhancing and beautifying the quality of life worldwide. Roses are extensively grown in many settings, ranging from modest gardens and indoor spaces, to terraces and balconies, as well as magnificent residential complexes, classical or modern aristocratic gardens, palaces, and imperial courts, rosarium etc. Their various roles, including economic, agricultural, industrial, ecological, environmental, cultural and educational, are fully acknowledged and appreciated. Furthermore, the rose possesses numerous symbolic functions and connotations, including spiritual ones, frequently representing love, beauty, harmony and elevated emotions (Gudin, 2000; Datta, 2018). It also symbolizes a yearning for improvement and encompasses a wide range of intense sentiments, ranging from pristine white, purity and tranquility to fiery passion or profound love. The rose, revered as the epitome of beauty, has emerged as a steadfast symbol for commemorating significant milestones in human existence. It has gracefully accompanied people during joyous occasions in society, as well as provided solace during intimate and personal moments.

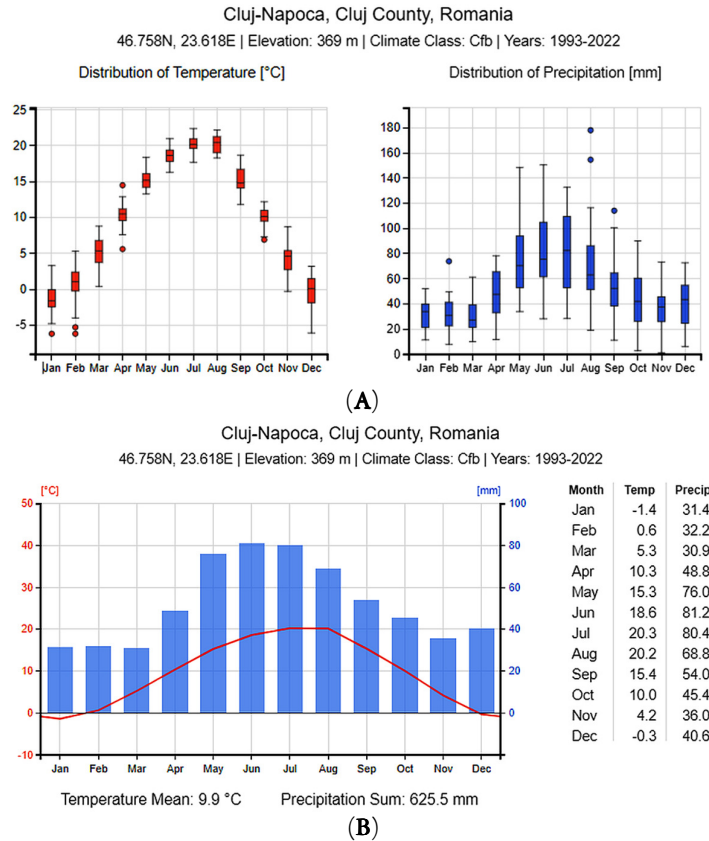
Rose culture has traditionally been highly valued in Transylvania, a region in north-central Romania, because roses not only beautified parks and gardens, but also provided a significant source of revenue for those involved. In the last century, Transylvanian horticultural nurseries were key providers of rose planting material, while A. Muhle in Timișoara and R. Palocsay and S. Wagner in Cluj-Napoca developed new rose varieties through breeding. The Horticultural Research Station (HRS) founded in 1953 in Cluj-Napoca, established a rose collection in 1962, which included 200 different cultivars. This has been continuously developed, now exceeding 320 genotypes, of which 48 being novel varieties created at HRS Cluj-Napoca. Assessing germplasm sources under various ecological situations is of the utmost importance for roses. This evaluation provides the required information for selecting and promoting the most suitable cultivars for cultivation and various uses, as well as selecting parental forms for breeding programmes. The breeding efforts at HRS Cluj-Napoca have been guided by these principles. The present study presents the results obtained from examining the current germplasm pool at HRS. Possible new findings provide valuable information for enhancing roses, not only at a local level, but also as knowledge that contributes to the universal heritage of this widely distributed and beloved species.

## Materials and Methods

### *The place where the research was carried out and the environmental conditions*

The research was conducted at the rose breeding laboratory located at the Horticultural Research Station (HRS), which is affiliated with the University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca. HRS is situated in the Municipality of Cluj-Napoca, in the north-western region of Romania, where the Apuseni Mountains, Someș Plateau, and Transylvanian Plain converge. HRS is situated in the southern part of the city, on the elevated platform on the northern incline of Feleac Hill. The soil suitability for roses and overall conditions in the field were specific to the geographical region and HRS zone (Matei *et al.*, 2020). The experimental field of roses (rosary) is situated at an altitude of roughly 369 m. The climate of Cluj-Napoca is classified as continental (Cfb – Figure 1A-B), influenced by its proximity to the Apuseni Mountains.

West-Atlantic effects are noticeable during the winter and autumn seasons. Winter temperatures frequently drop below freezing, although they seldom dip below  $-10^{\circ}\text{C}$ . Snow often persists for an average of 65 days during the winter season. During the summer months of July and August, the average temperature in the city is of approximately  $18^{\circ}\text{C}$ . However, it is worth noting that temperatures can occasionally soar to as high as  $35^{\circ}\text{C}$  to  $40^{\circ}\text{C}$  during summer peaks.



**Figure 1.** Climatic conditions in the study area, as multiannual averages (1993-2022): **(A)** Distribution of temperature and precipitation; **(B)** Temperature mean and precipitation sum. Data taken from ClimateCharts.net (Zepner *et al.*, 2020)

Despite the low levels of rainfall and ordinary humidity in the summer, there are few, yet powerful, thunderstorms that can be rather violent. In spring and autumn, temperatures fluctuate between 13 °C and 18 °C, and precipitation at this time is typically greater than in summer, characterized by more frequent, but less intense, rainfall episodes.

#### *Plant material and site conditions*

The biological material included in the hereby study consisted of 299 rose varieties from the HRS Cluj-Napoca collection, which serves as a valuable germplasm resource. It includes a range of genotypes, including highly regarded and popular varieties from around the world, as well as some lesser recognized ones, that have significant ornamental and ecological value. The collection also comprises indigenous cultivars, encompassing both antique and contemporary variations, with the most recent additions originating from the modern era of rose hybridization in Romania, including those developed at HRS Cluj-Napoca. All varieties were grafted on rootstocks of *Rosa canina* var. *inermis* (dog rose without thorns), each variety being represented by nine plants (bushes). Planting distances were different, depending on the types of roses, as follows: Hybrid tea – 90 cm between rows of plants and 40 cm between plants per row; Floribunda – 90 × 70 cm; Shrubs – 1.5 m × 1.5 m; Ground cover – 2.0 × 2.0 m; Climbers 1.5 × 1.5 m. The land was maintained grassy between the rows and black field on the rows of bushes, to loosen the soil and keep it clean of weeds, by performing three to four manual weedings per year, at a depth of 8-10 cm. The rose collection was not irrigated, and technological processes such as fertilization, pruning and shoot reductions, winter frost protection, or phytosanitary treatments were standard. During the growing season, diseases (i.e., powdery mildew, black spot, rust) and pests

(i.e. aphids) were controlled with a minimal number of interventions (4-5 treatments) using typical rose chemical compounds.

#### *Analysis of important traits in rose breeding and cultivation*

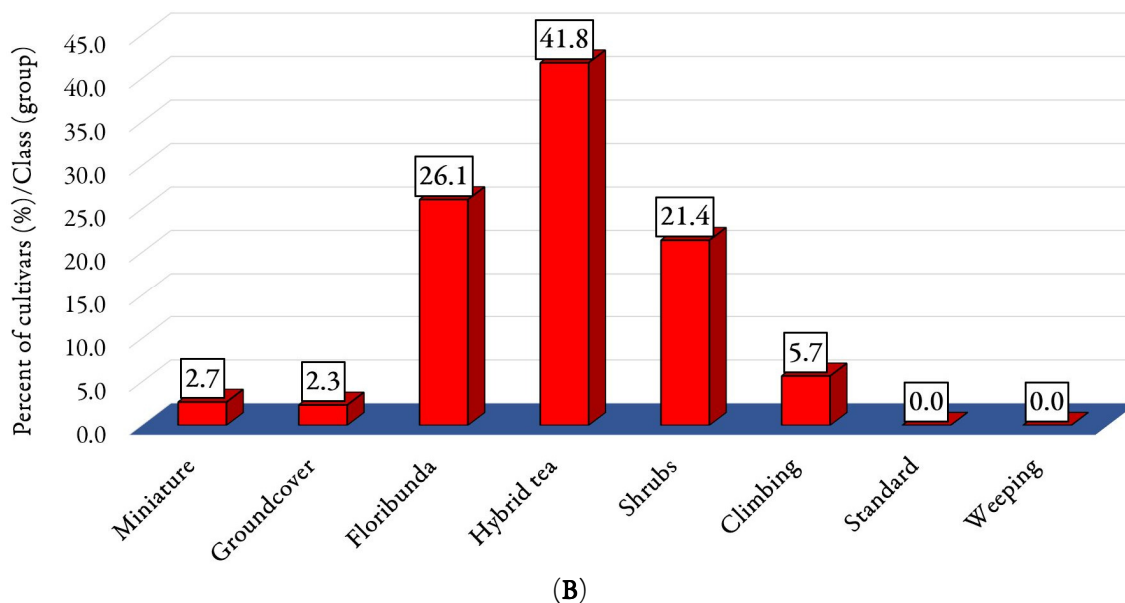
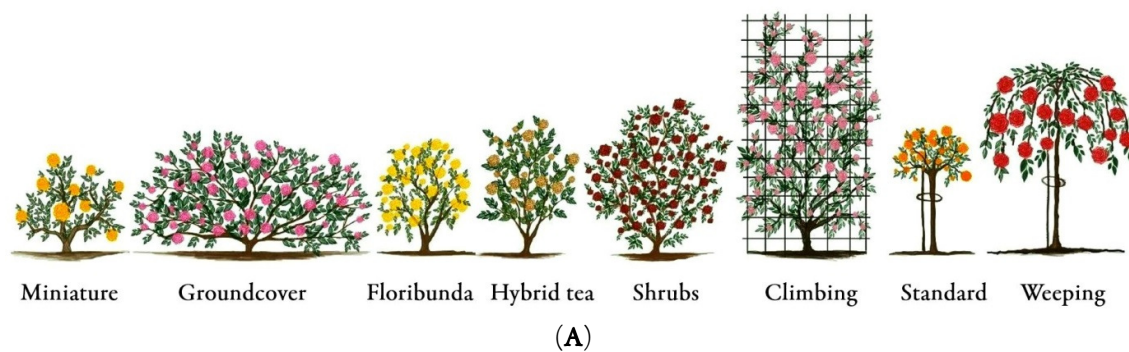
Specific observations and determinations were conducted as part of the evaluation of the rose genotypes from the germplasm pool at HRS Cluj-Napoca. These procedures were outlined in the work protocol of the specialized research units (Wagner, 2002). The observation registers were utilized to record the data, which was subsequently centralized on the computer for data analysis. Some observations and determinations were conducted in accordance with the criteria specified by the DUS test (UPOV, 2022). The UPOV guide (2022) employed classifications, to categorize genotypes based on growth into distinct classes or groups specific to roses, using notes from 1 to 8: 1 – miniature; 2 – groundcover; 3 – floribunda; 4 – hybrid tea; 5 – shrub; 6 – climbing; 7 – standard; 8 – weeping. Plant growth and ramification (habitus), excluding varieties with growth type climber, was assessed using UPOV scale: 1 – upright; 3 – semi-upright; 5 – intermediate; 7 – moderately spreading; 9 – strongly spreading. Depending on the type of flowers, the genotypes were classified into four categories, with the following notes: 1 – single; 2 – semi-double; 3 – double bloom; 4 – fully double (involte). The assessment of flower color was conducted using color groups, utilizing the UPOV system to assign notes ranging from 1 to 16, respectively: 1 – white or almost white; 2 – mixture of white; 3 – green; 4 – yellow; 5 – mix of yellow; 6 – orange; 7 – orange mixture; 8 – pink; 9 – pink mixture; 10 – red; 11 – mixture of red; 12 – red purple; 13 – purple; 14 – mix of purple; 15 – brown mixture; 16 – multicolored. Flower perfume was performed using UPOV notes (UPOV, 2022) from 1 to 3, as follows: 1 – absent or weak; 2 – medium; 3 – strong. The evaluation of frost resistance was conducted in natural conditions, utilizing a credit rating scale ranging from 1 to 5: 1 – weak; 2 – sensitive; 3 – tolerant; 4 – resistant; 5 – very resistant. The response of roses to disease attack was evaluated for the main pathogens in the HRS area, i.e. black spot (*Diplocarpon rosae* Wolf), powdery mildew (*Sphaerotheca pannosa* (Wallr. ex Fr.) Lév.) and rose rust (*Phragmidium mucronatum*), according to the credit rating scale, using notes from 1 to 8, but classified into five classes: 1-3 – strong attack; 4-5 – sensitive; 6 – moderate; 7 – resistant; 8 – very resistant. The overall decorative value, considering all the landscape and ornamental characteristics of the rose varieties in the collections, was evaluated visually, with grades from 1 (minimum) to 10 (maximum). To avoid the undervaluation or overvaluation of genotypes, the estimation was carried out within the groups of roses, considering the characters of interest specific to each group or class of roses. Because of the grading system, even if the evaluation included an average of each rating over a minimum of five years, the results are presented as whole numbers in the final table, not as decimals.

## **Results**

#### *Synthesis of the findings from the evaluation of rose cultivars*

The data collected from the 299 rose cultivars examined in the HRS Cluj-Napoca collection is presented in Table 1A (Appendix A). This table provides a summary of the most representative and comprehensive traits that hold significant importance in the fields of rose culture and breeding. An in-depth assessment of the classification of the 299 rose cultivars into the main classes or groups of plant type revealed that most cultivars belonged to the hybrid tea group (125), followed by floribundas (78) and shrubs (64).

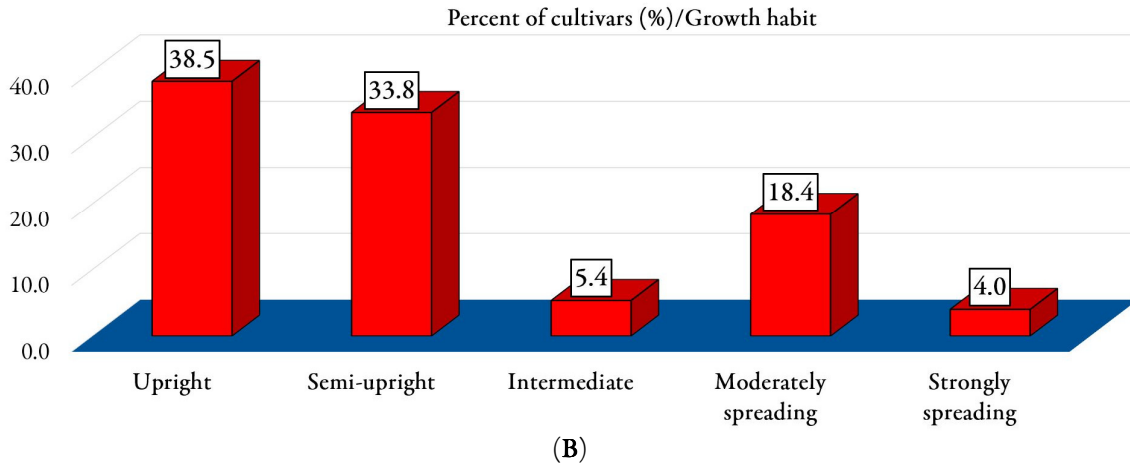
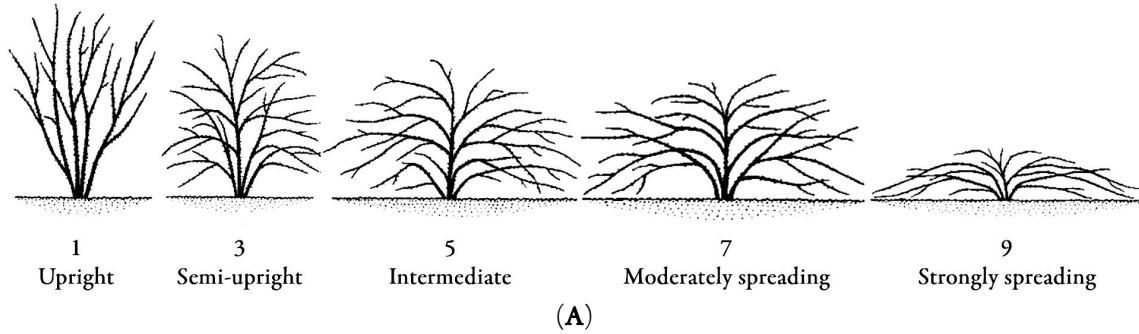
Figure 2A-B depicts the categorization of genotypes from the collection based on plant development and rose characteristics into primary classes or groups, as defined by the total number of genotypes analyzed. Figure 2A illustrates the distinct characteristics of growth habits based on the eight classes examined (after Treloar Roses, [www.treloarroses.com.au](http://www.treloarroses.com.au)), whereas Figure 2B displays the proportion of cultivars from the germplasm pool that were classified into each group.



**Figure 2.** The types of growth and branching of roses and their classification according to the class or group: (A) The main eight classes of rose growth habits according to Treloar Roses ([www.treloarroses.com.au](http://www.treloarroses.com.au)), slightly adjusted; (B) The percentage classification of the rose varieties from HRS Cluj-Napoca within the eight groups

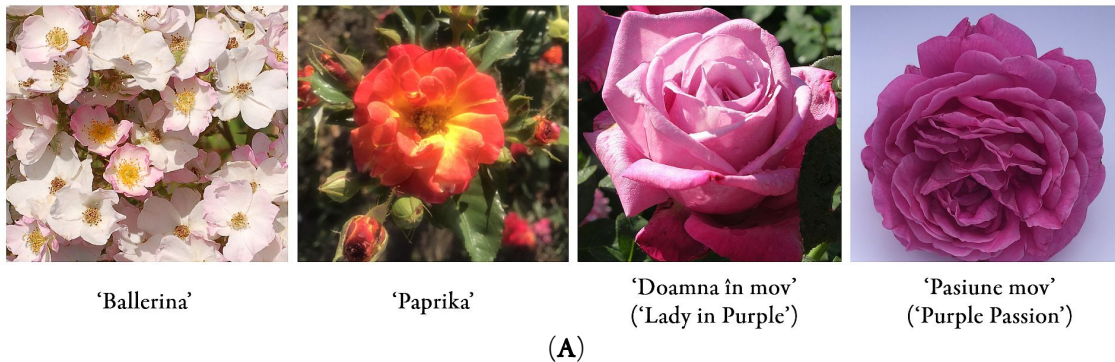
Hybrid tea varieties had the largest share, followed by floribundas and shrubs. Together, they represented 89.3% of the varieties in the collection. Miniature and groundcover roses had low proportions (2.7 and 2.3%). Cultivars were absent from the standard and weeping roses categories, because the grafting specific to these forms was not carried out (for example, on a tall stem or by budding a minimum of two shrubs on a stem). Of course, many of the cultivars in the previous categories could lend themselves to these spectacular forms of tree roses. Consequently, tree roses, also known as standards, are not classified under the fundamental categories since almost any rose that is grafted onto a tall trunk can be designated as a tree rose. Tree roses are commonly cultivated using hybrid teas, floribundas and miniatures (Walheim, 2000).

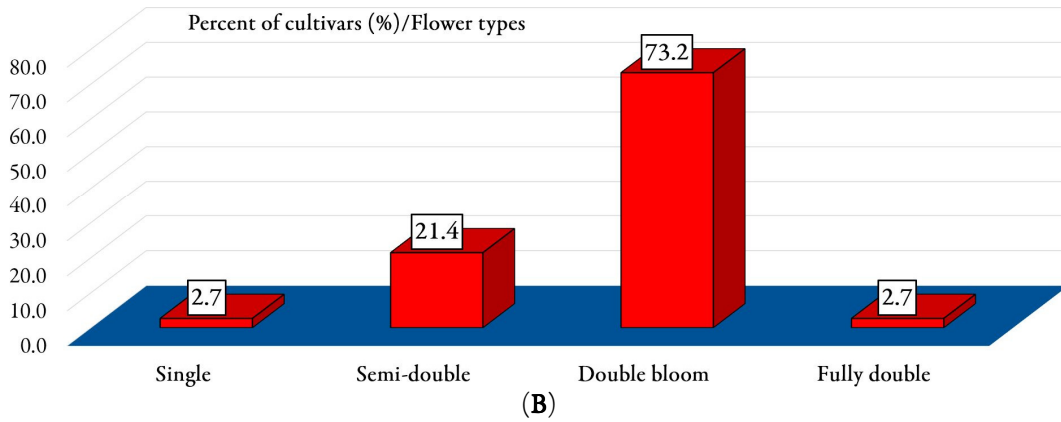
The varieties examined within the HRS Cluj-Napoca collection, based on their primary forms of habitus, were categorized into five growth habits according to UPOV (2022) (Figure 3A), according to which most varieties exhibited plants with upright growth, accounting for 38.5% of the total tested (Figure 3B). The percentages of semi-upright (33.8%) and moderately spreading (18.4%) plants were subsequently observed. The classifications of strongly spreading (4.0%) and intermediate (5.4%) had the lowest percentages of type growth and branching.



**Figure 3.** The types of growth habit and their classification according to the UPOV, excluding varieties with climber growth type: **(A)** The main five growth habit of roses according to UPOV (2022); **(B)** The percentage classification of the investigated varieties from HRS Cluj-Napoca within the five groups of growth habit

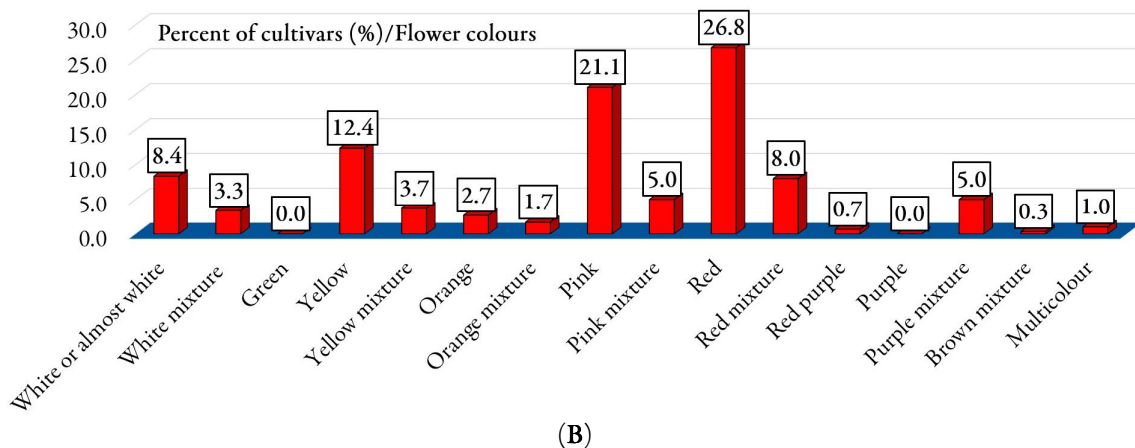
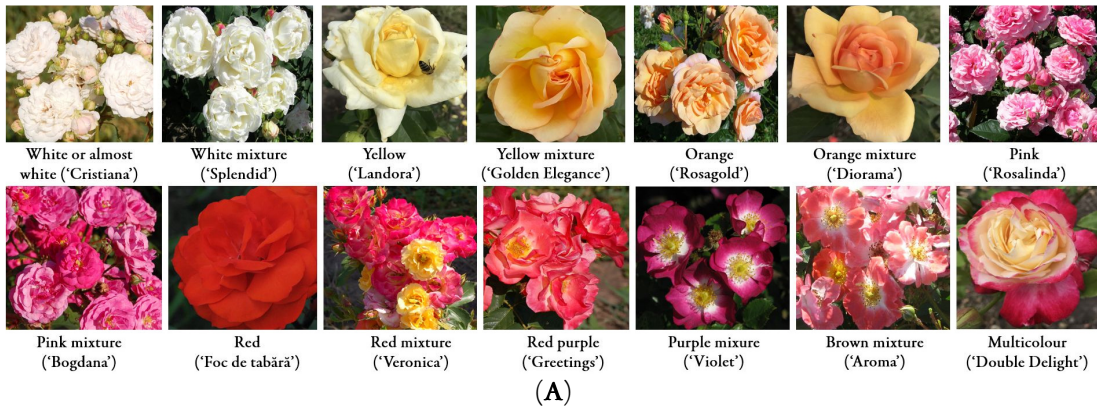
Based on the analysis of flower types (Figure 4A-B), the percentage of cultivars categorized into four distinct classes and varied from 2.7% to 73.2%. Most cultivars exhibited double bloom flowers, with the fewest being either single or fully double. The proportion of cultivars with semi-double flowers in terms of colour was found to be 21.4%.





**Figure 4.** The flower types of roses and their classification: (A) The four classes of roses according to Treloar Roses ([www.treloarroses.com.au](http://www.treloarroses.com.au)), using examples of cultivars from HRS Cluj-Napoca collection; (B) The percentage classification of the varieties from HRS Cluj-Napoca within the four groups depending on colours of flowers

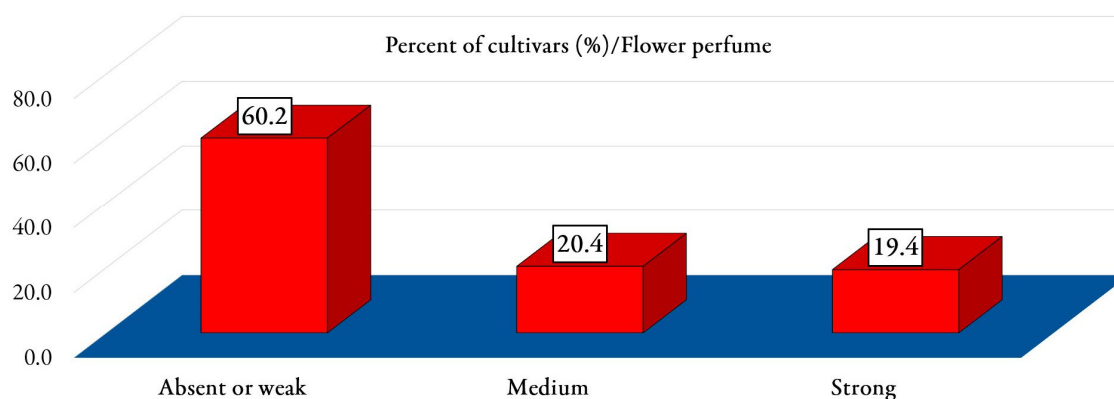
The outcomes depicted in Figure 5 were acquired through the categorization of the collection's varieties based on the colour of the flowers. A subset of fourteen out of the sixteen primary colours that were assessed, were identified in the HRS germplasm pool. These fourteen colours are illustrated in Figure 5A.



**Figure 5.** The flower colours of roses and their classification: (A) The main colour type of roses, using examples of cultivars from HRS Cluj-Napoca collection; (B) The percentage classification of the varieties from HRS Cluj-Napoca within the colours of flowers

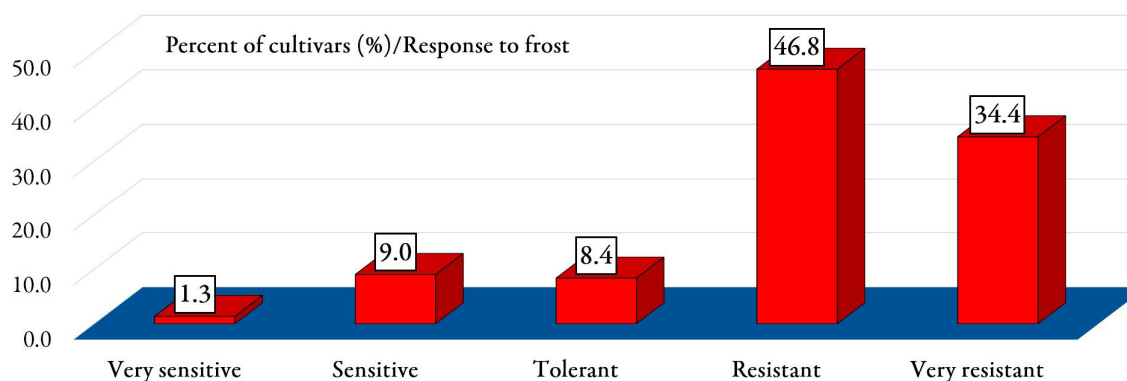
Among all varieties tested, most had red flowers (26.8%). These were followed by the varieties with pink flowers (21.1%) and yellow (12.4%). A significant proportion was represented by the varieties with white or almost white flowers (8.4%), red mixture (8.0%) and purple mixture (5.0%). Not a single variety in the rosarium had purple or green flowers (Figure 5B).

The classification of the 299 rose varieties tested in the HRS Cluj-Napoca collection into three groups based on blossom fragrance (Figure 6) revealed that the majority of these varieties had no scent. Thus, a total of 180 genotypes, or 60.2% of the varieties studied, had unscented or mildly scented flowers. There were 61 cultivars (20.4%) with medium fragrance, while only 58 cultivars (19.4%) had intensely perfumed blooms.



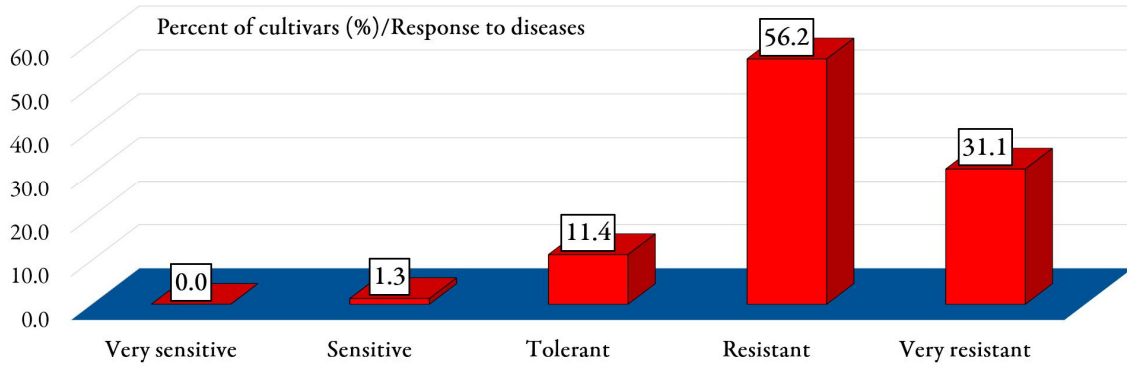
**Figure 6.** The percentage classification of the varieties from HRS Cluj-Napoca within the three groups depending on fragrance (perfume) of flowers

Even though sometimes there are very cold winters in the study area ( $-15\text{ }^{\circ}\text{C}$ ,  $-20\text{ }^{\circ}\text{C}$ ), most varieties showed a good response to frost (Figure 7). Thus, most varieties were included in the “Resistant” class (140, representing 46.8%), and 103 in the “Very resistant” class (103, representing 34.4%). A percent of 8.4% were considered tolerant to frost, 9.0% sensitive and only 1.3% very sensitive.



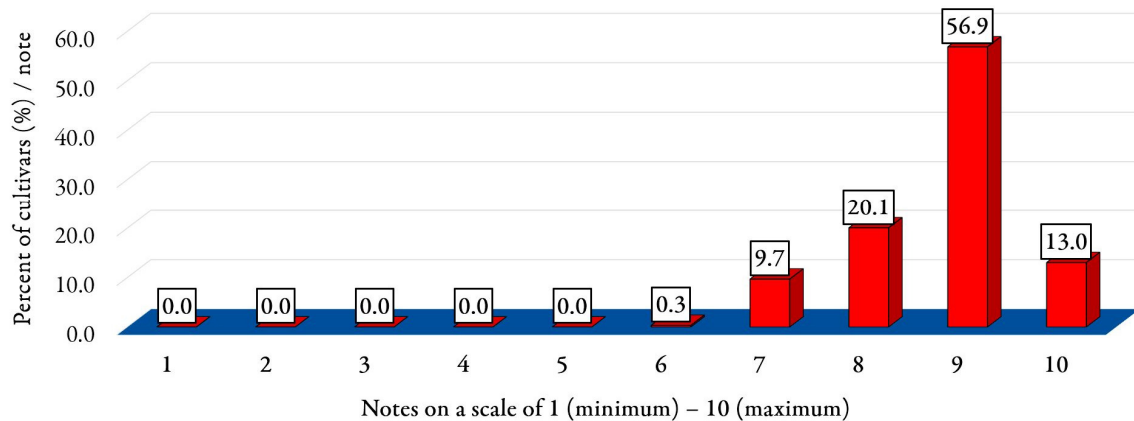
**Figure 7.** The percentage of the varieties from HRS Cluj-Napoca within the five groups depending on their response to frost

The classification of the 299 roses evaluated in the HRS Cluj-Napoca collection into five categories according to their disease response is illustrated in Figure 8. A proportion of 56.2% of the cultivars were categorized as “Resistant”, 31.1% as “Very resistant”, and 11.4% as “Tolerant” under the experimental factors. A total of 1.3% of the cultivars were categorized as “Sensitive”, while none of the cultivars were deemed “Very sensitive”.



**Figure 8.** The percentage classification of the varieties from HRS Cluj-Napoca within the five groups depending on their response to diseases attack

Figure 9 illustrates the percentage classification of varieties from HRS Cluj-Napoca within ten groups based on a gradual scale from 1 (minimum) to 10 (maximum), for the general decorative value of the plants. No less than 13.0% of the varieties were scored to the maximum for their overall ornamental characteristics. Most of the varieties (56.9%) were registered immediately below the maximum (respectively with 9). A proportion of 20.1% of the varieties were registered with grade 8, while only 9.7% with grade 7, and an insignificant proportion had grade 6 (0.3%). The breeding process and the selection to which these varieties were subjected were demonstrated once again by the decorative quality of all the varieties, so that at the bottom of the evaluation scale, meaning notes between 1 and 5, not a single variety was noted.



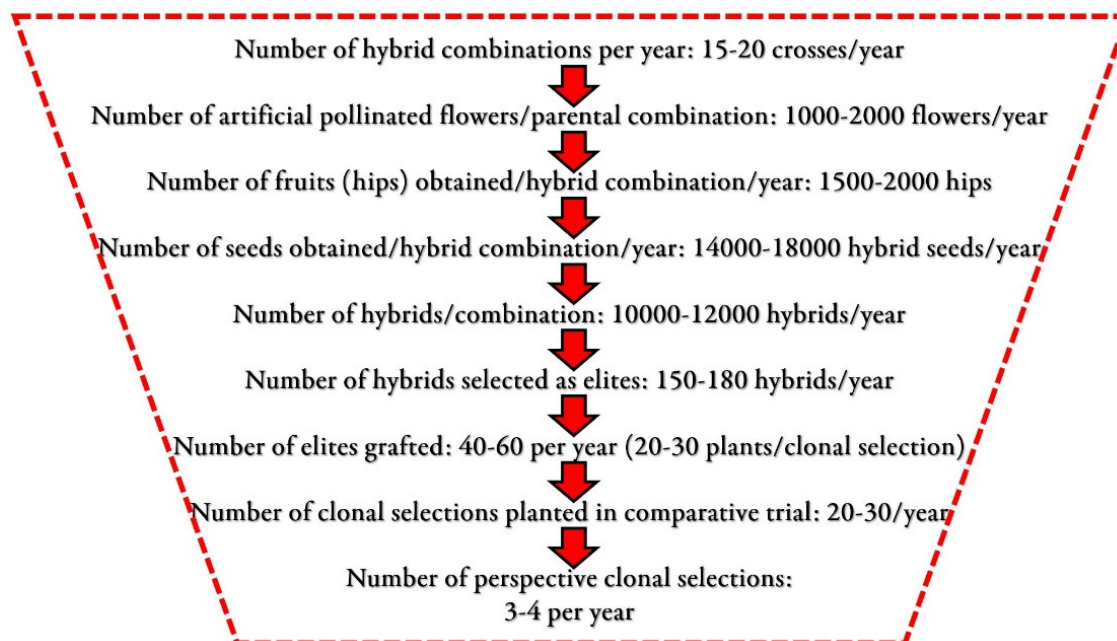
**Figure 9.** The percentage classification of the rose varieties from HRS Cluj-Napoca within ten groups depending on their note for overall decorative value

*The efficiency of artificial hybridization and selection in obtaining new rose cultivars at HRS Cluj-Napoca*

After the establishment of HRS Cluj-Napoca, in 1953, numerous cultivars of different horticultural species were created, but roses ranked first in terms of the number of cultivars. Thus, in the last period, after 1970, 45 new varieties of roses were created, as follows: ‘Foc de tabără’ (en. ‘Campfire’), ‘Luchian’, ‘Simfonia’ (‘Symphony’), ‘Golden Elegance’, ‘Incandescent’, ‘Rosabunda’, ‘Rosalinda’, ‘Mirela’, ‘Iudith’, ‘Auriu de Cluj’, ‘Rosagold’, ‘Candy Rose’, ‘Rusticana’, ‘Zburlici’, ‘Bordură de Nea’ (‘Snow Border’), ‘Nobilia’, ‘Splendid’, ‘Orange Ace’, ‘Golden Fiesta’, ‘Doamna în mov’ (‘Lady in Purple’), ‘Romana’, ‘Rosatop’, ‘Perla Transilvaniei’, ‘Nostalgica’, ‘Pasiune Mov’ (‘Purple Passion’), ‘Petrina’, ‘Carmen’, ‘Stelliana’, ‘Rosadoll’, ‘Puritate’ (‘Purity’),

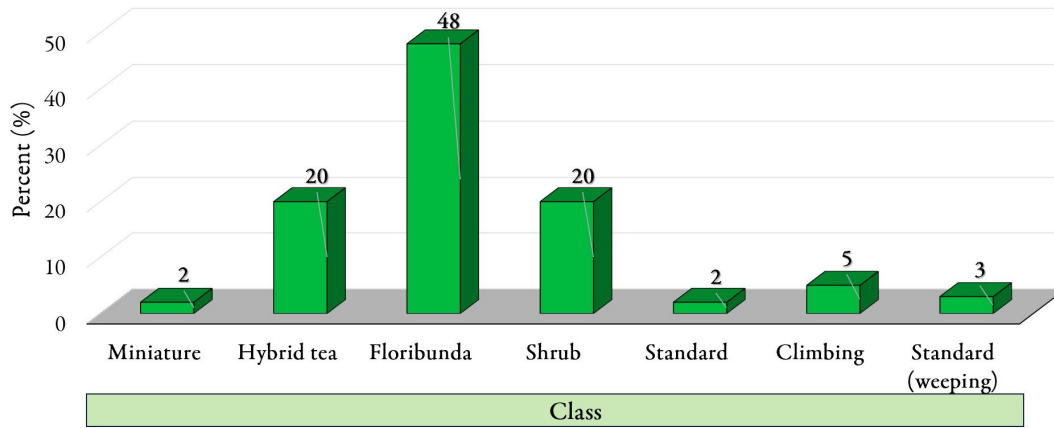
‘Aroma’, ‘Aurora’, ‘Sandra’, ‘Cezara’, ‘Maribella’, ‘Violet’, ‘Cristiana’, ‘Veronica’, ‘Afrodita’, ‘Curcubeu’ (‘Rainbow’), ‘Maria Cristina’, ‘Bogdana’, ‘Simina’, ‘Romanița’, ‘Sânziana’. In addition, there are two clonal elites/selections, namely ‘Luna Albă’ (‘White Moon’) and ‘Splendoria’, which were recently homologated as novel varieties and are awaiting patenting; ‘Zenaida’ is also awaiting approval. Table 1B (Appendix B) displays the synthetic presentation of the newly developed varieties produced at HRS Cluj-Napoca.

During this recent period, the mean annual number of hybrid combinations (crosses) was around 15 to 20 crossings, and the annual pollinated flowers per hybrid combination varied from 1,000 to 2,000 flowers. Parental forms and parental cross-breeding formulas have been established following the HRS germplasm resources and the general objectives of rose breeding. Based on annual average data, it was observed that each hybrid combination produced between 1,500 and 2,000 fruits (hips) per cross, while each hybrid combination provided between 14,000 and 18,000 seeds per year. An average of 10,000–12,000 hybrids (seedlings) were produced annually from each hybrid combination. Annually, between 150 and 180 hybrid seedlings were chosen as elites, while 40 to 60 selected elites were grafted (20 to 30 plants per clonal selection). Comparative trials typically involved the planting of 20–30 clonal selections annually, with the proportion of clonal selections designated as promising, usually varying from 3 to 4 per year. This strategy can be compared to a pyramid that has an extensive base (starting pool), which is represented by a very large number of hybrids. As the hybrids progress through the selection process, this base gradually narrows, passing to clonal selections, which are tested in trials, and then eventually obtaining possible new varieties (Figure 10).



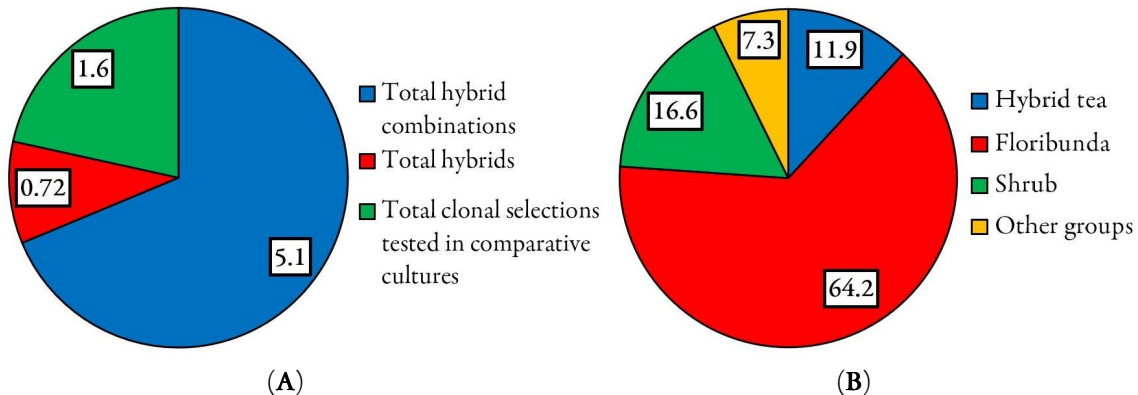
**Figure 10.** The annual advancement in artificial hybridizations within rose breeding at HRS, and the obtaining of hybrids and clonal selections

According to the classification of roses, most of the parental forms in the artificial hybridizations from HRS belonged to the floribunda class (48%). This was followed by hybrid tea and shrub, each accounting for 20% of the total parental forms (Figure 11). Miniature, climbing, standard and weeping roses were used as parents in hybridizations only in small proportions, between 2-5%.



**Figure 11.** Estimated proportion of rose types used in artificial hybridization as parents in HRS, based on rose classification (the percentage of varieties per class used as parents in all hybridizations)

Since 1970, HRS has achieved the following success rate in the creation of new varieties through hybridization: 5.1% average for new varieties produced from total hybrid combinations, 0.72% from total hybrids, and 1.6% from total clonal selections evaluated in comparative trials (Figure 12A). Of the total varieties created at HRS, hybrid tea varieties represent 11.9%, those from floribundas 64.2%, shrubs 16.6%, and other groups 7.1% (Figure 12B).



**Figure 12.** Rose hybridization success at HRS as proportion (%) of new cultivars: (A) Percent of new varieties obtained from: total hybrid combinations, total hybrids, and total clonal selections assessed in field trials; (B) Percent of new varieties obtained from parents belonging to different classes of roses

## Discussions

Institutionally initiated in 1953, the rose breeding program at HRS Cluj-Napoca, Romania, was carried out through the evaluation of hundreds of varieties sourced from national, as well as global assortments, in addition to obtaining a multitude of novel cultivars. The research of roses and the creation of new varieties at HRS continued the work initiated by the HRS founding director, Rudolf Palocsay (1900–1978). At present, the germplasm fund of roses is situated in a rosarium comprising 320 cultivars, 299 of which were assessed in the context of the current investigation. The collection’s cultivars provide a useful foundation for selecting parents appropriate for the intended breeding goals, and the present study identified cultivars that were

particularly noteworthy for the analysed traits. These traits (i.e., plant architecture/habitus, flower colour, fragrance, etc.), can be associated with other traits of interest (i.e. flowering behaviour), and can be feasible targets for rose breeding (Kawamura *et al.*, 2015; Datta, 2018).

At HRS, there exist longstanding and notable achievements in the breeding of diverse fruit tree species, vines, vegetables, flowers, and visually appealing dendrological plants, alongside the advancement of novel rose cultivars destined for open-air growing. Throughout the history of rose breeding at HRS, the primary focus has been on the ability to develop varieties with appealing ornamental attributes, as well as adequate responses to abiotic and biotic stress factors characteristic of the Romanian environment, specifically the northwestern part of the country, Transylvania, which includes the city of Cluj-Napoca and the horticultural research station. The new cultivars obtained are primarily intended for use in parks, gardens, and as cut flowers, and they offer a wide range of colour, form, scent, recurrent blooming and hardiness combinations. Even though there are various methods of inducing artificial variability, the primary breeding method used for all species, was artificial hybridization, followed by selection, which resulted in positive outcomes for both rose and other Rosaceae species (Wagner *et al.*, 2000; Sestras and Sestras, 2023).

The effectiveness of hybridization and the possibility of an efficient selection process for hybrid offspring in roses, as well as for other horticultural species are notably influenced by the parental forms utilized, their value, their heritability (the ability to transmit traits of interest), and how genetic recombination will occur (Gudin, 2000; Debener, 2003; Shupert *et al.*, 2004; Yan *et al.*, 2005; Nadeem *et al.*, 2015). Many difficulties arise in rose breeding due to factors that are not always predictable or easy to overcome. Among them are the poor compatibility of some parental forms (due to genetic, physiological or even morphological reasons) or the production of worthless offspring, poor seed germination, inheritance complexity of traits of interest, allogamy and different levels of ploidy (and as a result, a heterozygous genetic structure), frequency of unreduced gametes, occurrence of unbalanced 'canine' meiosis (and as a result, possible aneuploid descendants), the low rate of valuable plants within some hybrid combinations that can be chosen as elites in the hybrid generation F1, the need for vegetative propagation of the elites and also the influence of the rootstock on some characteristics of the selections chosen, the relatively long period required for the creation of a new cultivar (Jones, 2013; Leus *et al.*, 2018; Stoian-Dod *et al.*, 2023; Harmon *et al.*, 2023). In addition, according to Debener (2003), the extensive knowledge and experience in rose genetics and breeding, including crosses and selection applied in hybrid populations, obtained by private companies, are not accessible to the general public and are confidential. Datta (2018) concurs with Debener (2003) regarding rose breeding and discloses the scarcity of genetic information regarding the genetic underpinnings of the morphological and physiological attributes of roses.

The significant amount of artificial pollination noted within this investigation confirms that the hybridization process necessitates a large amount of labour and human resources, as well as land surfaces, greenhouses, and time dedicated to the development of new varieties (Datta, 2018). As evidenced by the new varieties shown in Table B1 (Appendix B), the rewards of this diligent work were satisfying. These novel varieties have succeeded in achieving the stated breeding goals. It can also be assumed that HRS's rose breeding goals are essentially the same as those of any other institution that works to develop new rose varieties. The novel varieties respond effectively to the primary abiotic stressors, which include low winter temperatures, early or late frosts, and even partial water scarcity, including during times when the vegetative or generative phenological phases are extremely active. Fungal diseases were prioritized over other biotic stress elements in the breeding aims. Like other Rosaceae (Dan *et al.*, 2015; Sestras *et al.*, 2009, 2011), rose breeding efforts in HRS have been efficient and have produced the intended outcomes through crosses between different parental forms, selection, and the use of molecular marker techniques. Choosing biotechnological tools and the right parents in crosses, made it possible to obtain progeny from which hybrids with a good response to the attack of several diseases could be identified and selected (Noack, 2003; Debener and Byrne, 2014). Consequently, the new varieties also have adequate responses against the attack of diseases such as powdery mildew (*Sphaerotheca pannosa*), black spot (*Diplocarpon rosae*), rust (*Phragmidium* spp.), cercospora leaf spot (*Cercospora* spp.).

The first two diseases pose significant challenges to rose cultivation worldwide. In addition, disease resistance is desired to reduce pesticide use. Extensive research is being conducted to explore novel genetic resistance sources and develop new cultivars (Debener and Linde, 2009; Whitaker and Hokanson, 2009; Leus, 2017). An exhaustive analysis of the remarkably extensive and rich history of roses, including their development in cultivation, society, culture, and breeding, reveals facets of significance that pertain to the most cherished flower globally, as well as to all cultivated species (Raymond *et al.*, 2018).

First, roses stand out for the extremely large number of species and varieties. Currently, the world is home to approximately 200 species of *Rosa* and over 37,000 varieties (Cui *et al.*, 2022), bred by anonymous or well-known plant breeders, through more or less scientific methods, more or less known or widespread in the world. This huge number of commercial rose varieties primarily comprises intricate tetraploid or triploid hybrids that originate from eight to ten diploid species of wild roses and a limited number of tetraploid rose species (Zlesak, 2007; Smulders *et al.*, 2019). The origin of this complex hybrid seems to give roses a relatively broad genetic base, unlike other cultivated species, which have a relatively narrow genetic base. If the complex genetic background of cultivated roses could protect them from the erosion and genetic vulnerability faced by agricultural species of great global importance, the challenges represented by climate change, global warming, soil erosion, and the intensification of the aggressiveness of pathogens and harmful insects are common to roses and all other cultivated species. Furthermore, it is believed that only eight to twenty rose species contributed to the development of the current complex hybrid rose cultivars, specifically *Rosa × hybrida* (Zlesak, 2007; Raymond *et al.*, 2018). The conclusion is that political and administrative factors, in addition to scientists, must be concerned with the continuation of rose breeding and the development of all cultivated species. Roses provide a plethora of additional advantages, in addition to their aesthetic value and potential contribution to the surroundings, environment and well-being.

The research on rose breeding in the HRS Cluj-Napoca area can be enhanced by considering the emerging social and economic factors, pedoclimatic conditions, and societal desires and requirements. The pedo-climatic conditions in this region are conducive to the cultivation of roses (Roman *et al.*, 2008), like the countries in Southeast Europe that have established unique traditions and notable accomplishments in the cultivation of the *Rosa damascena* species, such as Turkey and Bulgaria. Hence, potential breeding goals may encompass acquiring a variety of roses to produce oils and perfumes, the establishment and enlargement of agricultural cultivation, and the exploration of sustainable farming practices in the region, drawing inspiration from analogous practices that exist in nearby countries (Akgün, 2023). However, an effective plant breeding program must evaluate the impact of genotype-environment interactions and the associations between significant traits (Gitonga *et al.*, 2014).

Given that the experimental fields of HRS are situated near Feleac Hill and Forest, in a region characterized by hills and forests that are susceptible to soil erosion and landslides (Sestras *et al.*, 2018, 2019), it is necessary to recommence the research on developing varieties that can effectively utilize degraded land, which was initiated more than 25 years ago (Wagner, 2000), while considering the current conditions. The issues pertain to the rapid expansion of urban areas and the impact of urban infrastructure on the topography of adjacent hills and forests, as well as the exacerbation of green area degradation, erosion and landslides. On the other hand, new advances in precision agriculture research, particularly that concerning roses and their potential ecological uses, can be greatly aided by the development of new technologies in land inquiry, vegetation monitoring, GIS, UAV, and remote sensing (Aghaloo and Sharifi, 2023). Regardless, the inherent worth and positive capacity of roses present numerous opportunities and viewpoints for enhancing the environment, designing landscapes, and beautifying the surroundings of people.

## Conclusions

The rose breeding activity conducted at the Horticultural Research Station in Cluj-Napoca, Romania, has been institutionally pursued since 1953 and has achieved remarkable success. Various rose cultivars have been created from distinct rose classes, specifically selected for growing in parks and gardens and as cut flowers. Artificial hybridization was the primary strategy used to introduce the variability required for the selection and creation of new varieties. The research provided excellent practical outcomes, such as the development of a useful germplasm base, including new varieties, hybrids, and promising selections. Additionally, it produced scientific findings of theoretical significance for rose breeding. This study capitalizes on the extensive experience gained from conducting artificial pollinations, inducing variability through hybridization, identifying elite plants, choosing clonal selections, and registering new creations. The findings of this investigation can serve as significant milestones and be valuable for future research in rose breeding.

## Authors' Contributions

Conceptualization: GMSR, AFS and RES; Data curation: GMSR, APS; Formal analysis: GMSR and CD; Funding acquisition: LL and CB; Investigation: GMSR and APS; Methodology: GMSR and APS; Project administration: LL and CB; Resources: GMSR and LL; Software: AFS; Supervision: AFS and RES; Validation; Visualization: RLSD, CD and CB; Writing - original draft: GMSR, RLSD and AFS; Writing - review and editing: AFS and RES.

All authors read and approved the final manuscript.

## Ethical approval (for researches involving animals or humans)

Not applicable.

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## Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

## Appendix A

**Table A1.** Results regarding the evaluation of cultivars from the collection of roses from HRS Cluj-Napoca (class or group; plant habitus; flower appearance; flower colour; perfume; frost and disease response; general decorative value)

Nr.	Genotype	Class	Habitus	Flower type	Flower colour	Per-fume	Frost response	Disease response	Decorative value
1	Amalia	4	5	3	10	2	4	7	9
2	Aurea	4	3	3	5	1	5	7	10
3	Ambassador	4	1	3	6	1	4	7	9
4	Alliance	4	1	3	1	2	4	7	9
5	Auriu de Cluj	3	3	2	4	1	4	7	9
6	Artur Bell	3	1	3	4	3	5	8	8
7	Allgold	3	1	3	4	1	4	7	9
8	Akito	3	3	3	1	2	4	7	9
9	Angela	5	7	2	8	1	5	8	9
10	Aroma	5	7	2	15	3	5	8	10
11	Aurora	5	7	2	11	1	5	8	9
12	Afrodita	5	1	3	10	3	5	8	10
13	Acapella	4	1	3	11	3	4	7	8
14	Amore	4	1	3	10	1	2	7	7
15	Alissar Princess of Phoenicia	3	3	2	9	1	4	7	8
16	Arthur Bell	3	1	1	8	1	4	7	9
17	Anne Harkness	3	3	3	5	1	4	7	9
18	Acapulco	4	1	3	4	2	4	7	9
19	Alexander	4	1	3	11	1	4	7	9
20	Abraham Darby	3	3	9	5	2	4	7	8
21	Astrid Lindgren	3	1	3	2	1	4	7	7
22	Alec's Red	4	1	3	10	1	2	7	8
23	Baccara	4	3	3	10	2	3	7	8
24	Blake Velvet	4	1	3	10	2	4	7	9
25	Burgund '81	4	3	3	10	2	4	7	9
26	Baby Mascherade	1	7	3	8	1	4	7	9
27	Bonica	5	5	3	8	1	5	8	9
28	Brene de Liebe	3	1	3	10	3	4	7	9
29	Bella Rose	5	5	2	8	1	5	8	9
30	Bordura de Nea	5	7	1	1	1	5	8	9
31	Ballerina	5	5	1	8	1	5	8	9
32	Bogdana	5	7	3	9	1	5	8	9
33	Bel Ange	4	1	3	8	1	4	7	7
34	Black Magic	4	1	3	10	1	4	7	9
35	Black Night	4	3	3	10	1	2	7	8
36	Beaute	4	3	3	11	1	2	7	7
37	Berolina	4	3	3	10	2	4	7	9
38	Bella Rosa	3	3	3	8	1	4	6	7
39	Benita	3	3	3	4	2	4	7	9
40	Bianco	1	1	3	1	1	4	7	9
41	Brandy	4	1	3	7	1	4	7	9
42	Chrysler Imperial	4	1	3	10	3	4	7	9
43	Circus	1	3	2	9	1	3	6	8
44	Cri-Cri	1	7	3	8	1	4	7	9
45	Christiane Hörbiger	3	3	2	10	1	1	4	7
46	Cläre Grammerstorf	3	3	3	4	2	2	6	7

47	Coralin	1	7	4	8	1	4	7	9
48	Cosima	3	3	2	10	1	4	7	9
49	Carmen	5	7	2	10	1	5	8	9
50	Compassion	6	3	3	2	3	5	8	10
51	Centenaire de Lourdes	5	5	2	8	1	5	8	9
52	Candy Rose	5	7	2	8	1	5	8	9
53	Cluj-2010	3	3	3	11	1	5	8	9
54	Cluj Lnd. 2	4	1	3	4	2	3	7	8
55	Crown Princess Margareta	3	3	9	5	3	5	8	10
56	Casino	6	7	3	4	1	5	8	9
57	Carina	4	1	3	8	1	4	8	8
58	Carlita	4	3	3	9	1	5	7	9
59	Cristiana	5	7	3	2	3	5	8	10
60	Curcubeu	5	7	2	2	1	4	8	8
61	Cezara	5	7	2	5	1	5	6	7
62	Caprice de Meilland	4	1	3	5	3	4	7	9
63	China Town	4	3	3	4	1	2	2	6
64	Casa Nova	4	1	3	4	2	4	7	9
65	Crowning Glory	5	3	2	10	3	4	7	9
66	Coral Babylon Eyes	1	9	1	5	1	4	8	8
67	Dame de Coeur	4	5	3	11	2	3	7	8
68	Duftwolke	4	3	3	10	3	5	7	10
69	Dallas	4	1	3	6	1	3	7	8
70	Double Delight	4	1	3	16	2	4	7	9
71	Dalli Dalli	3	3	3	10	1	2	6	7
72	Diamond Jubilee	4	1	3	7	1	3	7	8
73	Diorama	4	3	3	7	2	4	7	9
74	Duftgold	4	3	3	4	3	4	7	9
75	Dr. Faust	3	3	3	8	1	2	6	7
76	Don-Juan	5	3	2	10	1	5	8	9
77	Danse du feu	6	7	3	10	2	5	8	10
78	Dublin Bay	6	7	3	10	2	5	8	10
79	Doamna in Mov	4	1	3	14	3	4	7	9
80	Ducat	6	7	3	4	1	5	8	9
81	Duftzauber	4	1	3	10	3	4	7	9
82	Doris Tysterman	4	3	3	10	1	2	7	7
83	Diana	4	1	3	4	1	4	7	8
84	Disco Dancer	3	3	2	11	1	4	6	8
85	Eminence	4	1	3	14	3	3	6	8
86	Emeraude d'Or	4	1	3	4	1	2	8	8
87	Eifel Tower	4	1	3	14	3	4	7	9
88	Edelweiss	3	3	2	1	1	1	4	7
89	Ernest Morse	4	3	3	9	1	4	7	9
90	Electron	4	5	3	8	1	4	7	9
91	Embrasment	3	3	3	10	1	4	7	9
92	Eye Paint	5	3	2	11	1	5	7	8
93	Eden Rose	3	1	9	5	2	4	7	8
94	Elina	4	1	3	4	1	4	7	9
95	Elle	4	3	3	8	3	4	7	9
96	Erotika	4	1	3	10	3	4	6	8
97	Escapade	3	1	2	9	1	4	7	9
98	Ena Harknes	4	3	3	10	1	2	6	8
99	Europeana	3	1	2	10	2	4	7	9

100	Elida	3	3	2	10	1	2	6	7
101	Europa's Rosengarden	5	7	2	8	1	5	8	9
102	Fortuna	4	1	3	9	1	3	7	8
103	Fruhrot	4	1	3	10	1	4	7	9
104	Flamingo	4	1	3	8	1	3	7	8
105	Foc de tabără	3	1	3	10	1	5	8	10
106	First red	4	1	3	10	2	4	7	9
107	Friesia	3	3	3	4	3	5	8	8
108	Ferdy	5	7	2	8	1	5	8	9
109	Fire Glow	5	7	2	10	1	5	8	9
110	Fisherman's Friend	3	3	3	14	1	4	6	8
111	Falstaff	5	1	4	10	3	4	7	9
112	Freude	4	1	3	9	2	4	7	9
113	Golden Elegance	4	1	3	5	1	3	7	8
114	Golden Holstein	3	3	3	4	3	4	7	9
115	Golstern	6	7	3	4	2	5	8	10
116	Golden Soares	6	7	3	4	1	5	8	9
117	Galia	4	1	3	6	1	4	8	8
118	Gold Medal	4	3	3	4	2	2	6	8
119	Gruss Heidelberg	6	7	3	10	1	5	8	9
120	Golden Holstein	3	3	3	4	3	2	7	7
121	Goldmarie	3	3	3	4	2	2	6	7
122	Georgia Burns	3	1	3	5	2	4	7	9
123	Greetings	3	1	2	12	1	4	7	9
124	Glorious	4	1	3	4	2	4	7	9
125	Golden-Fiesta	5	5	2	4	3	5	8	10
126	Hidalgo	4	1	3	10	1	5	7	10
127	Hansestadt Bremen	3	1	3	10	1	4	7	9
128	Haidetraum	5	7	2	10	1	5	8	9
129	Heidekind	5	7	2	10	1	5	8	9
130	Heidi	5	5	2	8	1	5	8	9
131	Harlequin	6	7	3	2	1	5	8	9
132	Heritage	3	3	3	8	3	4	7	9
133	Herz Ass	4	1	3	10	1	4	7	9
134	Hermann Schmidt	6	9	3	14	3	5	8	10
135	Holsteinperle	4	1	3	11	1	4	7	9
136	Irish Eyes	3	3	3	5	1	4	7	9
137	Iceberg	5	1	3	1	1	4	7	9
138	Incandescent	4	3	3	11	1	5	7	9
139	Ingrid Bergman	4	1	3	10	2	4	7	9
140	Iudit	3	3	3	4	1	3	6	8
141	Ilse Superior	6	1	3	1	3	5	8	10
142	Imperatrice Farah	4	1	3	2	1	2	6	7
143	Janina	4	3	3	9	1	4	7	9
144	Jimini-Cricket	3	3	2	10	1	2	6	7
145	John Armstrong	5	3	2	8	1	5	8	9
146	Königin Rosen	4	1	3	8	1	3	7	8
147	Koba	4	1	3	10	1	4	7	10

148	King's Ransom	4	3	3	4	2	5	7	9
149	Kordes Perfecta	4	3	3	8	1	1	4	7
150	Kromprinzess Victoria	4	3	3	8	1	1	7	7
151	Kimono	3	1	3	8	1	3	6	8
152	Karl Höchst	3	1	3	10	1	4	7	9
153	Kronenburg	4	1	3	10	1	2	6	7
154	Kent	2	9	2	1	1	4	7	9
155	King's Ransom	4	3	3	4	1	4	6	8
156	Kardinal	4	1	3	10	1	4	7	9
157	Las Vegas	4	1	3	9	1	3	7	8
158	La France	4	5	3	8	1	4	7	9
159	Landora	4	1	3	4	2	3	7	8
160	Luteția	4	1	3	4	1	4	7	9
161	Luchian	3	1	3	11	1	5	8	10
162	Lavendula	3	3	2	14	3	4	7	9
163	Lili Marlen	3	1	2	10	2	4	7	9
164	Leonardo da Vinci	3	3	3	8	1	4	7	9
165	La Sevillana	5	7	2	10	1	5	8	9
166	Lavender Dream	5	7	1	14	1	5	8	9
167	Little Buckaroo	5	3	2	10	1	5	6	8
168	Lucy Cramphorn	4	1	3	11	1	4	7	9
169	Louis de Funes	4	3	3	7	2	4	7	9
170	Liebeszauber	4	1	3	10	2	4	7	8
171	Marylin	4	1	3	9	2	3	7	8
172	Monica	4	1	3	6	2	3	7	8
173	Mr. Lincoln	4	1	3	10	3	4	7	9
174	Maia Oetker	4	3	3	8	1	4	7	9
175	Mainzer Fastnacht	4	3	3	14	3	3	7	8
176	Mme. Meilland	4	3	3	4	2	3	7	8
177	Maria Callas	4	3	3	8	2	3	7	8
178	Mabella	4	3	3	4	3	5	7	10
179	Mme Francisque Fabvre	4	1	3	8	1	5	7	10
180	Mirela	3	5	4	16	1	4	7	9
181	Margaret Merril	3	1	3	1	3	5	8	8
182	Marie Elisabeth	3	1	3	9	2	4	7	9
183	Montana	3	1	3	10	2	2	6	7
184	Masquerade	3	3	3	11	1	4	7	9
185	Mozart	5	3	2	8	2	5	8	10
186	Mary Rose	3	1	3	8	2	5	8	10
187	Maribella	5	7	3	10	1	5	6	7
188	Manuela	5	3	3	8	1	5	7	9
189	Michele Meilland	4	3	3	10	2	2	6	8
190	Mondiale	4	1	3	8	1	4	7	9
191	Maywonder	3	1	3	10	1	4	7	9
192	Majolica	3	3	2	10	1	3	6	8
193	Mariandel	3	3	3	10	3	4	7	9
194	Maigold	5	3	2	4	3	4	7	9
195	Madonna	4	3	3	8	3	4	7	9
196	Mascot '77	4	1	3	4	1	4	7	9
197	Mandarin	1	1	2	6	1	4	7	9
198	Mari Rose	4	1	4	4	2	4	7	9
199	Melina	4	1	3	10	2	4	7	10
200	Nostalgica	5	1	3	14	3	5	8	10

201	Nobilia	5	1	3	8	1	5	8	9
202	Nozomi	2	9	1	1	1	5	8	9
203	New-Dawn	6	7	3	1	1	5	8	9
204	Nina Weibul	3	1	3	10	2	4	7	9
205	Olympiad	4	1	3	10	1	4	7	9
206	Osiana	4	1	3	4	3	4	7	9
207	Orange Ace	4	1	3	11	1	3	7	8
208	Orangeade	3	5	2	8	1	4	7	9
209	Orange Triumph	5	7	2	10	1	5	8	9
210	Olala	3	3	3	10	1	4	7	9
211	Othello	4	1	4	12	3	4	7	9
212	Princess Of Wales	3	1	2	1	1	4	7	9
213	Prima Dona	4	1	3	11	3	4	8	9
214	Peter Frankensfeld	4	1	3	9	3	4	7	9
215	Papa Meiland	4	3	3	10	3	5	7	10
216	Paprika	3	3	3	10	1	4	7	9
217	Parador	4	3	3	8	1	4	7	9
218	Paola	4	1	3	10	1	4	7	9
219	Pascali	4	1	3	1	3	3	7	8
220	Polarstern	4	1	3	1	3	4	7	9
221	Prominent	3	1	3	11	2	4	7	9
222	Para-ti	1	7	3	1	1	4	7	9
223	Pasiune	5	3	4	14	3	5	8	10
224	Pink Bells	2	9	2	8	1	5	8	9
225	Puritate	5	7	1	1	1	5	6	7
226	Petrina	5	7	2	8	1	5	8	9
227	Pink Meidiland	5	7	2	8	1	5	8	9
228	Porta Nigra	4	3	3	10	1	2	7	7
229	Poker	4	3	3	1	3	2	7	7
230	Pastel Babylon Eyes	3	7	2	9	1	4	7	8
231	Perla Transilvaniei	5	7	3	14	1	5	8	9
232	Prominent	3	1	3	11	2	4	6	7
233	Romancze	5	7	3	8	1	2	7	8
234	Romstar	4	3	3	11	2	5	8	10
235	Rosabunda	3	3	3	8	1	5	8	10
236	Rosalinda	3	3	3	8	1	5	8	10
237	Rumba	3	3	3	11	3	4	7	9
238	Roklea	3	3	3	10	1	4	7	9
239	Rosagold	5	1	3	6	3	5	8	10
240	Rusticana	5	7	2	2	1	5	8	9
241	Red Candy	5	7	2	10	1	5	8	9
242	Rosadora	5	5	2	8	1	5	8	9
243	Rosarium Utersen	6	9	3	8	3	5	8	10
244	Regensberg	3	3	3	8	2	4	7	8
245	Red Bells	2	9	2	10	1	5	8	9
246	Romanita	3	3	3	10	1	4	7	8
247	Red Success	4	3	3	14	1	2	7	7
248	Rose de Rest	3	3	4	14	3	5	8	10
249	Red Berlin	4	3	3	10	2	4	7	9
250	Rosadoll	5	7	2	8	1	5	8	9
251	Rosatop	3	7	2	8	1	5	8	9
252	Royal Bassino	5	7	2	10	1	5	8	9

253	Red Intuition	4	1	3	11	2	4	7	9
254	Samantha	4	3	3	10	1	4	6	8
255	Super Star	4	1	3	11	2	4	7	9
256	Sutter's Gold	4	1	3	7	3	4	7	9
257	Sonia	3	1	2	10	1	4	7	9
258	Scherzso	3	3	3	10	1	4	7	9
259	Simina	5	1	3	8	1	5	8	9
260	Swany	2	9	2	1	1	5	8	9
261	Snow owl	5	7	2	2	3	4	7	9
262	Simfonia	4	1	3	1	2	5	6	8
263	Splendid	5	5	3	1	3	5	8	10
264	Sommerwind	5	7	2	8	1	5	8	9
265	SYmphtic	6	7	3	10	2	5	8	10
266	Sanzaiana	3	3	3	8	3	4	8	9
267	Snow Ballet	2	9	2	1	1	5	8	9
268	Schwarzen Madona	4	3	3	10	1	2	7	8
269	Sandra	5	3	3	10	3	5	8	10
270	Super-Excelsa	6	9	3	8	2	5	8	10
271	Stelliana	4	2	3	10	1	2	6	7
272	Zburlici	5	7	3	8	1	5	8	9
273	Sachsengruss	4	7	9	8	3	4	6	8
274	Sexy Rxy	3	3	3	8	1	4	7	9
275	Sunseeker	3	3	3	6	2	4	7	9
276	Tocade	4	3	3	8	1	3	7	8
277	The Queen Elisabeth	3	1	3	8	1	3	6	8
278	The Fairy	5	7	3	8	1	5	8	9
279	The Fairy Red	5	7	3	10	1	5	8	9
280	U.W.Seller	4	5	3	11	1	4	7	9
281	Veronica	5	7	3	11	2	5	8	10
282	Versillia	4	5	3	2	2	5	7	8
283	Versailles	4	1	3	9	1	4	7	9
284	Vigorosa	5	1	2	8	1	5	8	9
285	Violet	5	7	2	14	3	5	8	10
286	Wester Sun	4	1	3	4	1	4	6	8
287	Winchester Cathedral	4	1	4	2	1	4	7	9
288	White Success	4	3	3	1	2	4	7	9
289	West Coast	3	1	3	8	1	4	7	9
290	White Meidilland	5	7	2	1	2	5	8	10
291	White D.Perkhins	6	9	3	1	1	5	8	9
292	Withe Bells	2	9	2	1	1	5	8	9
293	Wagner's Favorit	4	3	3	11	2	4	7	9
294	Wettra	3	1	3	10	1	2	6	7
295	Westerland	5	1	3	6	3	4	7	9
296	Yellow Wonder	4	1	3	4	1	4	7	9
297	Yakimour	4	3	3	16	1	4	7	9
298	Yesterday	5	7	1	14	1	5	8	9
299	Zephrine	6	7	3	8	3	5	8	10

## Appendix B

**Table B1.** New varieties of roses obtained at the Horticultural Research Station (HRS), after 1970



### **'Foc de Tabăra'**

Class: Floribunda

Origin: 'Paprika' × 'Coup de Foudre'

Author: Ștefan Wagner, 1970

Description: Bushes of medium vigour, 70/45 cm with semi-erect branches, medium-sized, dark green, glossy leaves. Convoluted flowers (30 petals), large, grouped in clusters, fire-red petals that do not fade, without fragrance. Variety widely cultivated in Romania. For solids and borders. Awards: Certificate of Merit, Rome, 1973; Second Prize, Hradec Kralove, Czech Republic, 1975

### **'Luchian'**

Class: Floribunda

Origin: 'Paprika' × 'Coup de Foudre'

Author: Rudolf Palocsay, Ștefan Wagner, 1972

Description: Bushes of medium vigour, 50/40 cm, with spreading, thick branches and large thorns. Large, leathery, glossy leaves. The flowers are convoluted, large, velvety brick-red petals, without fragrance. Resistant to powdery mildew, sensitive to frost. For rebates and borders.



### **'Simfonia'**

Class: Hybrid tea

Origin: 'Mount Shasta' × 'Pascali'

Author: Ștefan Wagner, 1978

Description: Bushes of medium vigour, 80/40 cm, with erect growth, branches of medium thickness, few thorns. Dark green, semi-glossy leaves. Convoluted flowers (35 petals), large, slender buds with white petals, open slowly, with pleasant fragrance. Resistant to powdery mildew, susceptible to black spot. Sensitive to frost. Suitable for cut flowers. Awards: Third Prize, Hradec Kralove, Czech Republic, 1978

**‘Rosabunda’**

Class: Floribunda

Origin: ‘Frankfurt am Main’ × ‘Maria Callas’

Author: Ștefan Wagner, 1979

Description: Bushes of medium-large vigour, 90/60 cm with semi-erect branches and many thorns. Medium, glossy leaves. Convolutated flowers (35 petals), large, elegant buds, deep pink petals fade a little in strong sun. Moderate, pleasant fragrance. For gardens and parks, fences, borders, floral arrangements.



**‘Incandescent’**

Class: Hybrid tea

Origin: ‘Bond Street’ × ‘Dame de Coeur’

Author: Ștefan Wagner, 1991

Description: Bushes of medium vigour, 70/40 cm with erect branches and many thorns. Dark green leaves with a reddish tint, glossy. Twisted flowers (35 petals), large, spherical in shape, with bright brick-red petals. No fragrance. It blooms profusely. Slightly sensitive to frost. For gardens and parks, in small or massive groups.

**‘Auriu de Cluj’**

Class: Floribunda

Origin: ‘Orangeade’ × ‘Western Sun’

Author: Ștefan Wagner, 1991

Description: Bushes of medium vigour, 60/40 cm with erect branches. Light green, glossy leaves. Semi-wrapped flowers, yellow petals with pink iridescence towards the edges. Light, pleasant fragrance. Blooms early. For gardens and parks, borders, borders.





**'Romstar'**

Class: Hybrid tea

Origin: 'Baccara' × 'Coronado'

Author: Ștefan Wagner, 1991

Description: Vigorous bushes 100/50 cm, with erect growth. Medium green, semi-glossy leaves. Convolute flowers (35 petals), large, elongated buds with crimson-red petals, slightly velvety. Intense raspberry fragrance. Resistant to flouing and frost. Recommended for cut flowers and tall hedges.

**'Rosalinda'**

Class: Floribunda

Origin: 'Rosabunda' × 'Foc de Tabară'

Author: Ștefan Wagner, 1994

Description: Bushes of medium vigour, 80/40 cm with erect branches. Large, matte leaves. Involute flowers, elongated buds, pure pink petals, lighter on the outside. Light, pleasant fragrance. It blooms profusely in two to three distinct waves. Good disease and frost resistance. Excellent for borders, borders, fences.



**'Vigorosa'**

Class: Polyantha

Origin: 'Rosabunda' × 'Dr. Faust'

Author: Ștefan Wagner, 1994

Description: Bushes of great vigour, 150/100 cm with erect branches. Large, matte leaves. Semi-whorl flowers in rich, medium-sized clusters with pink petals with yellowish base. Intense perfume. Good disease and frost resistance. For solitary planting, small groups or hedges.

**'Zburlici'**

Class: Cover

Origin: 'Bonica 82' × 'La Sevellana'

Author: Ștefan Wagner, 1995

Description: Bushes of medium vigour, 60/70 cm. Light green, glossy leaves. Semi-wrapped, medium-sized flowers, clustered 5-7 with dark pink, delicate petals. Good disease and frost resistance. For parks and gardens.



**'Golden Elegance'**

Class: Hybrid tea

Origin: sport 'Ambassador'

Author: Ștefan Wagner, 1995

Description: Vigorous bushes, 100/50 cm with long, reddish branches. Large, dark green leaves with reddish and glossy shades. The flowers are large and convoluted (30 petals), elongated buds that open slowly and, in a spiral, with golden-yellow petals, sometimes with shades of pale pink. Soft perfume. Good disease resistance, sensitive to frost. Adequate to produce cut flowers in the field.

**'Rusticana'**

Class: Cover

Origin: 'Candy Rose' × 'Yesterday'

Author: Ștefan Wagner, 1995

Description: Bushes of medium vigour, 50/100 cm, with creeping branches. Glossy leaves. Semi-enveloped flowers, small to medium, with pale pink petals, without fragrance. For massive plantings.





**'Red Candy'**

Class: Cover

Origin: 'Candy Rose', open pollination

Author: Ștefan Wagner, 1995

Description: Bushes of medium vigour, 50/70 cm, with bent branches and glossy foliage. Simple flowers, many reds, light-coloured petals, with a white eye in the center. Slightly sensitive to frost. For massive plantings.

**'Bordura de nea'**

Class: Floribunda

Origin: 'Bonica '82' × 'Incandescent'

Author: Ștefan Wagner, 1995

Description: Bushes of medium vigour, 50/40 cm with dense branches and semi-glossy foliage. Simple, 5-petalled, small, white flowers in large clusters. Abundant flowering. Good disease and frost resistance. For borders and massive plantings.



**'Rosadora'**

Class: Floribunda

Origin: 'Candy Rose' × 'Yesterday'

Author: Ștefan Wagner, 1995

Description: Vigorous bushes, 90/70 cm, with erect and then drooping branches. Light green, glossy leaves. Twisted flowers, small, grouped in large clusters, pale pink petals. Good disease and frost resistance. For solitary plantings, in small groups, in massifs or fences.



**'Rosagold'**

Class: Floribunda

Origin: 'Vigorosa' × 'Allgold'

Author: Ștefan Wagner, 1995

Description: Bushes of great vigour, 100/50 cm, with erect branches, light green, glossy leaves. Convoluted flowers (more than 30 petals), large. Yellow petals mixed with pink. Intense perfume. Sensitive to frost. For massif plantings and borders, parks.



**'Simina'**

Class: Floribunda

Origin: 'Vigorosa' × 'Allgold'

Author: Ștefan Wagner, 1996

Description: Bushes of great vigour, 100/70 cm, with erect branches. Leaves leathery and glossy. Convoluted flowers (over 40 petals), large, appear grouped in rich clusters. Deep pink petals. Moderate fragrance. Abundant flowering. Good disease and frost resistance. For fences or small groups.

**'Judit'**

Class: Floribunda

Origin: 'Rosabunda' × 'Circus'

Author: Ștefan Wagner, 1996

Description: Bushes of medium vigour, 60/40 cm with erect branches, reddish, with large thorns and still, shiny leaves. Twisted flowers (over 30 petals), medium-large, with yellow petals iridescent with pink. Weak perfume. Good disease resistance, sensitive to frost. For massifs and borders, floral arrangements.





### **'Splendid'**

Class: Floribunda

Origin: 'Centenaire de Lourdes' × 'Clare Grammerstorf'

Authors: Ștefan Wagner, Gabriela Roman, 1997

Description: Bushes of medium vigour, 60/40 cm, with thick, semi-erect branches. Dark green, glossy leaves. Convoluted flowers, large, grouped by 5-7, cream-white petals with pink edges. Weak perfume. Good disease and frost resistance. For massif plantings and borders, parks.

### **'Nobilia'**

Class: De Parc

Origin: 'Rosabunda' × 'Dr. Faust'

Authors: Ștefan Wagner, Gabriela Roman, 1998

Description: Bushes of great vigour, 140/80 cm, erect branches, with many thorns. Dark green, glossy leaves. Large, coiled flowers (38 petals), of noble form, opening in a spiral. With light pink petals, with a faint fragrance. Abundant flowering in the first wave, moderate in the second. It resists frost and diseases well. For parks in small groups or as a solitary plant.



### **'Nostalgica'**

Class: Garden roses

Origin: 'Vigorosa' x 'Angela'

Author: Ștefan Wagner, 1998

Description: Vigorous bushes, 160/100 cm with erect branches and many thorns. Dark green, glossy and leathery leaves. Involute, spherical flowers, grouped in large bunches. Purple petals with pink exterior. Intense and sweet fragrance. Semi-remontant. Very disease and frost resistant. For solitary planting, in small groups or hedges. The first purple Romanian variety.

**'Carmen'**

Class: Groundcover

Origin: 'Candy Rose' × 'Yesterday'

Authors: Ștefan Wagner, Gabriela Roman, 1999

Description: Bushes of medium vigour, 70/90 cm with long, recurved branches, dark green, glossy leaves. Semi-whorl flowers, small-medium, grouped in large clusters. Petals red-light carmine. Weak perfume. For fences, as a cover or in a container.



**'Mirela'**

Class: Floribunda

Origin: 'Castanet' × 'Carillon'

Authors: Ștefan Wagner, Gabriela Roman, 1999

Description: Short bushes, 50/40 cm with medium, dark green, glossy leaves. Twisted flowers (50 petals), large, noble shape. Yellow petals with pink edges. Weak perfume. Abundant flowering in two distinct waves. For discounts, curbs, parks, containers.

**'Orange ace'**

Class: Hybrid tea

Origin: 'Rosabunda' × 'Galia'

Authors: Ștefan Wagner, Gabriela Roman, 1999

Description: Vigorous bushes, 100/50 cm, with erect branches and many thorns. Medium, glossy leaves. Convolute flowers (25 petals), urn-shaped buds, red-brick-carmine petals. Weak perfume. Good disease and frost resistance. For the production of cut flowers both in the field and protected spaces.



**'Golden Fiesta'**

Class: De Parc

Origin: 'Candy Rose' × 'Allgold'

Authors: Ștefan Wagner, Gabriela Roman, 2000

Description: Bushes of great vigour, 150/100 cm with erect branches. Light green, glossy leaves. Medium, coiled flowers (28 petals) with intense lemon-yellow petals. Moderate fragrance. The first wave of flowers is abundant, the second less so. Good disease and frost resistance. For parks, that solitary plants or small groups, fences.

**'Romana'**

Class: Hybrid tea

Origin: 'Rosabunda' × 'Landora'

Authors: Ștefan Wagner, Gabriela Roman, 1999

Description: Bushes of great vigour, 130/60 cm, with erect branches, medium thorns, arranged often. Dense, large-leaved, light green, semi-glossy foliage. Large, convoluted flowers (over 50 petals), brick-red, lack luster. Weak perfume. Good frost and disease resistance. Recommended for gardens, parks and cut flowers.



**'Doamna în mov'**

Class: Hybrid tea

Origin: 'Lavendula' × 'Mainzer Fastnacht' Author: Ștefan Wagner, Gabriela Roman, 1999

Description: Bushes of medium vigour, 70/40 cm with erect branches, very few thorns, Dark green leaves, semi-glossy, light. The medium-large flowers, wrapped (28 petals), elegantly shaped, appear singly or in groups of 3-5. Deep purple petals. Strong perfume. Sensitive to frost and black spot but resistant to powdery mildew and rust. For massive plantings.

**'Perla Transilvaniei'**

Class: Floribunda

Origin: 'Rusticana' × 'Lavender Dream' Authors: Ștefan Wagner, Gabriela Roman, 2004

Description: Bushes of medium vigour, 80/100 cm, with thin, semi-erect branches, with few thorns. The leaves are small, dark green, glossy. The flowers appear in large bunches, are coiled (22 petals), lilac-pink, with a small white eye. Weak fragrance. Good frost and disease resistance. For parks and gardens, hedges, container.





**'Petrina'**

Class: Floribunda

Origin: 'Bonica '82' × 'Lavender Dream' Authors: Ștefan Wagner, Gabriela Roman, 2004

Description: thorns, almost none. Medium, dark green, glossy leaves. Medium flowers (20 petals), many, pink, weak fragrance. Very good frost and disease resistance. For hedges, in massifs in parks or in small groups in gardens.

**'Rosatop'**

Class: Floribunda

Origin: [( 'Bonica '82' × 'Rosabunda' ) × ( 'Candy Rose' × 'Rumba' )]

Authors: Ștefan Wagner, Gabriela Roman, 2004

Description: Bushes of medium vigour, 80/80 cm, with semi-erect branches and very few thorns. Medium leaves, light green, semi-glossy. Semi-whorl flowers (20 petals), medium in size, dark crimson-red petals, with a large eye, white in the center. Weak perfume. Good frost and disease resistance. For planting in massifs or in small groups.



**'Rosadoll'**

Class: Floribunda

Origin: 'Rusticana' × 'Lavender Dream'

Author: Ștefan Wagner și Gabriela Roman, 2004

Description: Bushes of medium vigour, 80/70 cm, with thin, semi-erect branches, with few thorns. Medium, dark green, glossy leaves. Flowers arranged in bunches, semi-wrapped (17 petals), medium, lilac-purple. Good frost and disease resistance. For massif planting, borders, low fences and containers.

### **'Steliana'**

Class: Hybrid tea

Origin: 'Romstar' × 'Mme Meilland'

Authors: Gabriela Roman, Ștefan Wagner, 2005

Description: Bushes of medium-large vigour, 100/70 cm, erect branches of medium thickness, reddish and with few thorns. Large, coiled flowers (55 petals), of noble form, dark scarlet-red, medium, pleasant fragrance. It resists powdery mildew well, less so and black spotting. For massive plantings and cut flowers.



### **'Sandra'**

Class: Floribunda

Origin: 'Bonica' × 'Montana'

Authors: Gabriela Roman, Ștefan Wagner, 2008

Description: Vigorous bushes, 100/70 cm, almost spherical, with glossy and leathery foliage. The medium-large flowers (6-7 cm in diameter), appear in bunches, are wrapped (25-30 petals), pink-lilac in colour. Light but pleasant perfume. It blooms almost continuously all summer. Good disease and frost resistance. Planting in massifs or hedges is recommended.



### **'Curcubeu'**

Class: Floribunda

Origin: 'Judit' × 'Luchian'

Authors: Gabriela Roman, Ștefan Wagner, 2009

Description: Vigorous bushes 80/50 cm, with erect growth, thick branches and dark green, leathery and glossy foliage. The flowers are large (diameter 7-8 cm), coiled (21 petals), red-orange in colour, without fragrance. It blooms profusely until the first frosts. Good disease and frost resistance. It is recommended for massif plantings and hedges.



### **'Afrodita'**

Class: Floribunda

Origin: 'Montana' × 'Rosagold'

Authors: Gabriela Roman, Ștefan Wagner, 2009

Description: High vigour bush 100/65 cm, with dark green, decorative, glossy and leathery foliage. The flowers appear in bunches, with slightly elongated buds, wrapped (35 petals) salmon-pink in colour, large (diameter 9-10 cm), with a light, pleasant fragrance. Very good disease resistance and good frost resistance. It is recommended for massive plantings, hedges.

**'Cezara'**

Class: Floribunda

Origin: 'Candy Rose' × 'Nobilia'

Authors: Gabriela Roman, Ștefan Wagner, 2009

Description: Medium-vigorous, semi-erect bushes with thin, reddish branches with few thorns. Medium, dark green, glossy leaves. Semi-whorl flowers (19 petals), medium size, scarlet red with a yellow center eye. Very good disease and frost resistance. For massif plantings, borders, gardens.



**'Aurora'**

Class: Floribunda

Origin: 'Judit' × 'Luchian'

Authors: Gabriela Roman, Ștefan Wagner, 2009

Description: Bushes of medium vigour, with reddish, erect branches and few thorns. Medium-sized, dark green, glossy leaves. Twisted flowers (22 petals) light pink. Weak perfume. Very good disease resistance. For mass planting, borders, parks and gardens.

**'Pasiune in mov'**

Class: De Parc

Origin: 'Nostalgica' F2

Authors: Gabriela Roman, Ștefan Wagner, 2006

Description: Bushes of medium vigour 80/70 cm, arched branches. Medium leaves, light green, matte. Large, very wrapped flowers (80 petals), purple-lilac colour. Abundant flowering in the first wave, less in the second. Intense, pleasant, slightly sweet perfume. Ask for long cuts. For hedges, jam can be prepared from the petals.



**'Cluj 2010'**

Class: Floribunda

Origin: sport 'Foc de Tabără'

Authors: Ștefan Wagner, Angela Bokor, 2010

Description: Compact bushes of medium vigour 80/40 cm, semi-erect branches. Dark green, glossy leaves. Medium-sized flowers (6-7 cm) wrapped (27-31 petals), appear in bunches, 2-7 each. The colour changes from golden yellow to carmine red, with many intermediate phases found along the way. No fragrance. Rich bloom. Good disease and frost resistance. For massif planting or fences, borders.

**'Veronica'**

Class: Floribunda

Origin: 'Golden Holstein' × 'Montana'

Authors: Gabriela Roman, Ștefan Wagner, 2011

Description: Compact bushes of medium vigour, 80/40 cm with erect branches. Light green, semi-glossy leaves. The flowers are semi-entwined (more than 18 petals), medium in size, with yellow to red petals, with a great decorative effect. Abundant and continuous flowering. Weak perfume. Very good resistance to frost, diseases and pests. For planting in borders, in groups and gardens.



**'Wagner's favorit'**

Class: Hybrid tea

Origin: sport 'Alinka'

Author: Ștefan Wagner, 2012

Description: Bushes of medium vigour 80/45 cm, with erect branches, of medium thickness. Medium leaves of dark green colour, glossy, many. Large flowers, over 8 cm in the open phase, coiled (30 petals), elongated buds (4-5 cm), red-orange in colour, with yellow petal base. No fragrance. Good disease and frost resistance. For massive plantings or cut flower production. Lasts in water for 4-6 days.

**'Bogdana'**

Class: Floribunda

Origin: 'Rusticana' × 'Lavender Dream'

Authors: Gabriela Roman, Ștefan Wagner, Eugenia Hârșan, Maria Giurgiu, 2012

Description: Vigorous bushes, 110/90 cm, branches with rare and few thorns, with dark green leaves. The flowers are medium-sized, coiled (50 petals), grouped in large clusters, dark pink to purple-red petals. Pleasant fragrance. It is frost and disease resistant. For planting in groups and landscaping.



**'Aroma'**

Class: Shrub

Origin: 'Rusticana' × 'Lavender Dream' Authors: Gabriela Roman, Ștefan Wagner, Eugenia Hârșan, Maria Giurgiu, 2012

Description: Bushes of great vigour, 110/110 cm, globular shape, with thick and straight shoots, reddish-brown in colour. Dark green, semi-glossy leaves. The flowers are semi-whorl (12 petals), bicolor, cream-white with a brick-red upper third over which a very beautiful brown colour is superimposed. Weak perfume. Very good resistance to frost, diseases and pests. For planting in groups of 3-5 plants, hedges, gardens and landscaping.

### **'Puritate'**

Class: Shrub

Origin: 'Rusticana' × 'Lavender Dream'

Authors: Gabriela Roman, Ștefan Wagner, Eugenia Hârșan, 2013

Description: Bushes of medium vigour, with medium-sized, thick, semi-glossy leaves. The flowers are semi-involute (10 petals), arranged in short and compact inflorescences. The colour of the petals is pastel white towards the tip of the petals with pale pink. Continuous flowering. Weak perfume. Very good resistance to frost, diseases and pests. For massive plantings, parks, hedges, landscaping.



### **'Violet'**

Class: Shrub

Origin: 'Rusticana' × 'Lavender Dream'

Authors: Gabriela Roman, Ștefan Wagner, Eugenia Hârșan, Maria Giurgiu, 2015

Description: Wide bushes of great vigour, 100/180 cm with spreading, semi-erect branches. Medium-sized, dense, dark green, glossy leaves. The flowers are semi-circular (10 petals), purple-violet in colour with a large white eye in the center of the flower. Continuous flowering. Good perfume. It is very decorative with its foliage and the special colour of its petals. Very good resistance to frost, diseases and pests. For planting in parks, gardens, in groups of 3-5 plants, landscaping.

### **'Romanita'**

Class: Floribunda

Origin: 'Olala' × 'Pasiune Mov'

Author: Gabriela Roman, 2021

Description: Tall bushes of great vigour, 90/120 cm with semi-erect branches. Large, dense, dark green, glossy leaves. The flowers are semi-wrapped (12 petals), cyclamen pink in colour with a very large flower diameter. Continuous flowering. Weak fragrance. Very good resistance to diseases and pests. Suitable for planting in parks, gardens, landscaping.





### **'Sanzaiana'**

Class: Floribunda

Origin: 'Montana' × 'Rosagold'

Authors: Gabriela Roman, Eugenia Hârșan, Maria Giurgiu, 2021

Description: Bushes of medium vigour, 70/90 cm with erect branches. Dense medium-sized leaves, dark green, glossy. The flowers are coiled (35 petals), deep pink in colour with a very large flower diameter. Continuous flowering. Very good perfume. Very good resistance to diseases and pests. It lends itself to planting in parks and private gardens.

### **'Maribella'**

Class: Floribunda

Authors: Gabriela Roman, Wagner Stefan, Giurgiu Maria, Harsan Eugenia, 2016

Description: Bushes of medium vigour 80/90 cm, with erect branches. Medium-sized, light green, glossy leaves. The flowers are coiled (30 petals), blood-red with a white eye. Continuous flowering. Good resistance to diseases and pests. It lends itself to planting in parks and landscaping.



### **Rose varieties under patenting**



### **'Splendoria'**

Class: Floribunda

Origin: 'Golden Holstein' × 'Montana'

Author: Gabriela Roman, Eugenia Hârșan, Maria Giurgiu, Ulian Beșleagă, 2024

Description: Bushes of medium vigour, 80/90 cm with semi-erect branches. Medium-sized, dark green, glossy leaves. The flowers are wrapped (40 petals), golden yellow with a large flower diameter. Continuous flowering. Weak fragrance. Very good resistance to diseases and pests. It is suitable for planting in parks, in groups of 3-5 plants, landscaping.

**'Luna alba'**

Class: Floribunda

Origin: 'Golden Holtein' x 'Friesia'

Author: Gabriela Roman, Eugenia Hârșan, Maria Giurgiu, 2024

Description: Bushes of great vigour, 90/120 cm with erect branches. Small, dark green, glossy leaves. The flowers are wrapped (30 petals), white in colour with a yellow eye, with a small flower diameter. Continuous flowering. Medium fragrance. Very good resistance to diseases and pests. It is suitable for planting in groups of 3-5 plants, massive and landscaping.



## References

- Aghaloo K, Sharifi A (2023). A GIS-based agroecological model for sustainable agricultural production in arid and semi-arid areas: The case of Kerman Province, Iran. *Current Research in Environmental Sustainability* 6:100230. <https://doi.org/10.1016/j.crsust.2023.100230>
- Bhattacharjee SK, Banerji BK (2010). *The complete book of roses*. Aavishkar Publishers, Jaipur 302 003 (Raj.), India.
- Bilaşco Ş, Roşca S, Păcurar I, Moldovan N, Boş A, Negruşier C, Sestras P, Bondrea M, Naş S (2016). Identification of land suitability for agricultural use by applying morphometric and risk parameters based on GIS spatial analysis. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca* 44(1):302-312. <https://doi.org/10.15835/nbha44110289>
- Božanić Tanjga B, Ljubojević M, Đukić A, Vukosavljev M, Ilić O, Narandžić T (2022). Selection of garden roses to improve the ecosystem services they provide. *Horticulturae* 8(10):883. <https://doi.org/10.3390/horticulturae8100883>
- Cui WH, Du XY, Zhong MC, Fang W, Suo ZQ, Wang D, Dong X, Jiang XD, Hu JY (2022). Complex and reticulate origin of edible roses (*Rosa*, Rosaceae) in China. *Horticulture Research* 9:uhab051. <https://doi.org/10.1093/hr/uhab051>
- Dan C, Sestras AF, Bozdog C, Sestras RE (2015). Investigation of wild species potential to increase genetic diversity useful for apple breeding. *Genetika* 47(3):993-1011. <https://doi.org/10.2298/GENSRI1503993D>
- Datta SK (2018). Breeding of new ornamental varieties. *Current Science* 114(6):1194-1206. <https://www.currentscience.ac.in/Volumes/114/06/1194.pdf>
- De Vries DP, Dubois L (1996). Rose breeding: past, present, prospects. *Acta Horticulturae* 424:241-248. <https://doi.org/10.17660/ActaHortic.1996.424.43>
- Debener T (2003). Inheritance of characteristics. In: Roberts AV (Ed). *Encyclopedia of Rose Science*. Academic Press, pp 286-292. <https://doi.org/10.1016/B0-12-227620-5/00041-0>
- Debener T, Byrne DH (2014). Disease resistance breeding in rose: Current status and potential of biotechnological tools. *Plant Science* 228:107-117. <https://doi.org/10.1016/j.plantsci.2014.04.005>
- Debener T, Linde M (2009). Exploring complex ornamental genomes: The rose as a model plant. *Critical Reviews in Plant Sciences* 28(4):267-280. <http://dx.doi.org/10.1080/07352680903035481>
- Druitt L (2004). *The organic rose garden*. Taylor Trade Publishing.
- Gitonga VW, Koning-Boucoiran CF, Verlinden K, Dolstra O, Visser RGF, Maliepaard C, Krens FA (2014). Genetic variation, heritability and genotype by environment interaction of morphological traits in a tetraploid rose population. *BMC Genetics* 15:146. <https://doi.org/10.1186/s12863-014-0146-z>
- Gudin S (2000). Rose: genetics and breeding. In: Janick J (Ed). *John Wiley & Sons. Plant Breeding Reviews* 17:159-190. <https://doi.org/10.1002/9780470650134.ch3>
- Harmon DD, Chen H, Byrne D, Liu W, Ranney TG. 2023. Cytogenetics, ploidy, and genome sizes of rose (*Rosa* spp.) cultivars and breeding lines. *Ornamental Plant Research* 3:10. <https://doi.org/10.48130/OPR-2023-0010>
- Jones SE (2013). The inheritance of plant and flower traits in rose. Honors and Undergraduate Research. Retrieved 2023 August 18 from: <https://hdl.handle.net/1969.1/154894>
- Kawamura K, Hibrand-Saint Oyant L, Thouroude T, Jeauffre J, Foucher F (2015). Inheritance of garden rose architecture and its association with flowering behaviour. *Tree Genetics and Genomes* 11:22. <https://doi.org/10.1007/s11295-015-0844-3>
- Krussman G (1981). *The complete book of roses*. Portland, Oregon: Timber Press.
- Leus L (2017). Selection strategies for disease resistance in roses. Reference Module in Life Sciences. Elsevier. <https://doi.org/10.1016/B978-0-12-809633-8.05008-1>
- Leus L, Van Laere K, De Riek J, Van Huylenbroeck J (2018). Rose. In: Van Huylenbroeck J (Ed). *Ornamental Crops. Handbook of Plant Breeding* 11, pp 719-767. Springer International Publishing AG, part of Springer Nature. <https://link.springer.com/book/10.1007/978-3-319-90698-0>
- Matei I, Pacurar I, Rosca S, Bilaşco S, Sestras P, Rusu T, Jude ET, Tăut FD (2020). Land use favourability assessment based on soil characteristics and anthropic pollution. Case study Somesul Mic valley corridor, Romania. *Agronomy* 10:1245. <https://doi.org/10.3390/agronomy10091245>
- Nadeem M, Younis A, Riaz A, Lim KB (2015). Crossability among modern roses and heterosis of quantitative and qualitative traits in hybrids. *Horticulture Environment Biotechnology* 56:487-497. <https://doi.org/10.1007/s13580-015-0144-8>

- Noack R (2003). Selection strategies for disease and pest resistance. In: Roberts AV (Ed). Encyclopedia of Rose Science. Academic Press, pp 49-55. <https://doi.org/10.1016/B0-12-227620-5/00100-2>
- Raymond O, Gouzy J, Just J, Badouin H, Verdenaud M, Lemainque A, ... Bendahmane M (2018). The *Rosa* genome provides new insights into the domestication of modern roses. *Nature Genetics* 50(6):772-777. <https://doi.org/10.1038/s41588-018-0110-3>
- Roman G, Sestras R, Wagner S (2008). The response of several modern cultivars of landscape roses in the conditions of Cluj-Napoca, Romania. *Bulletin UASVM, Horticulture* 65(1):122-125.
- Sestras P, Bondrea MV, Cetean H, Sălăgean T, Bilașco Ș, Naș S, Spalevic V, Fountas S, Cîmpeanu SM (2018). Ameliorative, ecological and landscape roles of Făget Forest, Cluj-Napoca, Romania, and possibilities of avoiding risks based on GIS landslide susceptibility map. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca* 46(1):292-300. <https://doi.org/10.15835/nbha4611086>
- Sestras P, Salagean T, Bilasco S, Bondrea MV, Nas S, Fountas S, Spalevic V, Cimpeanu SM (2019). Prospect of a GIS based digitization and 3D model for a better management and land use in a specific micro-areal for crop trees. *Environmental Engineering and Management Journal* 18:1269-1277. <http://dx.doi.org/10.30638/cemj.2019.121>
- Sestras RE, Pamfil D, Ardelean M, Botez C, Sestras AF, Mitre I, Dan C, Mihalte L (2009). Use of phenotypic and MAS selection based on bulk segregant analysis to reveal the genetic variability induced by artificial hybridization in apple. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca* 37(1):273-277. <https://doi.org/10.15835/nbha3713135>
- Sestras RE, Sestras AF (2023). Quantitative traits of interest in apple breeding and their implications for selection. *Plants* 12(4):903. <https://doi.org/10.3390/plants12040903>
- Shupert D, Anderson N, Byrne D (2004). The inheritance of several traits in three diploid interspecific rose populations. *HortScience* 39:807-808. <https://doi.org/10.21273/HORTSCI.39.4.807E>
- Smulders MJ, Arens P, Bourke PM, Debener T, Linde M, De Riek J, ... Foucher F (2019). In the name of the rose: a roadmap for rose research in the genome era. *Horticulture Research* 6:65. <https://doi.org/10.1038/s41438-019-0156-0>
- Stoian-Dod RL, Dan C, Morar IM, Sestras AF, Truta AM, Roman G, Sestras RE (2023). Seed germination within genus *rosa*: the complexity of the process and influencing factors. *Horticulturae* 9(8):914. <https://doi.org/10.3390/horticulturae9080914>
- Treloar Roses (2023). Treloar Roses, 216 Princes Highway, Bolwarra VIC 3305 P: 1300 044852. Retrieved during 2019-2024 from [www.treloarroses.com.au](http://www.treloarroses.com.au)
- UPOV (2022). Guidelines for the Conduct of Tests for Distinctness, Uniformity and Stability. TG/11/8 Rev. 2. Rose UPOV Code: ROSAA, *Rosa* L. International Union for the Protection of New Varieties of Plants, Geneva. <https://www.upov.int/edocs/tgdocs/en/tg011.pdf>
- Wagner S (2002). Trandafirul. De la mit la mileniul trei [The rose. From myth to the third millennium]. ISBN: 973-0-02590-8, p 284.
- Wagner S, Ardelean M, Sestras R, Ghidra V, Pamfil D, Roman G, Florincescu A, Cordea M, Catana C, Budiu V (2000). Achievements in rose breeding at Cluj-Napoca, Romania, in the last thirty years. *Biotechnology and Biotechnological Equipment* 14(2):37-41. <https://doi.org/10.1080/13102818.2000.10819085>
- Walheim L (2000) *Roses for dummies*, 2nd Edition. Hungry Minds Inc, U.S.
- Whitaker VM, Hokanson SC (2009). Partial resistance to black spot disease in diploid and tetraploid roses: general combining ability and implications for breeding and selection. *Euphytica* 169:421-429. <https://doi.org/10.1007/s10681-009-9976-6>
- Yan ZF, Dolstra O, Hendriks T, Prins TW, Stam P, Visser PB (2005). Vigour evaluation for genetics and breeding in rose. *Euphytica* 145:339-347. <https://doi.org/10.1007/s10681-005-2070-9>
- Zepner L, Karrasch P, Wiemann F, Bernard L (2020). ClimateCharts.net – an interactive climate analysis web platform, *International Journal of Digital Earth* 14(3):338-356. <https://doi.org/10.1080/17538947.2020.1829112>
- Zlesak DC (2007). Rose. In: Anderson NO (Eds). *Flower Breeding and Genetics*. Springer, Dordrecht. [https://doi.org/10.1007/978-1-4020-4428-1\\_26](https://doi.org/10.1007/978-1-4020-4428-1_26)



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