ANNALS OF THE UNIVERSITY OF CRAIOVA

Series: ✔*Biology*
✔*Horticulture*
✔*Food products processing technology*
✔*Environmental engineering*

Vol. XXX (LXVI) - 2025

ASSESSING THE IMPACT OF WINTER CONDITIONS ON THE GROWTH AND SURVIVAL OF TRADITIONALLY INDOOR PLANT SPECIES CULTIVATED OUTDOORS: A CASE STUDY OF THREE TAXA — *AGAPANTHUS AFRICANUS* (L.) Hoffmanns, *TRACHELIUM CAERULEUM* (L.) AND *BEGONIA* 'STERLING MOON'

Niță Eugenia[1*], Paraschiv Anca Monica[2]
University of Bucharest, Botanical Garden "Dimitrie Brandza"
** Correspondence author. E-mail:* eugenianitza@yahoo.com

Keywords: *adaptation, agapanthus, begonia, trachelium, USDA 7*

ABSTRACT

Depending on their origin, the plants in Romania may be cultivated outdoors, where they must tolerate low winter temperatures, or indoors, where they require consistently warm conditions all year-round. Indoor plants are typically tropical or subtropical species adapted to stable temperatures, humidity, and specific light levels. Growing these species outdoors during winter in temperate or temperate-continental climates poses significant biological and ecological challenges. This study focuses on three taxa - Agapanthus africanus (L.) Hoffmanns*., Trachelium caeruleum* L.*, and Begonia 'Sterling Moon'—classified within USDA hardiness zones 7b (tolerating –15 °C to –12.2 °C) - 11. Although Bucharest lies in USDA zone 7, these taxa are generally cultivated in protected environments. The aim of the study is to assess their ability to withstand low winter temperatures and retain flowering and fruiting potential.*

INTRODUCTION

The taxa *Agapanthus africanus* (L.) Hoffmanns., *Trachelium caeruleum* (L.), and *Begonia* 'Sterling Moon' have been gaining horticultural interest due to their ornamental value, ecological versatility, and adaptability to various cultivation environments. Native to Mediterranean or subtropical regions, these species are utilized both as indoor plants and decorative garden species, depending on local climate conditions and species-specific requirements.

The name *Agapanthus* derives from the Greek words *agape* (love) and *anthos* (flower), meaning "flower of love" (Singh & Bajinath 2018). Also known as the Lily of the Nile (Mor et al., 1984), it is endemic to southern Africa (Reinten et al. 2011) and valued for its spherical blue or violet inflorescences borne on unbranched stalks 30–60 cm tall (Bailey 1914). In colder regions, it is often grown in containers and overwintered indoors, while in milder climates it may be used as a garden plant.

Trachelium caeruleum (L.), commonly referred to as "throatwort", is an herbaceous species in the Campanulaceae family native to the Mediterranean. Appreciated for its dense violet or blue inflorescences, it is used in gardens and as a cut flower (Bredmose 1987, Abraham 1989). Although frost-sensitive, it can be successfully grown in pots or in the ground with appropriate winter protection.

Begonia 'Sterling Moon' is a hybrid created by Ozzie Johnson in Marietta, Georgia, through the crossing of two unpatented, unidentified begonia hybrids in 2012. Selected in 2013 and introduced as a hardy perennial, it is known for its silver-green textured foliage and pink flowers, demonstrating tolerance to both heat and cold.

After geraniums, begonias are arguably the most popular houseplants (Bailey 1914). Their ease of cultivation, wide morphological diversity, profuse flowering or ornamental foliage, and shade tolerance make them particularly attractive.

The study of these taxa is relevant for evaluating the potential expansion of their cultivation range in temperate-continental regions like Romania, providing the opportunity to investigate their acclimation ability and phenological behavior under conditions atypical for their natural habitats.

MATERIALS AND METHODS

The taxa selected for this study — *Agapanthus africanus* (L.) Hoffmanns., *Begonia* 'Sterling Moon', and *Trachelium caeruleum* (L.) — belong to USDA hardiness zones 7–11, which correspond to minimum annual temperatures between –17.7 °C and –1.1 °C. The taxonomy used is in accordance with the Plants of the World Online (POWO) (https://powo.science.kew.org/taxon/). *Agapanthus africanus* (L.) Hoffmanns. and *Begonia* 'Sterling Moon' were sourced from a nursery specializing in in vitro propagation, ensuring both genetic uniformity and appropriate phytosanitary status. *Trachelium caeruleum* (L.) plants were grown from seeds purchased from a company specializing in ornamental plant seeds.

The plants were established in the experimental plot of the "Dimitrie Brândză" Botanical Garden, University of Bucharest, in an east-facing location offering morning indirect light and moderately favorable conditions for plants sensitive to thermal stress.

To test winter hardiness under natural conditions, the plants were not relocated indoors during the winter months. Instead, they were subjected to passive protection using a 20–25 cm layer of dry leaves, aiming to create a favorable microclimate at soil level and reduce nocturnal thermal fluctuations.

Average winter air temperatures in Bucharest were monitored and are presented in Table 1 to provide the climatic context necessary for interpreting survival, phenological patterns, and morphological damage at the end of the cold season.

Table 1

Average Monthly Temperatures – Bucharest

Average TemperatureBucharest	**December 2024**	**January 2025**	**February 2025**
	4 °C	4,3 °C	-0,6 °C

RESULTS AND DISCUSSION

During the winter season, all plants were protected with a dry leaf mulch. Despite this insulation, complete overwinter survival was recorded only for *Agapanthus* and *Trachelium* plants (100 % survival rate), while *Begonia* displayed lower cold tolerance, with only 60 % survival (Table 2).

Table 2

Winter Survival Rate *of Agapanthus, Trachelium, and Begonia*

Taxon	**Survival Rate**
Agapanthus	100 %
Begonia	60 %
Trachelium	100 %

In December 2024, minimum temperatures in Bucharest ranged from –3 °C to –1 °C, with daytime highs above freezing. The monthly average of 4.0 °C represented a +3.1 °C anomaly compared to the 1991–2020 reference period. January 2025 saw similar trends, while February experienced a significant cold wave, with temperatures reaching –19 °C. Special forecasts issued (table 3) by the Romanian National Meteorological Administration (ANM) indicated extreme lows of –18 °C during 20–24 February.

Table 3

Minimum Temperatures – Bucharest

Minimum Temperature Bucharest	**December 2024**	**January 2025**	**February 2025**
	–3 °C and –1 °C	–3 °C and –1 °C	–19 °C

Such temperature fluctuations critically affect plant resilience and their capacity to survive and adapt during winter. Understanding these thermal stressors is key to evaluating species-specific cold tolerance and overwintering success.

1. *Agapanthus africanus* (L.) Hoffmanns.

Three cultivars were studied: ‘Flower of Love’ (fig. 1), ‘Twister’ (fig 2) and ‘Northern Star’ (fig.3).

Figure 1. Flower of Love

Figure 2. Twister

Figure 3. Northen Star

Observations were initiated on plants in their second year of growth. As shown in Table 4, during the 2024 growing season, the plants exhibited relatively modest heights, with the cultivar ‘Flower of Love’ recording the highest average.

In contrast, data from the 2025 season indicate an overall increase in plant height across all cultivars, with the most notable development observed in the ‘Twister’ cultivar.

Table 4

Average Plant Height (cm) in 2024 and 2025

Agapanthus Cultivars	**Average Plant Height (2024)**	**Average Plant Height (2025)**
'Flower of Love'	25 cm	30 cm
'Twister'	20 cm	35 cm
'Northern Star'	23 cm	25 cm

An analysis of the average number of flowering stems per plant (Table 5) for each *Agapanthus* cultivar reveals significant interannual variation in flowering performance, with notable increases observed in 'Flower of Love' and 'Northern Star'.

Table 5

Average Number of Flowering Stems per Plant (2024–2025)

Agapanthus Cultivars	**Average number of flowering stems/plant (2024)**	**Average number of flowering stems/plant (2025)**
'Flower of Love'	2.4	6.6
'Twister'	2.4	0.8
'Northern Star'	0.8	3.2

The substantial increase in the number of flowering stems for the cultivars 'Flower of Love' (from 2.4 to 6.6) and 'Northern Star' (from 0.8 to 3.2) can be attributed to improved winter resilience and more efficient physiological recovery during the following growing season. These findings suggest that these cultivars exhibit enhanced cold tolerance and post-dormancy vigor under the specific climatic conditions of the 2024–2025 winter.

In contrast, 'Twister' showed a marked decline in flowering stem production, decreasing from 2.4 in 2024 to 0.8 in 2025. This reduction may reflect a higher sensitivity to low winter temperatures or other stress factors affecting its reproductive potential, possibly related to suboptimal adaptation to local overwintering conditions.

Regarding fruiting behavior, only the cultivar 'Flower of Love' produced mature fruits. Seeds collected from this cultivar were sown under greenhouse conditions in March; however, the germination rate was 0%. This suggests either poor seed viability or dormancy-related issues, raising concerns about the effectiveness of sexual reproduction under current cultivation practices. Additional studies on pollination efficiency, seed development, and dormancy-breaking treatments may be necessary to improve generative propagation outcomes.

Overall, these findings underscore the importance of cultivar selection in relation to winter hardiness and reproductive efficiency. They also highlight the need to complement vegetative propagation methods with improved strategies for sexual propagation, particularly for cultivars with promising floral traits but limited germination success.

2**.** The second taxonomic (fig. 4) unit selected for analysis is *Trachelium caeruleum* (L.).

Figure 4. *Trachelium caeruleum* (L.).

Figure 5. *Begonia* 'Sterling Moon'

The data collected did not yield highly conclusive insights. Although more vigorous growth was noted, the differences observed were not substantial. No fruiting was recorded during the first year, and as of the 2025 observation period, neither fruits nor seeds had yet developed. Importantly, cold temperatures did not impact their survival.

3. The third taxon selected (fig. 5) for this study is *Begonia* 'Sterling Moon'. Winter survival of *Begonia* 'Sterling Moon' was limited to 60 %, indicating relatively low cold tolerance.

Flowering was sporadic during the analyzed years (2024–2025), and no fruiting was observed. This suggests that the investigated taxon possesses limited reproductive potential and poor adaptation to the studied continental climate conditions.

CONCLUSIONS

This study highlights the differences in winter hardiness and reproductive performance of three ornamental taxa — *Agapanthus*, *Trachelium*, and *Begonia* — under temperate-continental climate conditions in Bucharest during 2024–2025. Despite dry leaf mulching, only *Agapanthus* and *Trachelium* achieved full overwinter survival. *Begonia* demonstrated reduced cold tolerance, with a 60 % survival rate, underscoring its limited adaptability.

Temperature data provided by ANM revealed mild conditions in December 2024, followed by an intense cold wave in February 2025, reaching – 19 °C. These fluctuations likely influenced plant growth and reproduction outcomes.

Among *Agapanthus* cultivars, 'Flower of Love' and 'Northern Star' showed notable improvements in vegetative and flowering performance in 2025. 'Twister' showed a decline, possibly due to higher sensitivity to winter stress. Only 'Flower of Love' produced seeds, but germination was unsuccessful, indicating challenges in generative propagation.

Begonia showed limited flowering and no fruiting in both years, with a low survival rate, confirming its vulnerability to winter stress. *Trachelium* showed no negative impact from cold and developed vigorously in its second year, though fruiting was absent.

Overall, this study highlights the critical role of cultivar selection and winter protection strategies in optimizing both survival and reproductive performance. It also underscores the need to integrate improved sexual propagation methods

alongside vegetative approaches, particularly for cultivars with promising floral traits but limited germination success.

Future research should focus on elucidating the physiological mechanisms underlying cold tolerance and reproductive barriers, as well as on developing agronomic practices that enhance the resilience and propagation efficiency of these ornamental species in continental temperate climates.

REFERENCES

Abraham H.H. 1989. Handbook of Flowering. Vol. VI: 770.

Bailey L.H. 1914. Manual of gardening: practical guide to the making of home grounds and the growing of flowers, fruits and vegetable for home use. Availeble in https://www.gutenberg.org/cache/epub/9550/pg9550-images.html(capVIII).

Bredmose N. 1984. Trachelium caeruleum: a possible new cut-flower. Vol. 100, No. 18, 548-549.

Mor Y., Halevy A. H., Kofranek A. M., et al. 1984. Postharvest handling of lily of the Nil flowers. J. Am. Soc. Horti. Sci. 109(4): 494-497.

Reinten E. Y., Coetzee J. H., van Wyk B. E. 2011. The potential of South African indigenous plants for international cut flower trade. S. Afr. J. Bot. 77(4): 934-946.

Singh Y., Baijinath H. 2018. Agapanthus campanulatus: amaryllidaceae – agapanthoidae. Curti's Bot. Mag. 35(2):106-124.

https://powo.science.kew.org/taxon/.