horticulturae

Article

Compatibility and Possibility of New Ornamental Geophytes for Their Utilization in Landscape Architecture

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Abstract: Ornamental geophytes, renowned for their beauty, hold a special place among flower enthusiasts and producers, enhancing the aesthetic appeal of gardens and orchards. The main aim of this study was to ascertain the viability of cultivating decay-resistant genotypes and identify appropriate planting locations for each species within a one-to-three-year timeframe, contingent upon the specific species. The research took place at the Flower and Plant Production Center of the Gorgan Municipality's Landscape and Urban Green Space Organization in Iran, with the primary focus on leveraging various geophyte flower species to optimize urban landscapes and elevate their visual allure. Utilizing a completely randomized block design with three replications, the study examined numerous species in the landscape. Various plant growth parameters were evaluated, including flowering time, optimal planting time, flower longevity on the plants, speed of underground bulb sprouting time, and visual quality of the samples. Results revealed that *Narcissus jonquilla* and *Alstroemeria aurea* cv. Balance exhibited the longest flower longevity, lasting for 43 days in the second year of growth. Conversely, *Gladiolus hybrida* (cv. Alexander) and *Canna indica* (cv. Flaccida and cv. Phasion) demonstrated a flower longevity of 13 days across both cultivation years. *Alstroemeria* and *Crocosmia* showed the shortest flowering time, significantly reduced compared to the first year due to the altered planting time. The assessment of visual quality highlighted *Polianthes*, *Dahlia*, and *Gladiolus* cultivars as displaying the highest visual appeal among the studied species. These findings yield valuable insights into the potential production and/or breeding of decay-resistant hybrid cultivars well suited for such regions.

Keywords: cultivation feasibility; cluster analysis; correlation coefficients; landscaping; ornamental features; new ornamental geophytes; bulbous flower species

Citation: Babarabie, M.; Sardoei, A.S.; Jamali, B.; Hatami, M.; Nicola, S.; Devecchi, M. Compatibility and Possibility of New Ornamental Geophytes for Their Utilization in Landscape Architecture. *Horticulturae* **2024**, *10*, 3. https://doi.org/10.3390/horticulturae10010003

Academic Editor: Genhua Niu

Received: 31 October 2023
Revised: 13 December 2023
Accepted: 14 December 2023
Published: 19 December 2023

1. Introduction

Today, ecological approaches in landscape architecture have emerged as exemplary models for enhancing environmental quality and promoting sustainability. Additionally, landscapes play a pivotal role in infusing vitality into urban environments [1]. However, challenges posed by climatic conditions and unsustainable resource utilization, particularly water, have compelled city managers to incorporate ornamental geophytes in landscape design [1,2]. As cities rapidly expand, urban landscapes become increasingly essential for the emotional well-being of residents [3]. Ornamental geophytes exhibit impressive adaptability to local climatic conditions and water availability, allowing them to thrive in their environment. Moreover, they demonstrate resilience, obviating the need for excessive reliance on fertilizers, pesticides, or irrigation [4]. Consequently, establishing landscapes using ecologically compatible species holds special significance, making the identification of suitable ornamental plants a top priority.

Cultivating ornamental plants offers a multitude of advantages encompassing environmental benefits such as climate regulation, economic advantages like energy conservation, social enhancements including improved privacy and security, and aesthetic contributions to beautifying communities and urban structures [5–8]. Beyond aesthetics, ornamental plants foster a profound human connection with nature in urban areas [9,10], serving as integral elements of urban life rather than mere decorations. Ornamental geophytes, in particular, provide essential food sources for urban pollinators such as bees [11]. Overall, ornamental plants play a pivotal role in emphasizing the importance of green spaces within densely populated urban regions.

The utilization of commercial ornamental plants, renowned for their aesthetic attributes, plays a crucial role in various urban domains such as creating landscapes that foster socialization and environmental education [12]. Several ornamental geophyte species, primarily from cosmopolitan families like *Liliaceae*, *Iridaceae*, and *Amaryllidaceae*, are cultivated in Iran, significantly contributing to vibrant displays of colorful flowers in the landscape [13]. These flowers hold immense potential in the horticultural and floricultural industries, serving as exquisite options for cut flowers and potted plants, and enhancing landscape quality [13]. The origin of the ornamental geophytes used in this experiment varies depending on the species, namely *Polianthes tuberosa* (Mexico), *Crocosmia aurea* (Madagascar), *Hedychium coronarium* (Madagascar), *Alstroemeria aurea* (Chile), *Freesia refracta* (South Africa), *Narcissus tazetta* and *Narcissus jonquilla* (Asia, Spain, and Portugal), *Hyacinthus orientalis* (the Netherlands), *Tulipa gesneriana* (the Netherlands), *Iris* × *hollandica* (the Netherlands), *Dahlia pinnata* (Mexico, Colombia), *Gladiolus hybrida* (South Africa), and *Canna indica* (South Africa) [14].

In the urban landscape of Gorgan city (moderately humid), a diverse range of seasonal flowers and ornamental shrubs are cultivated. However, the utilization of geophytes resistant to decay has been significantly limited, underscoring the need for further investigations to ensure the successful cultivation of such species. Selecting suitable species that can adapt to the ecological conditions of the region is a major challenge that can be effectively addressed by choosing appropriate ornamental geophytes [15]. However, in certain provinces of Iran, this aspect has received less attention due to various reasons and limitations related to soil, water, and climate conditions. Therefore, exploring the potential for cultivating high-humidity ornamental geophytes, particularly to enhance diversity in urban landscapes, becomes necessary. We speculate on the relationships between measurement variables and New Ornamental Geophytes.

The main objective of this work was to study the feasibility of cultivating decay-resistant genotypes and determining suitable locations for each plant after a period of one to three years, depending on the species.

2. Material and Methods

Gorgan, spanning an area of 3567 hectares, is positioned as one of Iran's northern cities and operates as the administrative center of Golestan province, located southeast of the Caspian Sea. Nestled at the foothills of the northern Alborz mountain range, its geographic coordinates range from 37°00′–37°30′ north latitude to 54°00′–54°30′ east longitude.

2.1. Plant Materials and Growth Conditions

The experiment unfolded at the Flower and Plant Production Center of the Gorgan Municipality's Landscape and Urban Green Space Organization (Iran), over a two-year period from 2019 to 2020. Underground ornamental geophyte organs were sourced from Zanbag, a specialized producer situated in Mahalat City, within Iran's central province. Detailed information on the scientific names, families, flower colors, ornamental organs, irrigation needs, and propagation method of the studied geophytes is provided in the supplementary material (Table S1). Various species, including *Polianthes tuberosa* L., *Crocosmia aurea* L., *Hedychium coronarium* J. Koenig, *Alstroemeria aurea* Graham, *Freesia refracta* (Jacq.) Klatt, *Narcissus tazetta* L., *Hyacinthus orientalis* L., *Tulipa gesneriana* L., *Iris* × *hollandica* H.R. Wehrh., *Dahlia pinnata* Cav., *Gladiolus hybrida*, and *Canna indica* L., were cultivated following recommended commercial guidelines for planting dates, depth, and density (Table S2). The initial planting took place in early March 2019, while the second-year planting began on 16 May, considering assessments of flowering time and visual flower quality from the first year. Climatic data (temperature, relative humidity, and rainfall) were obtained from a meteorological station in the experimental area (Figure 1). The geographic coordinates of the experimental area are 37°00′–37°30′ N and 54°00′–54°30′ E.

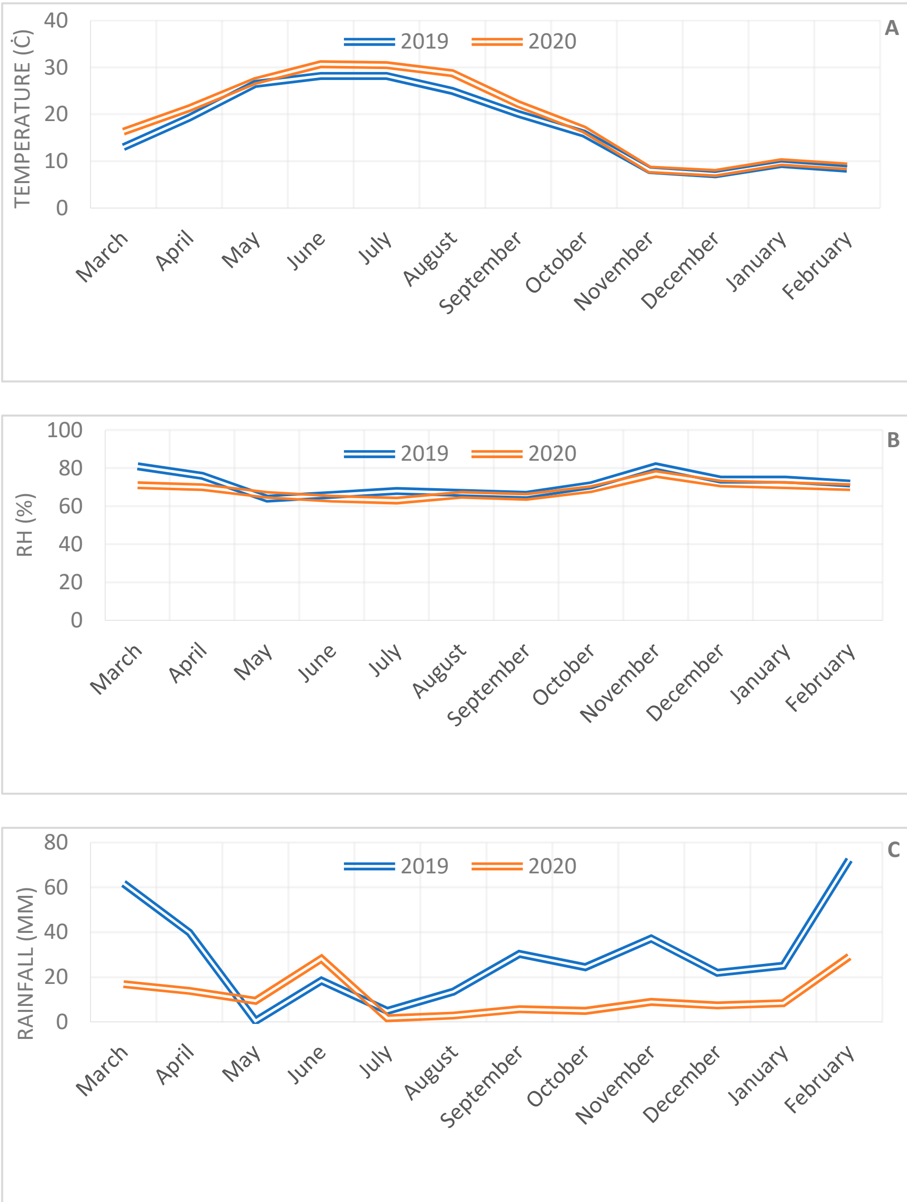

Figure 1. Climatic data in the experimental area for 2019 and 2020: air temperature (**A**), relative humidity—RH (**B**), and rainfall (**C**). Data presented are the mean values.

Before planting, the soil underwent disinfection using Captan (Orthocid, Aria Chemical Company, Tehran, Iran) fungicide (2 g L^{-1}) for 20 min. The Captan fungicide, belonging to the phthalimide class, possesses both protective and therapeutic effects, suitable for foliar spraying, seed disinfection, and sterilizing ornamental geophytes and soil.

The underground organs were planted in a soil mixture comprising clay (40%), sand (30%), and decomposed manure (30%), which underwent disinfection after blending. The designated plot was divided into sections, allocating a 6-square-meter plot (2 square meters per replication) for each plant variety individually, with 12–32 samples per replication. Subsequent to planting, routine maintenance practices such as manual weeding, irrigation, and fertilization were carried out as required. During the growth and testing phases, plants were watered when the soil dried completely. Chemical fertilizers (Ziegler, Plößberg, Germany) containing NPK (nitrogen, phosphorus, and potassium) along with micronutrients were applied thrice, at a 4 g m^{-2} dosage. Approximately 20 days after planting each species, a compound fertilizer (10–52–10) was administered. Subsequently, a 20–20–20 fertilizer was applied at 20-day intervals, supplemented with necessary micronutrients. Ahead of the flowering stage, varying based on each plant's specific flowering time, a 36–12–12 fertilizer was utilized. Adhering to the manufacturer's instructions, 40 g of fertilizer was employed per 10 L of water. Fertilizers were prepared in a 1000 L tank and sprayed on the plants at the specified intervals.

2.2. Optimal Planting Time

After the initial planting in the first year and subsequent measurement of relevant characteristics along with the assessment of visual quality, the optimal planting dates for different underground plant organs, as studied in this research, were determined (Tables S2 and S3). For instance, shifting the planting date of *Gladiolus* and *Canna* from April to March in the second year resulted in the majority of bulbs and rhizomes flowering. This change not only improved the quality of the flowers, leading to a greater number of florets, but also led to substantial growth in the height of *Canna* cultivars, making them suitable for various landscape applications, including covering undesirable areas.

Underground organs planted in the spring of the first year, 2019, were harvested in late November of the same year. Similarly, plants planted during autumn and winter were harvested in late March of the subsequent year, 2020. After these harvested organs experienced a significant decrease in moisture content, they were carefully stored in a cool, shaded storage facility to maintain their viability for the second-year planting. Additionally, the soil analysis results relevant to the project can be found in Table S4.

2.3. Measurements

During the growth stages of the plants, several morphological characteristics were measured, including visual quality, flower longevity on the plant, flowering time, and bulb sprouting time. These assessments were repeated in the second year of cultivation. Visual quality was evaluated using a scoring system ranging from 1 to 5. A rating of 5 represented excellent quality, 4 very good, 3 good, 2 average, and 1 poor, based on extensive experience, prior experiments, and commercial criteria for ornamental geophytes [16]. Specifically, plants exhibiting exceptional quality and beauty in all aerial parts including leaves, stems, and flowers (e.g., transparent color of leaves and flowers, healthy and straight stem without unusual paleness and bending) received the highest score (4 or 5). Conversely, plants lacking these characteristics (such as yellowing leaves, faded flower petals, or crooked stems) were rated lower (1 or 2). Plants showing positive attributes in some parameters and negative in others received an average score (3).

The method employed to determine flower longevity involved the following steps: The start of flower appearance, along with the budding and blooming of florets, marked the beginning of the assessment period [17]. The duration of flower longevity was measured as the number of days a flower remained viable on the plant. Flower longevity concluded when a 50% reduction in flower and floret quality was observed. For example, in *Polianthes* [18] and *Narcissus* sp. flowers, this was when 50% of florets transitioned from white to yellow and brown, or in *Crocosmia* sp. flowers, when 50% of the blooms darkened in color [19]. This parameter holds significant importance in green spaces, where the value of a flower increases if it persists longer on the plant.

The germination time of corms, bulbs, rhizomes, and tuberous roots was calculated from the planting date [20]. Flowering time was measured from the planting of the underground parts until the appearance of the plant's inflorescence. Flower life duration was calculated from the time when the plant's inflorescence appeared and fully opened until there was a 50% reduction in visual quality (as previously described). Bulb sprouting time was determined from the planting of the underground organs until germination occurred, calculated as the number of days of germination.

2.4. Experimental Design and Statistical Analysis

This experiment utilized a factorial design within a completely randomized block design (CRBD), involving 3 replications with 12 to 32 samples per replication, depending on the species: 12 for *Crocosmia aurea*, *Hedychium coronarium*, and *Gladiolus hybrida*; 20 for *Iris* × *hollandica* and *Canna indica*; 24 for *Polianthes tuberosa*, *Alstroemeria aurea*, *Freesia refracta*, *Narcissus tazetta*, *Tulipa gesneriana*, and *Dahlia pinnata*; 32 for *Narcissus jonquilla* and *Hyacinthus orientalis*. Statistical analyses began with descriptive statistical analysis to understand the initial quality of the collected data. Calculating means simplified and condensed the extensive dataset for easier interpretation. Subsequently, more sophisticated analyses were conducted. Duncan's test, executed through SAS software (version 4.9; SAS Institute Inc., Cary, NC, USA), was employed for computing mean squares and experimental errors to ascertain differences between datasets. The Duncan's Multiple Range Test (DMRT) was applied at a significance level of $p \leq 0.05$ to identify distinctions among means. Pearson's correlation coefficient was calculated to evaluate the correlations between various pairs of parameters utilizing SPSS. (version 26; IBM Corp., Armonk, NY, USA). Cluster analysis was employed to categorize genotypes for breeding programs, aiming to promote genetic diversity. Furthermore, linear regression analysis, conducted using SPSS software (version 26) was employed to predict the value of variables in the first year based on the variables' second-year values.

3. Results

3.1. Descriptive Statistics

Descriptive statistics are presented in Table 1, illustrating the characteristics of ornamental geophytes studied during the first and second years of the experiment. Among the studied plants, visual quality exhibited the least variability, indicated by a standard deviation (SD) of 0.95. In contrast, flower longevity, bulb sprouting time, and flowering time showed broader ranges of variation. Specifically, in the first year, these parameters displayed ranges of 9.51, 12.31, and 67.41, respectively. In the second year, the ranges narrowed slightly to 0.84, 10.23, 10.62, and 45.23, respectively.

Table 1. Descriptive statistics of various parameters in studied ornamental geophytes (first and second year of experiment, 2019 and 2020) (sample size: 12–32).

	First Year			**Second Year**		
Morpho-Physiological Variables	**Minimum**	**Maximum**	**Mean ± Standard Deviation**	**Minimum**	**Maximum**	**Mean ± Standard Deviation**
Bulb sprouting time (days)	6	68	20.64 ± 12.31	11	68	24.13 ± 10.662
Visual quality (score)	2	5	4.05 ± 0.95	2	5	4.45 ± 0.84
Flowering time (days)	64	389	129.71 ± 67.41	12	235	125.03 ± 45.23
Flower longevity (days)	12	45	26.24 ± 9.51	12	47	26.83 ± 10.23

3.2. Cost of Ornamental Geophytes

An economic assessment of planting ornamental geophytes in this research was conducted to determine the price for each square meter of planting, providing designers with various economical options among different plant types. In all green space projects, calculating the cost per square meter is a key criterion; thus, the prices are listed per unit and per square meter (Table 2). According to Table 2, *Polianthes tuberosa*, *Crocosmia aurea*, and *Crocosmia aurea* were found to have the lowest cost for purchasing underground plant organs. The cost is also influenced by the planting distance, with 24 tuberose bulbs considered suitable for planting per square meter, while only 12 *Crocosmia aurea* bulbs can be accommodated in the same area. Conversely, the highest cost was associated with purchasing *Crocosmia aurea*, primarily due to the import of bulbs from the Netherlands to Iran. Although *Canna indica* has a short flowering period limited to the New Year's celebrations in Iran, it proves to be considerably more cost-effective in the long run. Additionally, it not only flowers but also maintains attractive green foliage, enhancing its ornamental appeal.

Table 2. The approximate market price of studied geophytes.

Scientific Name	Price of Single Geophyte (USD)	Total Price per Square Meter (USD)
Polianthes tuberosa	0.06	1.44
Crocosmia aurea	0.12	1.44
Hedychium coronarium	0.08	0.96
Alstroemeria aurea	0.7	16.8
Freesia refracta	0.1	2.4
Narcissus tazetta *Narcissus jonquilla*	0.07	1.68
Hyacinthus orientalis	0.6	19.2
Tulipa gesneriana	0.26	8.32
Iris × *hollandica*	0.08	1.92
Dahlia pinnata	0.28	5.60
Gladiolus hybrida	0.1	2.4
Canna indica	0.12	1.44

3.3. Flowering Time

Table 3 presents the duration of flowering time during the first (2019) and second years (2020) of the experimental period. Among the ornamental geophyte varieties in the first year of the experiment, *Gladiolus hybrida* cv. Rose Supreme (95.6 days), *Dahlia pinnata* cv. Aragon (120.3 days), *Polianthes tuberosa* cv. Mahallati (99.6 days), *Canna indica* cv. Flaccida (107 days), *Freesia refracta* cv. Red Beauty (145 days), *Hyacinthus orientalis* cv. Fondant (66.6 days), *Tulipa gesneriana* cv. Buster (64.3 days), and *Narcissus paperwhite* (130.3 days) exhibited the shortest flowering times, and these were statistically different at a 5% probability level.

Table 3. Flowering time of studied geophytes in two years of experiment (2019–2020).

Species	First Year (Day)	Second Year (Day)
Alstroemeria aurea cv. Balance	320.0 b	107.3 h–m
Gladiolus hybrida cv. Alexander	100.6 mn	79.0 n–p
Gladiolus hybrida cv. Rose Supreme	95.6 n	100.6 h–m
Dahlia pinnata cv. Red Runner	146.6 e	195.3 b
Dahlia pinnata cv. Mystic Illusion	134.6 f	185.3 b
Dahlia pinnata cv. Aragon	120.3 g	152.0 cd
Polianthes tuberosa cv. Mahallati	99.6 mn	142.3 c–e
Polianthes tuberosa cv. Pearl	110.6 hi	118.6 f–h
Polianthes tuberosa cv. Majesty	118.3 gh	130.3 e–g
Canna indica cv. Flaccida	107.0 im	87.6 m–o

Table 3. *Cont.*

Species	First Year (Day)	Second Year (Day)
Canna indica cv. Striped Beauty	132.6 f	158.6 c
Canna indica cv. Phasion	114.0 g–i	136.0 d–f
Crocosmia aurea cv. Aurora	381.6 a	231.0 a
Freesia refracta cv. Ambassador	159.6 d	149.3 c–e
Freesia refracta cv. Bastogne	158.0 d	141.6 c–e
Freesia refracta cv. Red beauty	145.0 e	152.0 cd
Freesia refracta cv. Pink Passion	161.0 d	154.6 cd
Iris × hollandica cv. Blue Magic	209.0 c	197.3 b
Hyacinthus orientalis cv. Blue Jacket	72.6 pq	72.6 op
Hyacinthus orientalis cv. Fondant	66.6 qr	66.6 op
Hyacinthus orientalis cv. Aiolos	76.0 o	76.0 n–p
Hyacinthus orientalis cv. Blue Roman	70.0 p–r	70.0 op
Tulipa gesneriana cv. Buster	64.3 s	64.3 p
Tulipa gesneriana cv. Strong Gold	75.6 o	75.6 n–p
Tulipa gesneriana cv. Irani	112.0 hi	112.0 g–i
Narcissus tazetta	112.0 hi	104.6 h–m
Narcissus paperwhite	100.3 mn	95.3 i–n
Narcissus jonquilla	130.3 f	138.6 c–f

Values followed by the same letter within column are not significantly different ($p < 0.05$) according to Duncan's multiple range test.

In the second year of the experiment, *Gladiolus hybrida* cv. Alexander (79 days), *Dahlia pinnata* cv. Aragon (152 days), *Polianthes tuberosa* cv. Pearl (118.6 days), *Canna indica* cv. Flaccida (87.6 days), *Freesia refracta* cv. Bastogne (141.6 days), *Hyacinthus orientalis* cv. Fondant (66.6 days), *Tulipa gesneriana* cv. Buster Strong Gold (64.3 days), and *Narcissus paperwhite* (95.3 days) exhibited the shortest flowering times.

3.4. Flower Longevity

Table 4 displays the flower longevity observed during the first (2019) and second years (2020) of the experimental period. In the first year, among the ornamental geophyte varieties, *Gladiolus hybrida* cv. Rose Supreme (19.3 days), *Dahlia pinnata* cv. Aragon (36 days), *Polianthes tuberosa* cv. Pearl (16 days), *Canna indica* cv. Flaccida and *Canna indica* cv. Phasion (16 days), *Freesia refracta* cv. Bastogne (39.6 days), *Hyacinthus orientalis* cv. Blue Roman (28 days), *Tulipa gesneriana* cv. Buster and *Tulipa gesneriana* cv. Strong Gold (27.6 days), *Narcissus tazetta*, and *Narcissus jonquilla* (39.6 days) exhibited the longest flower longevity. During the second year, the highest flower longevity was observed in *Gladiolus hybrida* cv. Rose Supreme (16 days), *Dahlia pinnata* cv. Aragon (41 days), *Polianthes tuberosa* cv. Mahallati (6.17 days), *Canna indica* cv. Flaccida (14.6 days), *Freesia refracta* cv. Pink Passion (38 days), *Hyacinthus orientalis* cv. Blue Roman (28 days), *Tulipa gesneriana* cv. Buster and *Tulipa gesneriana* cv. Strong Gold (27.6 days), and *Narcissus jonquilla* (43.3 days).

The findings revealed significant variations in flower longevity among the studied plants. *Narcissus jonquilla* displayed the longest flower longevity, persisting for 43 days in the second year. Conversely, *Alstroemeria* plants exhibited the shortest flower longevity, enduring for only 13 days in both years of cultivation, as detailed in Table 4. Flower longevity plays a pivotal role in landscapes, notably for ornamental plants, contributing significantly to the overall visual allure of green spaces [21]. Our results are consistent with prior findings concerning various ornamental geophyte species [11,22–25].

The study unveiled differences in flower longevity among various cultivars of the examined plants. With the exception of the *Canna indica*, all other species showcased an increase in flower longevity during the second year of cultivation. This improvement likely stemmed from the well-timed planting in the second year, which fostered better growth and development, leading to longer-lasting flowers on the plant stems.

Table 4. The longevity of the flowers of different plant species in two years of experiment (2019–2020) (5 samples per replication).

Species	First Year (Days)	Second Year (Days)
Alstroemeria aurea cv. *Balance*	38.0 a–c	43.0 a
Gladiolus hybrida cv. Alexander	12.6 m	13.0 o
Gladiolus hybrida cv. Rose Supreme	19.3 h	16.0 mn
Dahlia pinnata cv. Red Runner	31.6 d	35.0 f
Dahlia pinnata cv. Mystic Illusion	30.3 de	38.6 b–d
Dahlia pinnata cv. Aragon	36.0 c	41.0 ab
Polianthes tuberosa cv. Mahallati	15.0 im	17.6 im
Polianthes tuberosa cv. Pearl	16.0 i	17.3 i–n
Polianthes tuberosa cv. Majesty	14.6 im	16.3 mn
Canna indica cv. Flaccida	16.0 i	14.6 no
Canna indica cv. Striped Beauty	15.0 im	13.0 o
Canna indica cv. Phasion	16.0 i	12.6 o
Crocosmia aurea cv. Aurora	35.6 c	39.3 bc
Freesia refracta cv. Ambassador	37.0 bc	35.3 ef
Freesia refracta cv. Bastogne	39.6 ab	36.6 c–f
Freesia refracta cv. Red beauty	25.3 fg	26.0 g
Freesia refracta cv. Pink Passion	40.6 a	38.0 c–e
Iris × *hollandica* cv. Blue Magic	23.3 g	27.3 g
Hyacinthus orientalis cv. Blue Jacket	19.3 h	19.3 i
Hyacinthus orientalis cv. Fondant	23.3 g	23.3 h
Hyacinthus orientalis cv. Aiolos	17.6 hi	17.6 im
Hyacinthus orientalis cv. Blue Roman	28.0 ef	28.0 g
Tulipa gesneriana cv. Buster	27.6 ef	27.6 g
Tulipa gesneriana cv. Strong Gold	27.6 ef	27.6 g
Tulipa gesneriana cv. Irani	18.0 hi	18.0 im
Narcissus tazetta	39.6 ab	36.0 d–f
Narcissus paperwhite	35.0 c	34.6 f
Narcissus jonquilla	39.6 ab	43.3 a

Values followed by the same letter within column are not significantly different ($p < 0.05$) according to Duncan's multiple range test.

3.5. Bulb Sprouting Time

Table 5 presents the variations in bulb sprouting time during the first (2019) and second years (2020) of the experimental period. In the first year, the shortest sprouting time among ornamental geophyte varieties was observed in *Gladiolus hybrida* cv. Alexander and *Gladiolus hybrida* cv. Rose Supreme, which significantly differed from other varieties. Conversely, the longest sprouting time was observed in *Polianthes tuberosa* cv. Mahallati and *Iris* × *hollandica* cv. Blue Magic. In the second year of the experiment, the shortest sprouting time among the ornamental geophyte varieties was observed in *Freesia refracta* cv. Ambassador.

Table 5. Bulb sprouting time in studied geophytes in two years of experiment (2019–2020) (5 samples per replication).

Species	First Year (Days)	Second Year (Days)
Alstroemeria aurea cv. *Balance*	16 f–h	18 o–s
Gladiolus hybrida cv. Alexander	6.33 q	18.33 n–s
Gladiolus hybrida cv. Rose Supreme	6.66 q	16 s
Dahlia pinnata cv. Red Runner	9.67 p	18.6 m–r
Dahlia pinnata cv. Mystic Illusion	11 op	21.6 f–h
Dahlia pinnata cv. Aragon	10.33 op	20.6 g–n
Polianthes tuberosa cv. Mahallati	13.67 mn	20 h–q
Polianthes tuberosa cv. Pearl	16 fgh	21.3 f–h
Polianthes tuberosa cv. Majesty	13.33 n	20.3 h–p
Canna indica cv. Flaccida	21.66 de	32 d

Table 5. *Cont.*

Species	First Year (Days)	Second Year (Days)
Canna indica cv. Striped Beauty	21.66 de	30 d
Canna indica cv. Phasion	21.33 e	22.3 fg
Crocosmia aurea cv. Aurora	20 e	27.3 e
Freesia refracta cv. Ambassador	11.33 o	12.3 t
Freesia refracta cv. Bastogne	14.33 i–n	17.6 p–s
Freesia refracta cv. Red beauty	15 h–m	17.3 q–s
Freesia refracta cv. Pink Passion	17.33 f	19.6 i–q
Iris × *hollandica* cv. Blue Magic	52.66 b	45.6 b
Hyacinthus orientalis cv. Blue Jacket	16.67 fg	16.6 rs
Hyacinthus orientalis cv. Fondant	20 e	20 h–q
Hyacinthus orientalis cv. Aiolos	23 cd	23 f
Hyacinthus orientalis cv. Blue Roman	20 e	20 h–q
Tulipa gesneriana cv. Buster	17.33 f	17.3 q–s
Tulipa gesneriana cv. Strong Gold	17.33	21 f–i
Tulipa gesneriana cv. Irani	21 e	66.6 a
Narcissus tazetta	66.66 a	18 o–s
Narcissus paperwhite	15.33 g–i	21.3 f–h
Narcissus jonquilla	23.33 c	39.3 c

Values followed by the same letter within column are not significantly different ($p < 0.05$) according to Duncan's multiple range test.

3.6. Visual Quality

Table 6 illustrates the variations in visual quality across the first (2019) and second years (2020) of the experimental period. In the first year, the highest visual quality was observed in several varieties of ornamental geophytes: *Alstroemeria aurea* cv. Balance, *Canna indica* cv. Phasion, *Crocosmia aurea* cv. Aurora, *Freesia refracta* cv. Pink Passion, *Iris* × *hollandica* cv. Blue Magic, *Hyacinthus orientalis* cv. Blue Jacket, *Hyacinthus orientalis* cv. Fondant, *Hyacinthus orientalis* cv. Aiolos, *Tulipa gesneriana* cv. Buster, *Tulipa gesneriana* cv. Strong Gold, *Narcissus tazetta*, *Narcissus paperwhite*, and *Narcissus jonquilla.* These varieties exhibited statistically significant differences in visual quality compared to others (Figure 2). Conversely, the lowest visual quality was observed in *Gladiolus hybrida* cv. Alexander, *Polianthes tuberosa* cv. Majesty, *Polianthes tuberosa* cv. Mahallati, and various *Dahlia* varieties. In the second year of the experiment, the highest visual quality was found in several ornamental geophyte varieties: *Gladiolus hybrida* cv. Rose Supreme, *Polianthes tuberosa* cv. Pearl, *Iris* × *hollandica* cv. Blue Magic, various *Canna indica* varieties, various *Freesia* sp. varieties, *Crocosmia aurea* cv. Aurora, *Hyacinthus* varieties excluding cv. Blue Roman, and *Tulipa* varieties excluding cv. Irani.

Table 6. Visual quality in studied geophytes in two years of experiment (2019–2020) (5 samples per replication).

Species	First Year (Score 1–5)	Second Year (Score 1–5)
Alstroemeria aurea cv. Balance	5 a	4 b
Gladiolus hybrida cv. Alexander	3 c	4 b
Gladiolus hybrida cv. Rose Supreme	4 b	5 a
Dahlia pinnata cv. Red Runner	3 c	4 b
Dahlia pinnata cv. Mystic Illusion	3 c	4 b
Dahlia pinnata cv. Aragon	3 c	4 b
Polianthes tuberosa cv. Mahallati	3 c	4 b
Polianthes tuberosa cv. Pearl	4 b	5 a
Polianthes tuberosa cv. Majesty	3 c	4 b
Canna indica cv. Flaccida	4 b	5 a
Canna indica cv. Striped Beauty	4 b	5 a
Canna indica cv. Phasion	5 a	5 a

Table 6. *Cont.*

Species	First Year (Score 1–5)	Second Year (Score 1–5)
Crocosmia aurea cv. Aurora	5 a	5 a
Freesia refracta cv. Ambassador	4 b	5 a
Freesia refracta cv. Bastogne	4 b	5 a
Freesia refracta cv. Red beauty	4 b	5 a
Freesia refracta cv. Pink Passion	5 a	5 a
Iris × hollandica cv. Blue Magic	5 a	5 a
Hyacinthus orientalis cv. Blue Jacket	5 a	5 a
Hyacinthus orientalis cv. Fondant	5 a	5 a
Hyacinthus orientalis cv. Aiolos	5 a	5 a
Hyacinthus orientalis cv. Blue Roman	4 b	4 b
Tulipa gesneriana cv. Buster	5 a	5 a
Tulipa gesneriana cv. Strong Gold	5 a	5 a
Tulipa gesneriana cv. Irani	4 b	4 b
Narcissus tazetta	5 a	5 a
Narcissus paperwhite	5 a	5 a
Narcissus jonquilla	5 a	5 a

Values followed by the same letter within column are not significantly different ($p < 0.05$) according to Duncan's multiple range test.

3.7. Correlation Coefficient Analysis

The Pearson's correlation coefficients between the studied parameters for the first year are presented in Figure 3. Notably, bulb sprouting time exhibited the highest positive correlation with visual quality (0.356). Furthermore, flower longevity showed robust positive correlations with both visual quality (0.282) and flowering time (0.412). These findings underscore the interconnectedness of these parameters and emphasize their significance in evaluating the overall quality of the studied plants. Moving to Pearson's correlation coefficients among the studied parameters for the second year, as illustrated in Figure 4, a significant and positive correlation was observed between flower longevity and flowering time (0.373).

3.8. Cluster Analysis

Cluster analysis was conducted based on sprouting time in both the first and second years, resulting in the categorization of the 31 plants into five distinct clusters (Figure 5). Clusters one to three comprised individual ornamental geophytes: *Hyacinthus orientalis* cv. Fondant, *Hyacinthus orientalis* cv. Blue Roman, *Hyacinthus orientalis* cv. Aiolos. Cluster four included *Iris × hollandica* cv. Blue Magic, *Hyacinthus orientalis* cv. Blue Jacket, *Tulipa gesneriana* cv. Buster, and *Narcissus tazetta*. Meanwhile, cluster five represented the remaining populations, indicating a notable differentiation of this group compared to the others.

Similarly, cluster analysis was employed to categorize all the studied ornamental geophytes based on their visual quality parameter for both first and second years. The dendrogram displayed the division of the 31 plants into 16 distinct clusters (Figure 6). Cluster one encompassed a total of 13 geophytes, including *Gladiolus hybrida* cv. Alexander, *Gladiolus hybrida* cv. Rose Supreme, *Dahlia pinnata* cv. Red Runner, *Dahlia pinnata* cv. Mystic Illusion, *Dahlia pinnata* cv. Aragon, *Polianthes tuberosa* cv. Mahallati, *Polianthes tuberosa* cv. Pearl, *Polianthes tuberosa* cv. Majesty, *Canna indica* cv. Flaccida, *Canna indica* cv. Striped Beauty, *Freesia refracta* cv. Ambassador, *Freesia refracta* cv. Bastogne, and *Freesia refracta* cv. Red beauty. The remaining geophytes were distributed among clusters 2 to 16.

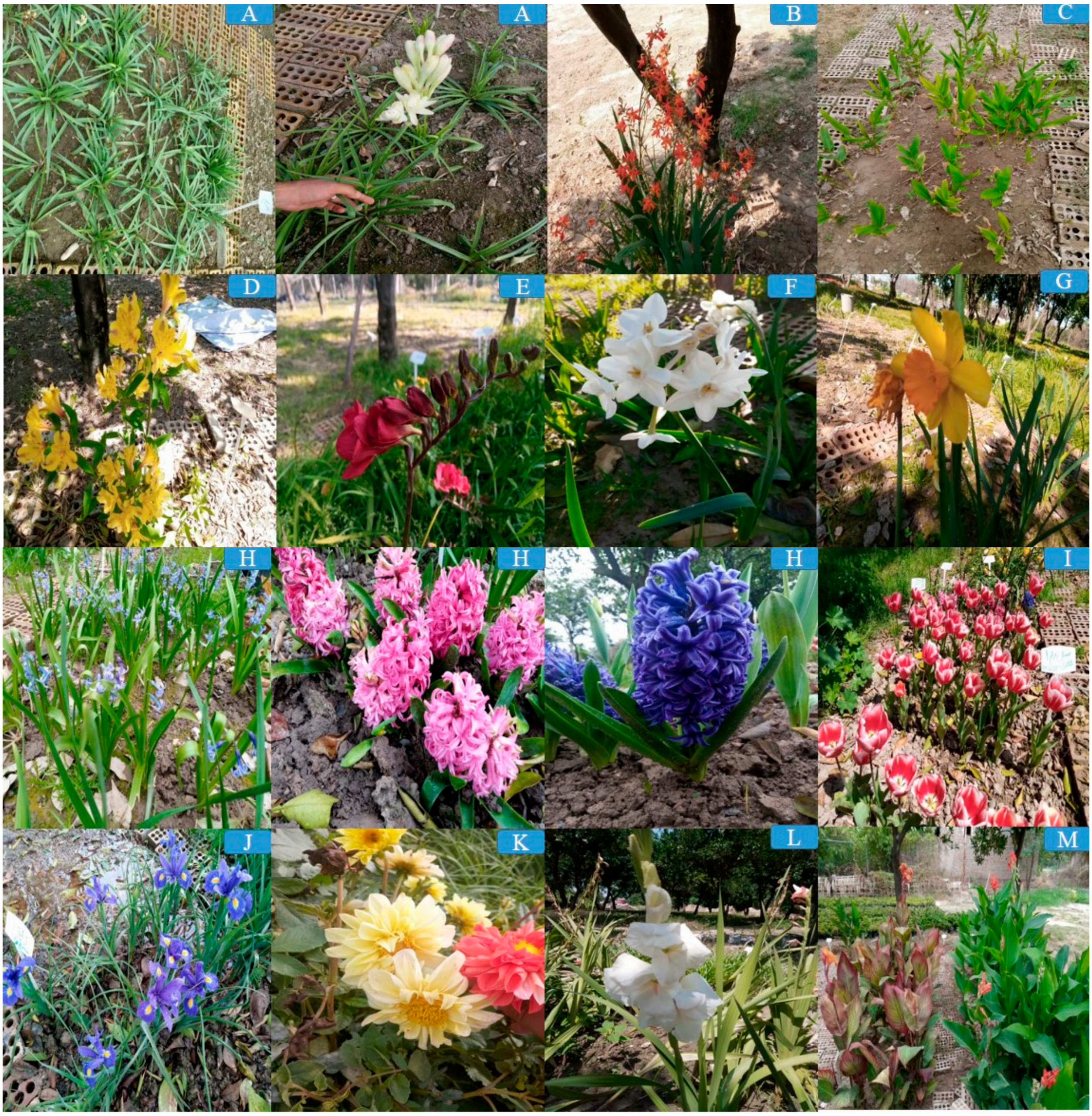

Figure 2. Cultivated ornamental geophytes at the experimental site. Flowering in *Polianthes tuberosa* (**A**), *Crocosmia aurea* (**B**), *Hedychium coronarium* (**C**), *Alstroemeria aurea* (**D**), *Freesia refracta* (**E**), *Narcissus tazetta* (**F**), *Narcissus jonquilla* (**G**), *Hyacinthus orientalis* (**H**), *Tulipa gesneriana* (**I**), *Iris* × *hollandica* (**J**), *Dahlia pinnata* (**K**), *Gladiolus hybrida* (**L**), *Canna indica* (**M**).

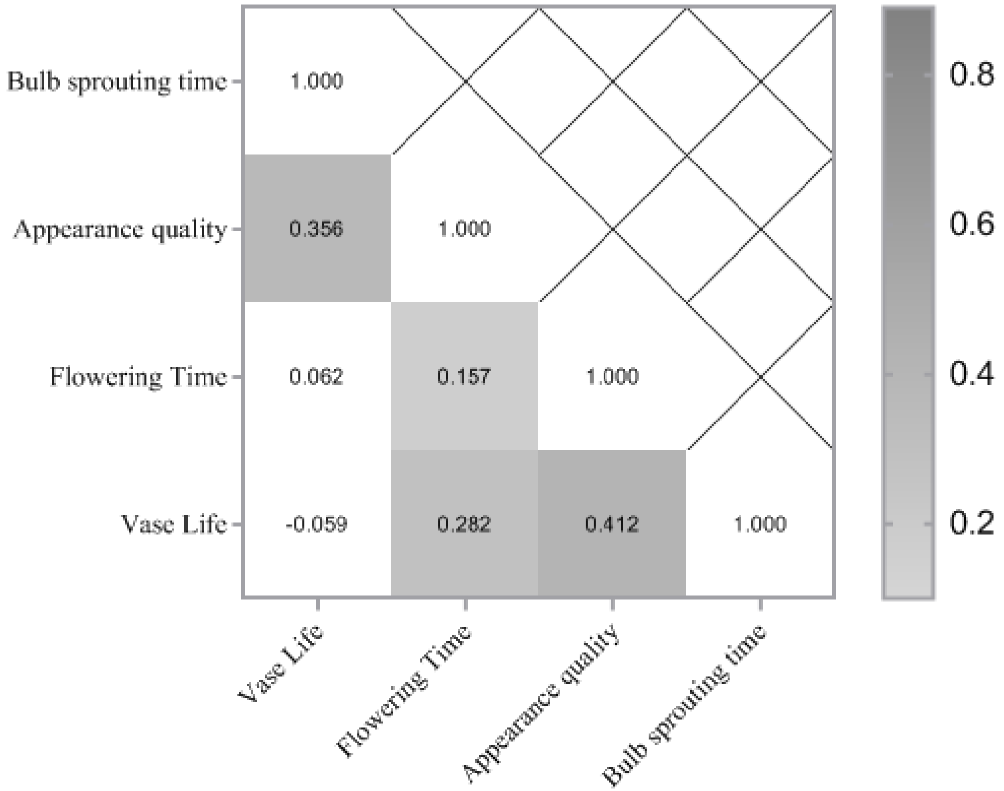

Figure 3. Heat map of mutual relations of variables in correlation coefficients between the traits under study in ornamental geophytes in first year.

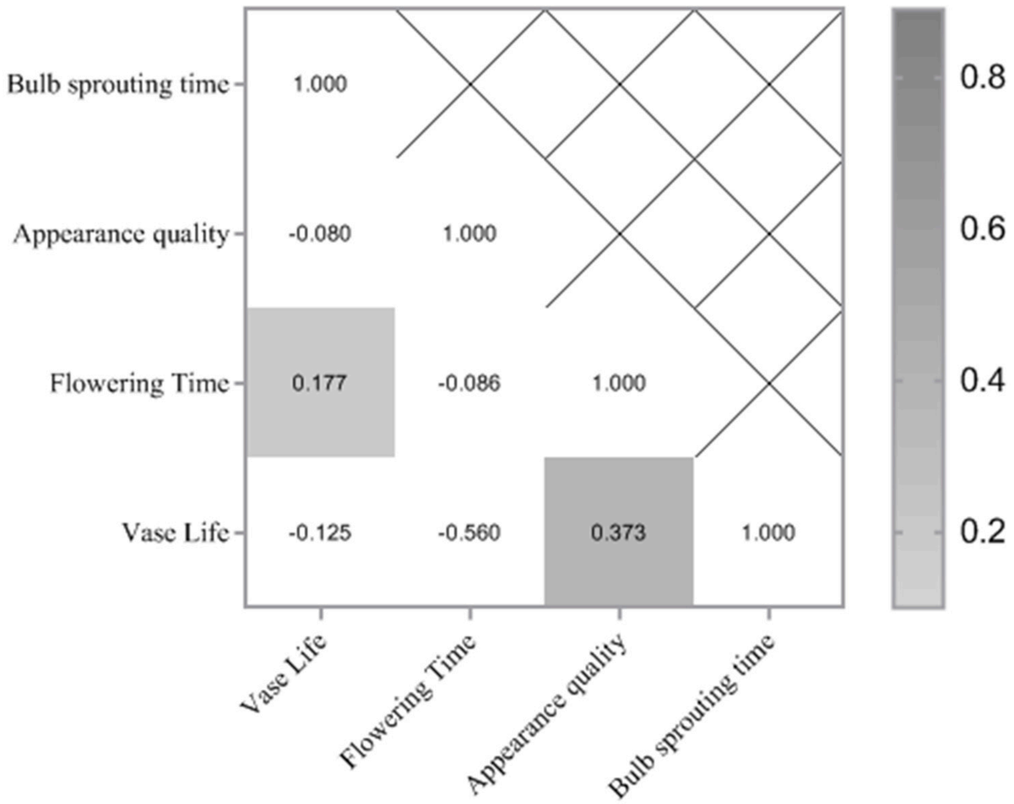

Figure 4. Heat map of mutual relations of variables in correlation coefficients between the traits under study in ornamental geophytes in second year.

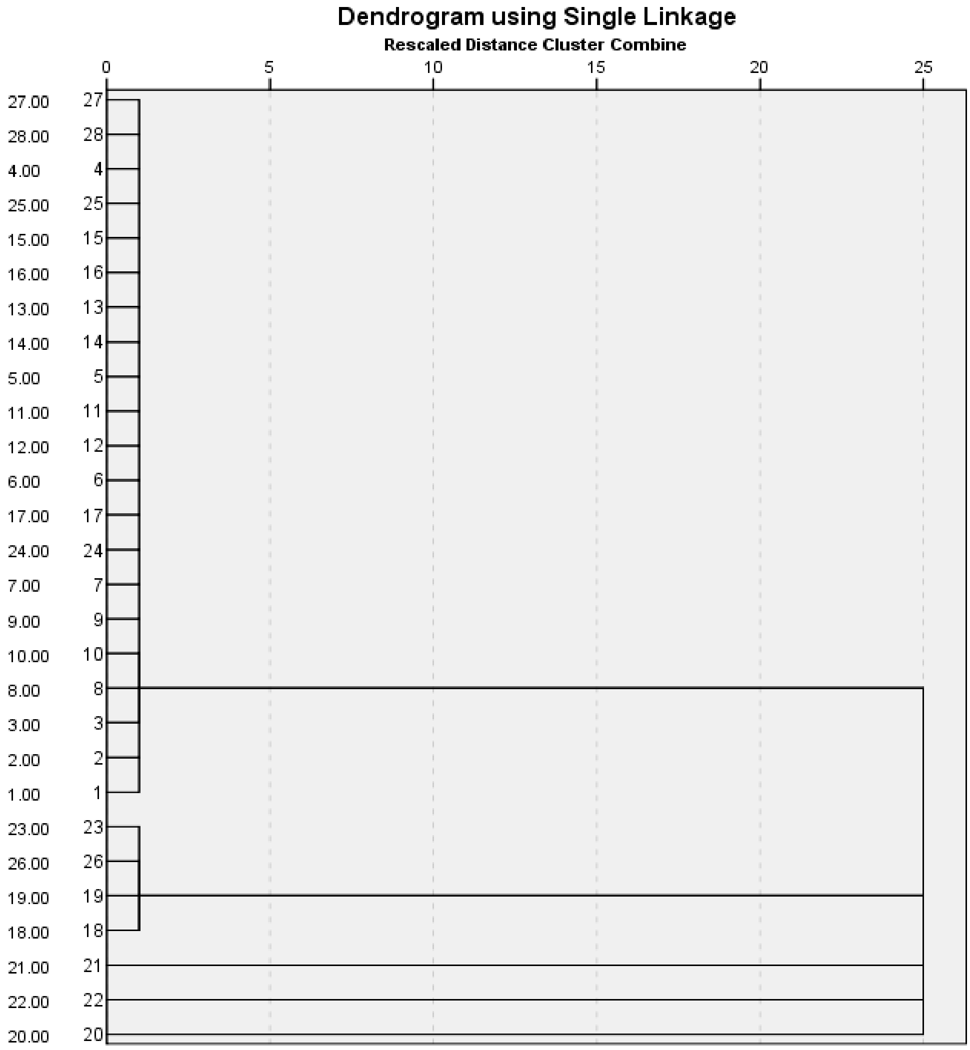

Figure 5. Cluster analysis of the parameter 'Bulb sprouting time' in studied geophytes. The sequences were aligned using the CLUSTAL W method and grouped using the Neighbor-Joining method. 1—*Alstroemeria aurea* cv. *Balance*, 2—*Gladiolus hybrida* cv. Alexander, 3—*Gladiolus hybrida* cv. Rose Supreme, 4—*Dahlia pinnata* cv. Red Runner, 5—*Dahlia pinnata* cv. Mystic Illusion, 6—*Dahlia pinnata* cv. Aragon, 7—*Polianthes tuberosa* cv. Mahallati, 8—*Polianthes tuberosa* cv. Pearl, 9—*Polianthes tuberosa* cv. Majesty, 10—*Canna indica* cv. Flaccida, 11—*Canna indica* cv. Striped Beauty, 12—*Canna indica* cv. Phasion, 13—*Crocosmia aurea* cv. Aurora, 14—*Freesia refracta* cv. Ambassador, 15—*Freesia refracta* cv. Bastogne, 16—*Freesia refracta* cv. Red beauty, 17—*Freesia refracta* cv. Pink Passion, 18—*Iris × hollandica* cv. Blue Magic, 19—*Hyacinthus orientalis* cv. Blue Jacket, 20—*Hyacinthus orientalis* cv. Fondant, 21—*Hyacinthus orientalis* cv. Aiolos, 22—*Hyacinthus orientalis* cv. Blue Roman, 23—*Tulipa gesneriana* cv. Buster, 24—*Tulipa gesneriana* cv. Strong Gold, 25—*Tulipa gesneriana* cv. Irani, 26—*Narcissus tazetta*, 27—*Narcissus paperwhite*, 28—*Narcissus jonquilla*.

Additionally, cluster analysis based on the flowering time categorized the 31 studied ornamental geophytes into nine different groups (Figure 7). The first group comprised 11 ornamental geophytes, including *Gladiolus hybrida* cv. Rose Supreme, *Dahlia pinnata* cv. Red Runner, *Dahlia pinnata* cv. Mystic Illusion, *Dahlia pinnata* cv. Aragon, *Polianthes tuberosa* cv. Mahallati, *Polianthes tuberosa* cv. Pearl, *Polianthes tuberosa* cv. Majesty, *Canna indica* cv. Striped Beauty, *Canna indica* cv. Phasion, *Freesia refracta* cv. Red beauty, and *Narcissus jonquilla*. The second group included 10 ornamental geophytes, among which were *Alstroemeria aurea* cv. Balance, *Gladiolus hybrida* cv. Alexander, *Canna indica* cv. Flaccida, *Crocosmia aurea* cv. Aurora, *Freesia refracta* cv. Ambassador, *Freesia refracta* cv. Bastogne, *Freesia refracta* cv. Pink Passion, *Iris* × *hollandica* cv. Blue Magic, *Narcissus tazetta*, and *Narcissus paperwhite*. The remaining plants were distributed among clusters 3 to 9.

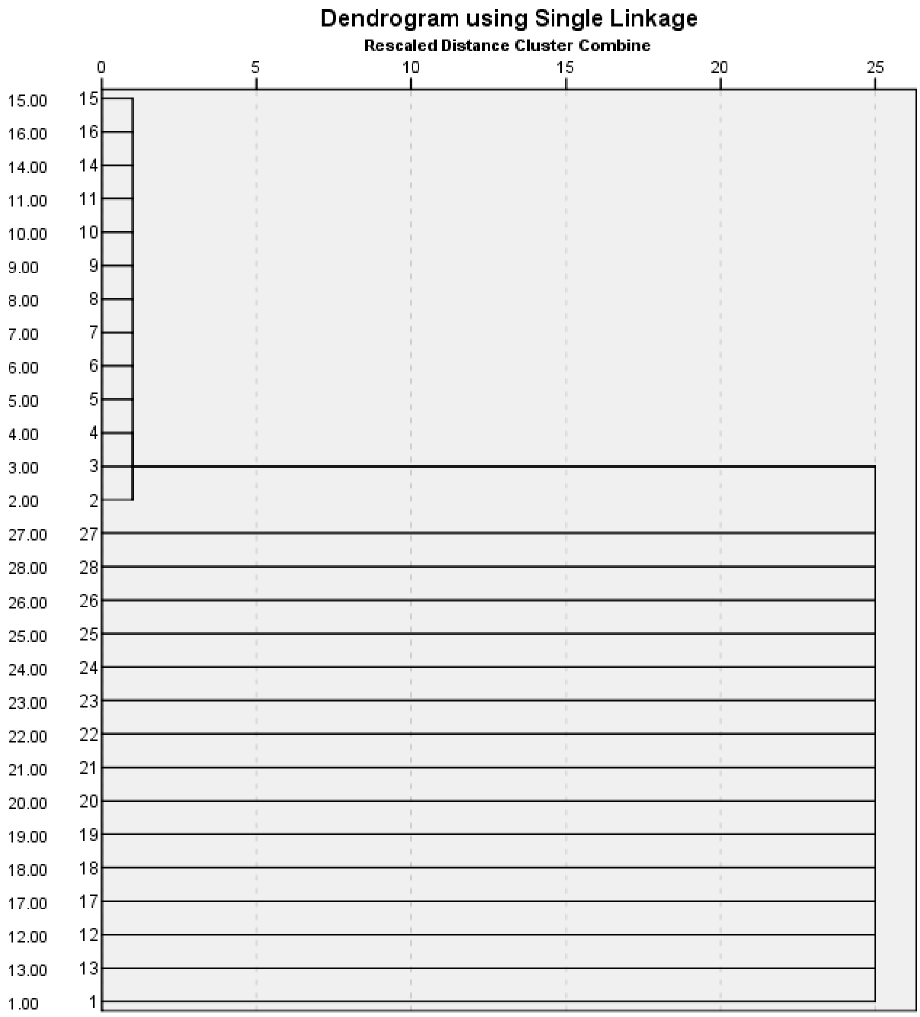

Figure 6. Cluster analysis of the parameter 'visual quality' in studied geophytes. The sequences were aligned using the CLUSTAL W method and grouped using the Neighbor-Joining method. 1—*Alstroemeria aurea* cv. *Balance*, 2—*Gladiolus hybrida* cv. Alexander, 3—*Gladiolus hybrida* cv. Rose Supreme, 4—*Dahlia pinnata* cv. Red Runner, 5—*Dahlia pinnata* cv. Mystic Illusion, 6—*Dahlia pinnata* cv. Aragon, 7—*Polianthes tuberosa* cv. Mahallati, 8—*Polianthes tuberosa* cv. Pearl, 9—*Polianthes tuberosa* cv. Majesty, 10—*Canna indica* cv. Flaccida, 11—*Canna indica* cv. Striped Beauty, 12—*Canna indica* cv. Phasion, 13—*Crocosmia aurea* cv. Aurora, 14—*Freesia refracta* cv. Ambassador, 15—*Freesia refracta* cv. Bastogne, 16—*Freesia refracta* cv. Red beauty, 17—*Freesia refracta* cv. Pink Passion, 18—*Iris* × *hollandica* cv. Blue Magic, 19—*Hyacinthus orientalis* cv. Blue Jacket, 20—*Hyacinthus orientalis* cv. Fondant, 21—*Hyacinthus orientalis* cv. Aiolos, 22—*Hyacinthus orientalis* cv. Blue Roman, 23—*Tulipa gesneriana* cv. Buster, 24—*Tulipa gesneriana* cv. Strong Gold, 25—*Tulipa gesneriana* cv. Irani, 26—*Narcissus tazetta*, 27—*Narcissus paperwhite*, 28—*Narcissus jonquilla*.

The dendrogram resulting from the cluster analysis based on flower longevity displayed the division of the 31 studied geophytes into nine distinct clusters (Figure 8). Cluster one comprised 11 ornamental geophytes, namely *Gladiolus hybrida* cv. Rose Supreme, *Canna indica* cv. Striped Beauty, *Canna indica* cv. Phasion, *Canna indica* cv. Flaccida, *Freesia refracta* cv. Ambassador, *Freesia refracta* cv. Bastogne, *Freesia refracta* cv. Pink Passion, *Narcissus tazetta*, and *Narcissus paperwhite*. The second cluster consisted of 12 ornamental geophytes, including *Alstroemeria aurea* cv. *Balance*, *Gladiolus hybrida* cv. Alexander, *Dahlia pinnata* cv. Red Runner, *Dahlia pinnata* cv. Mystic Illusion, *Dahlia pinnata* cv. Aragon, *Polianthes tuberosa* cv. Mahallati, *Polianthes tuberosa* cv. Pearl, *Polianthes tuberosa* cv. Majesty, *Crocosmia aurea* cv. Aurora, *Freesia refracta* cv. Red beauty, *Iris hollandica* cv. Blue Magic, and *Narcissus jonquilla*. The remaining plants were distributed among clusters 3 to 9.

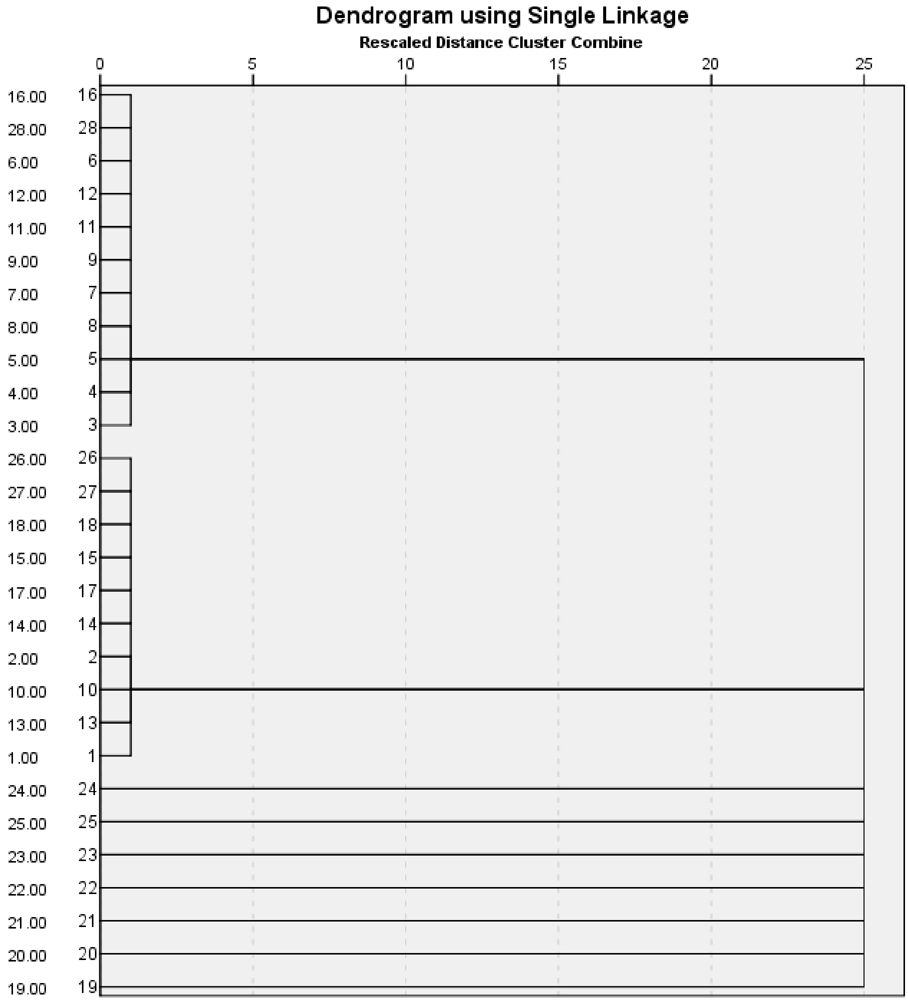

Figure 7. Cluster analysis of the parameter 'flowering time' in studied geophytes. The sequences were aligned using the CLUSTAL W method and grouped using the Neighbor-Joining method. 1—*Alstroemeria aurea* cv. *Balance*, 2—*Gladiolus hybrida* cv. Alexander, 3—*Gladiolus hybrida* cv. Rose Supreme, 4—*Dahlia pinnata* cv. Red Runner, 5—*Dahlia pinnata* cv. Mystic Illusion, 6—*Dahlia pinnata* cv. Aragon, 7—*Polianthes tuberosa* cv. Mahallati, 8—*Polianthes tuberosa* cv. Pearl, 9—*Polianthes tuberosa* cv. Majesty, 10—*Canna indica* cv. Flaccida, 11—*Canna indica* cv. Striped Beauty, 12—*Canna indica* cv. Phasion, 13—*Crocosmia aurea* cv. Aurora, 14—*Freesia refracta* cv. Ambassador, 15—*Freesia refracta* cv. Bastogne, 16—*Freesia refracta* cv. Red beauty, 17—*Freesia refracta* cv. Pink Passion, 18—*Iris × hollandica* cv. Blue Magic, 19—*Hyacinthus orientalis* cv. Blue Jacket, 20—*Hyacinthus orientalis* cv. Fondant, 21—*Hyacinthus orientalis* cv. Aiolos, 22—*Hyacinthus orientalis* cv. Blue Roman, 23—*Tulipa gesneriana* cv. Buster, 24—*Tulipa gesneriana* cv. Strong Gold, 25—*Tulipa gesneriana* cv. Irani, 26—*Narcissus tazetta*, 27—*Narcissus paperwhite*, 28—*Narcissus jonquilla*.

3.9. Regression Liner Analysis

Figure 9 displays the changes in flower longevity between the first and second years. As per the regression coefficient, each unit change in the second year corresponds to a 0.895-unit change in the first year ($p \leq 0.001$).

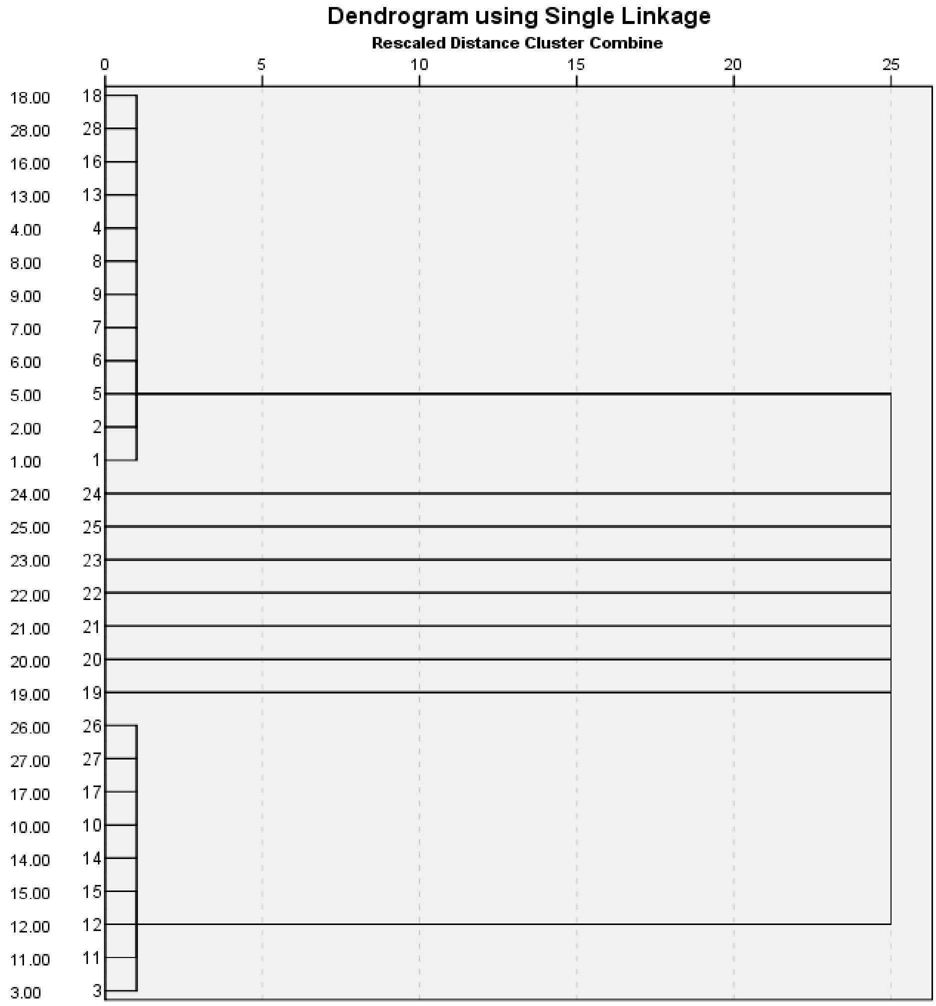

Figure 8. Cluster analysis of the parameter 'flower longevity' in studied geophytes. The sequences were aligned using the CLUSTAL W method and grouped using the Neighbor-Joining method. 1—*Alstroemeria aurea* cv. *Balance*, 2—*Gladiolus hybrida* cv. Alexander, 3—*Gladiolus hybrida* cv. Rose Supreme, 4—*Dahlia pinnata* cv. Red Runner, 5—*Dahlia pinnata* cv. Mystic Illusion, 6—*Dahlia pinnata* cv. Aragon, 7—*Polianthes tuberosa* cv. Mahallati, 8—*Polianthes tuberosa* cv. Pearl, 9—*Polianthes tuberosa* cv. Majesty, 10—*Canna indica* cv. Flaccida, 11—*Canna indica* cv. Striped Beauty, 12—*Canna indica* cv. Phasion, 13—*Crocosmia aurea* cv. Aurora, 14—*Freesia refracta* cv. Ambassador, 15—*Freesia refracta* cv. Bastogne, 16—*Freesia refracta* cv. Red beauty, 17—*Freesia refracta* cv. Pink Passion, 18—*Iris × hollandica* cv. Blue Magic, 19—*Hyacinthus orientalis* cv. Blue Jacket, 20—*Hyacinthus orientalis* cv. Fondant, 21—*Hyacinthus orientalis* cv. Aiolos, 22—*Hyacinthus orientalis* cv. Blue Roman, 23—*Tulipa gesneriana* cv. Buster, 24—*Tulipa gesneriana* cv. Strong Gold, 25—*Tulipa gesneriana* cv. Irani, 26—*Narcissus tazetta*, 27—*Narcissus paperwhite*, 28—*Narcissus jonquilla*.

Figure 11 depicts the variations in visual quality between the first and second years. Based on the regression coefficient, a one-unit change in the visual quality of the second year correlates with a 0.6685-unit change in the first year ($p \leq 0.001$).

Figure 12 illustrates the changes in flowering time between the first and second years. According to the regression coefficient, each unit change in flowering time equals a 0.4119-unit change in the first year ($p \leq 0.01$).

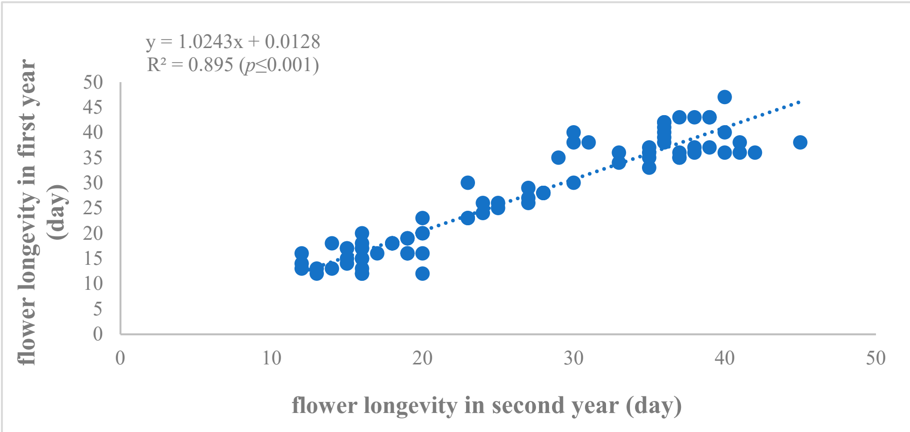

Figure 9. Regression analysis of the flower longevity changes between the first and second year of experiment (2019–2020).

Figure 10 presents the shifts in sprouting time across the two years. The regression coefficient indicates that for every unit change in the second year, there is a 0.7901-unit change in the first year ($p \leq 0.001$).

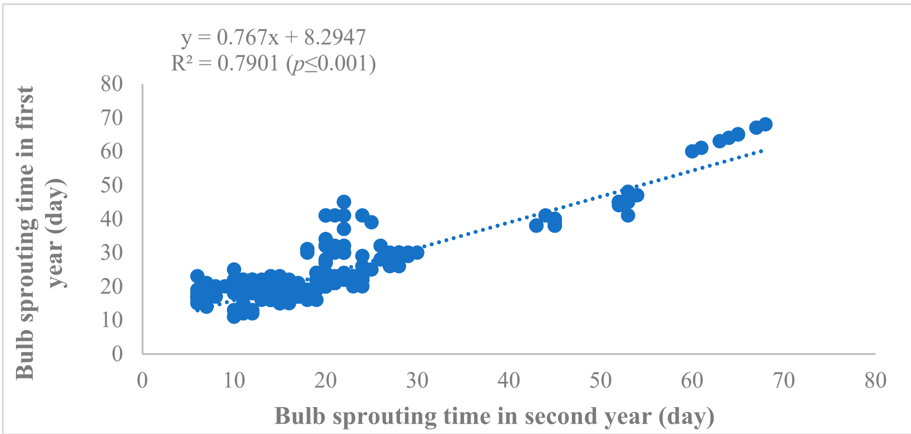

Figure 10. Regression analysis of the bulb sprouting time changes between the first and second year of experiment (2019–2020).

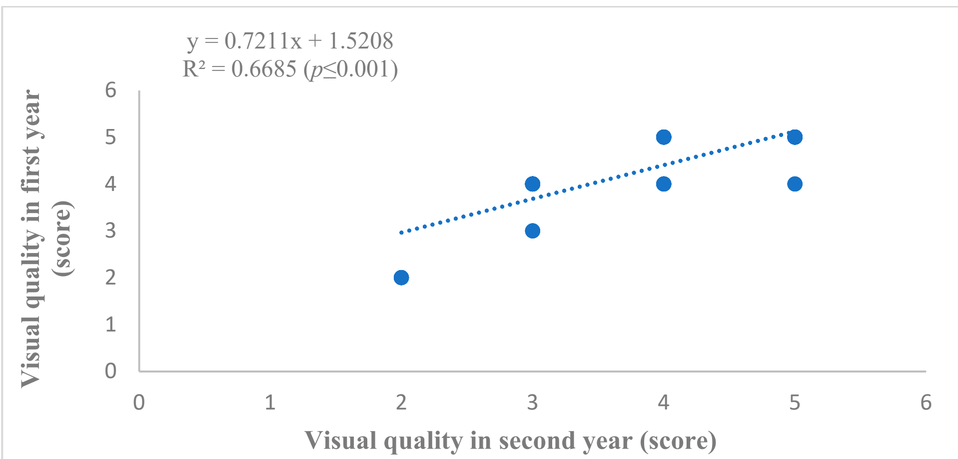

Figure 11. Regression analysis of the visual quality changes between the first and second year of experiment (2019–2020).

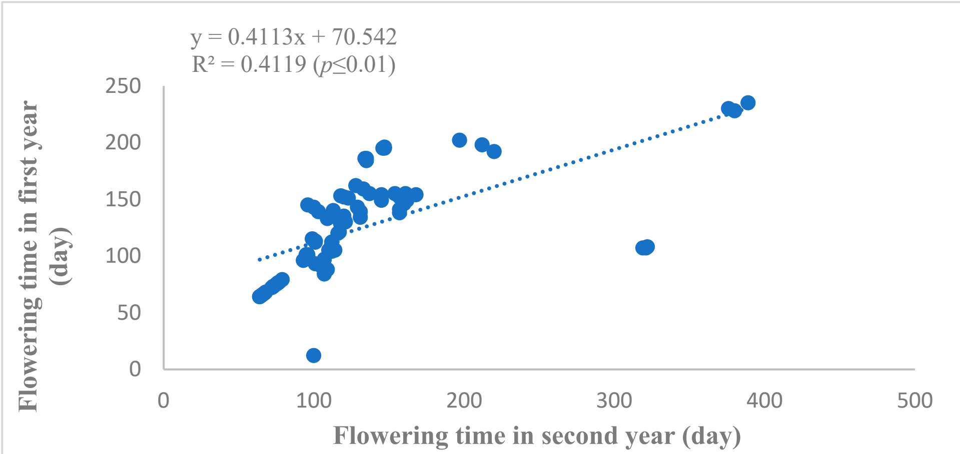

Figure 12. Regression analysis of the flowering time changes between the first and second year of experiment (2019–2020).

Ornamental geophytes are underutilized in urban landscapes in certain regions like Gorgan, which has a temperate–humid climate. To address this gap, a selection of geophyte species was made based on specific criteria, including resilience to environmental and ecological stresses as well as compatibility with local soil types. Standard agricultural soil was used for cultivation to comprehensively assess their performance, focusing on visual quality and flowering ability. Many ornamental geophytes are considered perennial or long-lasting plants, minimizing the need for constant soil disturbance. Avoiding constant removal from the soil is crucial for these species, as frequent digging up may lead to increased labor costs and storage needs until the next planting season. Species like *Canna indica*, *Freesia refracta*, *Narcissus tazetta*, and *Polianthes tuberosa* (with a flower longevity of approximately 3–5 years) can thrive when left undisturbed in the ground [26,27].

The diverse climatic requirements of ornamental geophytes were pivotal for successful cultivation. Tropical and subtropical species like *Polianthes tuberosa* and *Hedychium coronarium* suit the semi-tropical climate of Gorgan, requiring less attention during hot summers. Conversely, temperate species like *Narcissus tazetta*, *Hyacinthus orientalis*, and *Tulipa gesneriana* benefit from the moderate fall and winter climate, fulfilling their requirements for chilling periods to encourage prolific flowering.

4. Discussion

Table 3 displays variations in flowering time among different plant varieties. Notably, despite robust vegetative growth and standardized underground organ size, *Hedychium coronarium* and two varieties of *Polianthes tuberosa* failed to produce any flowers. This absence of flowering, particularly in the *Polianthes* varieties, might be due to their potential incompatibility with the local climate. These specific cultivars, known for their yellow and pink colors, were selected for experimental purposes despite not being traditionally cultivated in Iran. Interestingly, even in the second year and with adjusted planting time, these varieties remained unable to flower. Flowering in geophytes involves multiple stages, from induction, initiation, differentiation, maturation, and organ growth to flowering and senescence [28]. Each of these stages is intricately regulated by a combination of internal and external factors. Detailed knowledge of these stages in various ornamental geophytes is available, as this knowledge is crucial for the successful cultivation of geophytes. For example, studies have provided comprehensive insights into the flowering stages of popular geophyte species such as *Tulipa* [29] and *Narcissus* [30].

The absence of flowering in the first year for *Hedychium coronarium* could be due to improper planting timing. Yet, in the second year, even under late-winter planting in cool conditions, the lack of flowering persisted. Factors such as the soil's inadequate electrical conductivity might have influenced this outcome, as suggested by Table 1, which shows variations in the number of days from planting to flowering between the first and the second year for many plants. Adjusted planting times in the second year notably affected flowering duration. For example, *Alstroemeria* and *Crocosmia aurea* exhibited significant reductions in the time from planting to flowering in the second year, while certain plants like *Dahlia* and *Canna* exhibited longer flowering periods in the second year, possibly due to necessary root and aboveground organ growth to support flowering [31].

The results highlight substantial variations in flower longevity among the studied plants. *Narcissus jonquilla* exhibited the highest flower longevity, lasting 43 days in the second year. On the other hand, *Alstroemeria* had the shortest flower longevity, persisting for only 13 days each year (Table 4). Flower longevity greatly influences the visual appeal of ornamental plants in landscapes [21]. Our results were in agreement with previous findings for various ornamental geophyte species [12,22–25]. The study unveiled differences in flower longevity among various cultivars of the examined plants. With the exception of the *Canna indica*, all other species demonstrated an increase in flower longevity during the second year of cultivation. This enhancement can be attributed to the well-chosen planting time for the second year, which improved growth and development, resulting in longer-lasting flowers on the plant stems.

The Alexander *Gladiolus* displayed the highest sprouting rate, taking only 7 days for sprouting, whereas the *Iris* × *hollandica* 'Blue Magic' had the lowest sprouting rate, requiring 53 days. In the second year, the *Ambassador freesia* showed the highest sprouting rate, while *Iris* × *hollandica* 'Blue Magic' had the lowest sprouting rate (Table 5). The 53-day sprouting duration of *Iris* × *hollandica* 'Blue Magic' can be attributed to its specific chilling requirement for optimal growth and development. It is important to note that a lower sprouting rate does not necessarily indicate an inferior species or cultivar, as each plant may have unique growth characteristics and requirements [32]. Considering the annual growth cycle, plants showed increased growth during the second year compared to the first year. The findings regarding bulb sprouting time were consistent with previous research [33]. Planting time plays a significant role in regulating the growth and visual quality of ornamental geophytes such as *Gladiolus*. Additionally, it contributes to enhancing the beauty of these plants in the landscape for an extended period [34,35].

Polianthes tuberosa cv. Cinderella and cv. Super Gold exhibited the lowest visual quality. Conversely, certain plants demonstrated excellent visual quality consistently over the two years, specifically all *Narcissus* and *Crocosmia aurea* cultivars. Some species displayed improved visual quality in the second year compared to the first year, including *Polianthes*, *Dahila*, and *Gladiolus* (Table 6). The visual quality of the plants used is one of the fundamental criteria for a successful green space design. The aforementioned two varieties of *Polianthes* received the lowest scores due to their limited growth and lack of flowering. Additionally, due to the appropriate planting time in the second year, *Polianthes*, *Dahila*, and *Gladiolus* plants achieved higher scores in terms of visual quality. Overall, the quality of underground organs, soil type, planting time, and the climate of the region significantly influence the visual quality of bulbous plants [36]. During the second year, there was a noticeable enhancement in the visual quality of the plant [12,23,33,37]. The *Freesia refracta* exhibited a flowering period from September–October until March–April, coinciding with the dormancy of other plants (Table S2, Figure 2), allowing its presence in landscapes during this period without requiring irrigation, as noted by Farahmand and Nazari [13]. *Canna indica*, on the other hand, flowered from May–June until December–January, showcasing its distinctive burgundy color throughout the summer and early autumn. The *Crocosmia aurea* species produced vibrant orange to red flowers during the summer season. According to previous research, *Tulipa gesneriana* is highly recommended for urban landscapes due to its extensive range of colors and long flowering period. Lastly, *Hyacinthus orientalis*, with its beautiful clustered flowers, adds a remarkable beauty to urban landscapes during the spring season (Figure 2). *Gladiolus* plants offer a wide range of colors and can effortlessly enhance the beauty of any space. *Dahlia pinnata*, belonging to the *Asteraceae* family, comprises varieties known for their drought tolerance and suitable flowering time for landscapes

(Figure 2). *Polianthes tuberosa*, *Narcissus tazetta*, *Narcissus jonquilla*, and *Hyacinthus orientalis* not only contribute to the visual appeal of urban landscapes but also emit delightful fragrances, filling the environment with a pleasant scent after rainfall or irrigation [38]. *Alstroemeria aurea*, *Freesia refracta*, and *Iris* × *hollandica*, cultivated in various colors, are also popular ornamental plants in Gorgan. Furthermore, the *Iris* species, with its bright yellow to blue flowers, proves to be an effective choice for urban landscapes.

The primary distinguishing features of plants utilized in landscape design are their size, form, texture, and color. Among these, size and color, in particular, serve as the initial and most noticeable visual characteristics when compared to other attributes. People are drawn to the appearance of plants, and therefore, the size and color directly influence the attractiveness and overall visual composition of a design. Comprehension of the space in the observer's eyes, which necessitates an interplay of flower colors and scale, is essential for achieving a successful design [39–41]. The backbone of landscape design comprises trees and shrubs, while seasonal flowers and bulbous geophytes play a vital role in the subsequent stage. These plants captivate immediate attention with their vivid colors, profuse flowering, and striking forms. Due to their remarkable aesthetic qualities, seasonal flowers and bulbous plants are extensively utilized in urban areas, especially in flowerbeds [39,41].

Further investigation into *Hyacinthus* and *Tulipa* revealed that constant soil moisture led to bulb rot over time. In contrast, other species did not encounter this issue, underscoring the importance of plant selection. Although *Hyacinthus* and *Tulipa* create a captivating spring ambiance, our findings suggest their use as annual container plants rather than perennials in this region's conditions. Moreover, certain species, such as *Canna indica*, *Iris* × *hollandica*, and *Gladiolus hybrida*, showed alignment with our hypotheses regarding their resistance to various weather conditions.

Ornamental geophytes are often overlooked in urban landscapes, particularly in regions such as Gorgan, characterized by a temperate–humid climate. To bridge this gap, geophyte species were carefully selected based on criteria encompassing resilience to environmental stresses and compatibility with local soil types. Standard agricultural soil was utilized for cultivation to thoroughly evaluate their performance, focusing on visual quality and flowering ability. Many ornamental geophytes are known for their longevity, minimizing the necessity for frequent soil disturbance. This is essential to avoid increased labor costs and storage requirements between planting seasons. Species like *Canna indica*, *Freesia refracta*, *Narcissus tazetta*, and *Polianthes tuberosa*, with a flower longevity of approximately 3–5 years, thrive when left undisturbed in the ground [26,27].

The varied climatic needs of ornamental geophytes play a crucial role in their successful cultivation. Tropical and subtropical species like *Polianthes tuberosa* and *Hedychium coronarium* are well suited to Gorgan's semi-tropical climate, demanding less care during hot summers. Conversely, temperate species like *Narcissus tazetta*, *Hyacinthus orientalis*, and *Tulipa gesneriana* benefit from the moderate fall and winter climate, fulfilling their chilling needs for prolific flowering.

5. Conclusions

The study aimed to identify decay-resistant genotypes suitable for temperate–humid regions. Thirty-one commercial genotypes underwent assessment in Gorgan. While species selection considered traits, results varied, with *Hyacinthus* and *Tulipa* failing to flower in the second year due to constant soil moisture, which led to bulb rot over time. This study advises using them as annual container plants instead of perennials. Some species like *Canna indica*, *Iris* × *hollandica*, and *Gladiolus hybrida* showed promise in weather resistance. Despite challenges, the findings highlight the potential for growing ornamental geophytes in the urban landscapes of Gorgan City. However, several critical factors need to be considered, including appropriate planting dates, selection of suitable cultivars, acquisition of high-quality underground organs, and suitable soil conditions. Based on our results, all species studied are generally recommended for cultivation, except for *Polianthes tuberosa*, which failed to produce flowers.

Supplementary Materials: The following supporting information can be downloaded online at: https://www.mdpi.com/article/10.3390/horticulturae10010003/s1, Table S1. Scientific name, family, flower color, ornamentally important organ, irrigation requirement, propagation method of studied geophytes. Table S2. Planting time of underground organs in studied geophytes. Table S3. Flowering time (month) of studied geophytes. Table S4. Soil analysis conducted in the experiment.

Author Contributions: Conceptualization: M.B. and A.S.S.; methodology, formal analysis: A.S.S. and B.J.; investigation: M.B.; data curation: M.H.; writing—original draft preparation: M.B. and A.S.S.; writing—review and editing: M.H., S.N. and M.D.; validation: A.S.S.; visualization: M.B. and B.J.; project administration: A.S.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: All data are presented in the article.

Conflicts of Interest: The authors declare no conflict of interest.

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