INFLUENCE OF TREATMENTS WITH GROWTH RETARDANTS ON THE ORNAMENTAL PROPERTIES OF *LAGERSTROEMIA INDICA* L. PLANTS

INFLUENȚA TRATAMENTELOR CU RETARDANȚI ASUPRA ÎNSUȘIRILOR ORNAMENTALE ALE PLANTELOR DE *LAGERSTROEMIA INDICA* L.

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Abstract.
The behavior of the species Lagerstroemia indica under the ecological conditions of the south-eastern part of Romania has been studied for several years at the Botanical Garden of Galati. The present experiment analyzed the effect of treatment with Alar 85 SG (growth retardant based on daminozide) on L. indica plants obtained from seeds and grown in pots under unprotected conditions. Based on the observations it was found that the reduction in plant height, the increase in the number of branches, the earliness of flower buds and flowering initiation, and the prolongation of flowering time of the plants were directly proportionally influenced by the concentration of the growth retardant used as 0.3% and 1%. The results recommend the treatment with Alar 0.3% as efficacious, considering that the effect on other characters ensuring flowering quality (inflorescence length, number of inflorescences / plant, number of flowers/inflorescence, density of flowers in inflorescences and flowering capacity of plants) was diminished by increasing the concentration to 1%.
Key words: daminozide, plants growth regulator, Indian lilac, ornamental characters

Rezumat.
Comportarea speciei Lagerstroemia indica în condițiile ecologice din zona de sud-est a României a fost studiată de mai mulți ani la Grădina Botanică Galați. Experiența de față a analizat efectul tratamentului cu Alar 85 SG (retardant de creștere pe bază de daminozidă) asupra plantelor de L. indica obținute din semințe și cultivate la ghivece, în condiții neprotejate. Pe baza observațiilor s-a constatat că reducerea înălțimii plantelor, creșterea numărului de ramificații, timpurietatea apariției bobocilor florali și a începutului înfloririi, precum și prelungirea duratei de înflorire a plantelor au fost influențate direct proporțional de concentrația retardantului de creștere, 0,3% și 1%. Rezultatele recomandă ca eficient tratamentul cu Alar 0,3%, având în vedere că la alte caractere care asigură calitatea înfloririi

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(lungimea inflorescențelor, numărul de inflorescențe/plantă, numărul de flori / inflorescență, densitatea florilor în inflorescențe și capacitatea de înflorire a plantelor) efectul s-a diminuat prin creșterea concentrației la 1%.
Cuvinte cheie: daminozida, regulator de creștere pentru plaante, liliac indian, caractere ornamentale

INTRODUCTION

Lagerstroemia is a genus of the family Lythraceae, with over 50 woody species native to tropical and subtropical regions of Southeast Asia and Australia [De Wilde and Duyfjes, 2013; Hao et al., 2024; Liu et al., 2008], but also widespread in other mild-climate habitats of North, Central and South America [Liu et al., 2013]. Due to their longevity, relatively good resistance to biotic and abiotic factors, abundant and long-lasting flowering etc., many species of the genus are valued as ornamental plants in garden landscaping or as pot plants [Riddle and Mizell, 2016; Saensouk and Saensouk, 2023; Wang et al., 2023].

Lagerstroemia indica L. (summer lilac, Indian lilac, crepe myrtle), one of the most popular species of the genus, is a medium to tall shrub native to southern China, the Himalayas and Indochina. It is among the few species of *Lagerstroemia* that exhibits better cold hardiness and can be cultivated in temperate regions [Pounders et al., 2007]. It is also drought resistant and resistant to air and soil pollution [Qiao et al., 2024; Wang et al., 2023]. In China and other Southeast Asian countries, it has been used for over 1500 years in traditional medicine, with almost all parts of the plant containing compounds with hypoglycemic, antimicrobial, analgesic, hepatoprotective, antimicrobial, anti-Alzheimer etc. [Liu et al., 2013; Li et al., 2024; Riddle and Mizell, 2016; Yue et al., 2024; Wang et al., 2023]. From an ornamental point of view, it is considered one of the most valuable species, in addition to numerous cultivars (with brightly colored flowers, beautifully colored foliage, long flowering period, diverse architectural forms etc.), many obtained by interspecific hybridization [Ju et al., 2018; Yu et al., 2014].

For ornamental purposes, *L. indica* is also cultivated in pots or containers, in which case, plant size control becomes an important aspect in cultivation technology and can be achieved by genetic, ecological, cultural or chemical methods [Malik et al., 2017]. The use of growth retardants is one of the effective strategies in reducing growth. Most plant growth retardants act by inhibiting gibberellin synthesis, reducing cell division in the shoot subapical meristem and elongation of cells, which results in plants with compact habit, improved leaf color, flower production and quality, flowering earliness etc. [Carvalho-Zanão et al., 2017; El-Sheibany et al., 2007; Warner and Erwin, 2003]. Studies have shown that plant response to the action of retardants can be influenced by a number of factors: plant particularities (taxonomic classification, developmental stage, endogenous hormonal balance etc.), environmental conditions, type of retardant and its concentration [Carvalho-Zanão et al., 2017; Tedila, 2022]. For example, at low concentrations retardants usually reduce cell elongation, while at high concentrations they further reduce cell division [Warner and Erwin, 2003]. Daminozide (succinic acid 2,2-dimethyl hydrazide) is a chemical inhibitor commonly used in horticultural practice, with

different names (Alar, Kylar, B-Nine, B-995) [Abbas and Al-Bakkar, 2023]. Alar is a highly mobile compound plants, and foliar application is one of the common and effective methods [Abbas and AL-Bakkar, 2023; Velasco-Ramírez et al., 2022].

The aim of this study was to analyze the influence of daminozide (Alar-85) on some morpho-decorative characters of *Lagerstroemia indica* plants grown in pots.

MATERIAL AND METHOD

The experiments were conducted from February to October 2024, in the Botanical Garden of the Galati Museum Complex. Since 2011, the Botanical Garden of Galati has specimens of *L. indica* (Fig. 1) with extremely rich flowering in the summer-autumn season and very well adapted to the specific climatic conditions of the area (average annual temperature 10^0C, minimum temperature in the last 10 years of -16.7^{0}C and maximum of +38.3^{0}C, with an average rainfall in the last 10 years of 412.4 L/m^2). In this study, the biological material consisted of Indian lilac (*Lagerstroemia indica*) obtained from seeds and grown in pots.

Fig. 1. Botanical Garden of Galați - *L. indica* flowering (original)

Seeds were collected from specimens existing in the botanical garden collection and sowing was carried out under warm greenhouse conditions on February 19, 2024. After seedlings were planted, the seedlings were repotted in 50 mm diameter alveolar pallets, and at the end of May, the plants were transferred to 3 L pots in a substrate consisting of garden soil, manure and sand, in a 1:1:1 ratio. The most vigorous, well-rooted and uniformly growing plants were selected (Fig. 2) and transferred to the experiment field in a sunny place.

Fig. 2. *L. indica* seedlings (from alveolar pallets) before planting in pots (original)

Treatments with Alar 85 SG were applied foliar, in three stages, set at intervals of about 14 days (15 June, 2 July and 16 July). The experiment was monofactorial, the experimental factor being the concentration of retardant used. Three experimental variants resulted: V_1 - untreated plants (control); V_2 - plants treated with Alar 0.3%; V_3 -

plants treated with Alar 1%. The variants were arranged in randomised blocks with 3 replicates (5 plants/replication). With the exception of the treatments specific to each variant, the other maintenance works were applied in a unitary way and the amount of water administered to each pot was identical.

Monitoring of the plants until the end of the growing season included observations and determinations not only in terms of vegetative growth (stem height and branching degree), but also flowering (flowering capacity and flowering phenology, number of inflorescences / plant, inflorescence length and number of flowers/inflorescence). The results obtained were statistically interpreted using analysis of variance LSD [Săulescu and Săulescu, 1967] and were compared with the control (V1 – plants not treated with growth retardant).

RESULTS AND DISCUSSIONS

Observations carried out on *Lagerstroemia indica* plants grown from seed and treated with Alar 85 SG approximately four months after sowing and two weeks after transfer of the transplanted seedlings to 3 litre pots, respectively, revealed the effect of the retardant depending on the concentration used. The three treatments carried out at 2-weekly intervals, starting on 15 June, influenced both vegetative growth (height, branching degree) and the quantity and quality of flowering.

Table 1 presents values of stem height and number of branches of plants, as differences between the values recorded at the first treatment and at the end of the growing season. The height difference had values between 10.0 and 32.4 cm. In the control, untreated plants (V_1), the difference in height between the two specified times was 32.4 cm. Compared to the control, the difference in height growth was reduced by 50% in treatments with Alar 0.3% (V_2) and by approx. 70% at concentrations of 1% (V_3). From a statistical point of view, the differences from the control were very significant positive. The branching capacity of the stems was directly proportional to the concentration of the growth retardant (Table 1). In untreated plants, the number of main branches was 5.6; treatment with Alar 0.3% increased the number of branches by 10.7%, and at concentrations of 1% the number of branches increased by 28.6%. Compared to the control, the differences were distinctly significant positive and very significant positive.

The results obtained are in line with the trend also reported in other species treated with daminozide-based retardants (reduced plant height, increased number of branches), such as in roses [Carvalho-Zanão et al., 2017], *Chrysanthemum morifolium* [El-Sheibany et al., 2007; Roepke et al., 2013; Sitawati and Ni'mah, 2018], *Dahlia variabilis* [Malik et al., 2017], *Pelargonium peltatum* [Tedila, 2022], *Eustoma grandiflorum* [Velasco-Ramírez et al., 2022], *Hibiscus radiatus* [Warner and Erwin, 2003].

Table 1

The difference in height growth and branching of plants stem

Variants	Height (cm)			Number of branches/ plant (pc)		
	Abs. val.	Diff.	Signif.	Abs. val.	Diff.	Signif.

V_1	**32.4**	**-**	**control**	**5.6**	**-**	**control**
V_2	16.2	-16.2	000	6.2	0.6	xx
V_3	10.0	-22.4	000	7.2	1.6	xxx

$LSD_{5\%}$ = 1.0 $LSD_{5\%}$ = 0.3
$LSD_{11\%}$ = 1.7 $LSD_{1\%}$ = 0.6
$LSD_{0.1\%}$ = 3.2 $LSD_{0.1\%}$ = 1.1

From an ornamental point of view, characters related to flowering are very important elements in the judgement of the ornamental value of plants. Unlike other woody plants obtained from seeds that bloom after 2-3 years, the Indian lilac can flower from the first year.

In our study, both flowering capacity and inflorescence quality were favoured by Alar treatments.

The length and number of inflorescences/plant (Table 2) had maximum values in plants treated with 0.3% Alar 85 SG. Compared to the control plants, which formed, on average, a single inflorescence with a length of 2 cm, in the V_2 variant obtained 5.6 inflorescences/plant with a length of 4.5 cm, with very significant positive differences. In variant V_3, although the results exceeded the control (3.6 inflorescences/plant, 3.1 cm long), they did not reach the level of those in V_2. The phenomenon of a reduction in the number of flowers or inflorescences/plant (even if exceeding the control) with increasing daminoside concentration was also reported in other ornamental species, such as *Dahlia variabilis* `Charmit` [Malik et al., 2017], *Eustoma grandiflorum* [Velasco-Ramírez et al., 2022].

Table 2

Influence of Alar 85 SG treatment on the length and number of inflorescences

Variants	Inflorescence length (cm)			Number inflorescences/ plant (pc.)		
	Abs. val.	Diff.	Signif.	Abs. val.	Diff.	Signif.
V_1	**2.0**	**-**	**control**	**1.0**	**-**	**control**
V_2	4.5	2.5	xxx	5.6	2.6	xxx
V_3	3.1	1.1	xx	3.6	4.6	xxx

$LSD_{5\%}$ = 0.4 $LSD_{5\%}$ = 0.3
$LSD_{11\%}$ = 0.6 $LSD_{1\%}$ = 0.4
$LSD_{0.1\%}$ = 1.2 $LSD_{0.1\%}$ = 0.8

The trend was similar for the number of flowers / inflorescence, four times higher than the control at 0.3% Alar and 2.3 times higher at 1% Alar (Table 3).

Table 3

Influence of Alar 85 SG treatment on the number of flowers per inflorescence and the density of flowers in the inflorescence

Variants	Number flowers/inflorescence (pc.)			Inflorescences density (flowers/1 cm inflorescence)		
	Abs. val.	Diff.	Signif.	Abs. val.	Diff.	Signif.
V_1	**3.0**	**-**	**control**	**1.5**	**-**	**control**
V_2	12.3	9.3	xxx	2.7	1.2	xxx

V_3	6.6	3.6	xxx	2.1	0.6	xx

$LSD_{5\%}$ = 0.3
$LSD_{11\%}$ = 0.6
$LSD_{0.1\%}$ = 1.1

$LSD_{5\%}$ = 0.2
$LSD_{1\%}$ = 0.4
$LSD_{0.1\%}$ = 0.7

The quality of inflorescences was also analysed in terms of the density of flowers in the inflorescence, by the number of flowers per 1 cm inflorescence (table 3). With 2.7 flowers/cm, the inflorescences of V_2 had the most compact appearance. In the control version, the inflorescences were looser, with 1.5 flowers/cm, and in the Alar 85 SG 1% treated version the values were intermediate (2.1 flowers/cm).

There were also differences between the variants in terms of the number of flowering plants. All the plants treated with Alar at concentration of 0.3% (V_2) have blossomed (100%). At higher concentrations (1%), the growth retardant had an inhibitory effect, reducing the number of flowering plants by 40% compared to the V_2 variant. Untreated plants (V_1) flowered only 40% (Fig. 3).

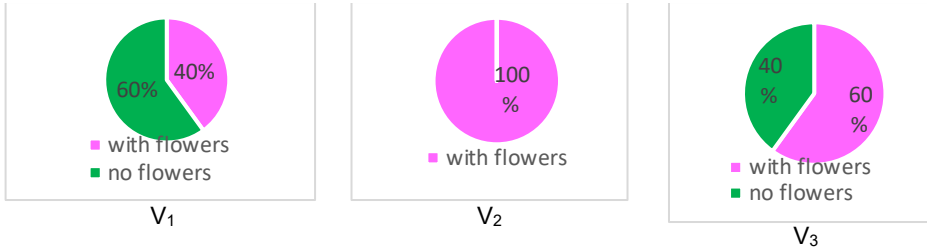

Fig. 3. Proportion of plants with flowers and without flowers

Monitoring of the main flowering phenophases revealed the earliness of flower buds and the onset of flowering in *L. indica* plants treated with retardant. From sowing to flower bud emergence the control plants took more than 6 months (192 days), 24-27 days longer than the Alar 85 SG-treated plants (Fig. 4). Delayed flower bud emergence has also been reported in some pot-grown varieties of *Chrysanthemum morifolium* (`Time Jewel`) [Sitawati and Ni'mah, 2018], but the literature also indicates situations where daminozide treatment resulted in delayed flower bud emergence in dahlia [Malik et al., 2017]. Flowering started 18-21 days earlier in both retardant-treated variants (Fig. 4). Regardless of the concentration of retardant used, the effect was similar, with a difference of 2-3 days between V_2 and V_3.

The decorative effect of the plants, as assessed by the length of time the flowers were maintained on the plant, was improved by Alar treatment, with the period extended to 47 days compared to only 29 days in the control (Fig. 5).

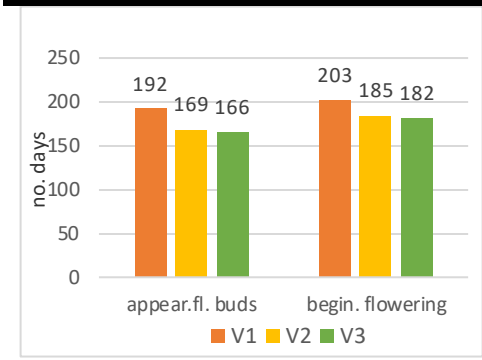

Fig. 4. No. days from sowing to the appearance of flower buds and the beginning of flowering

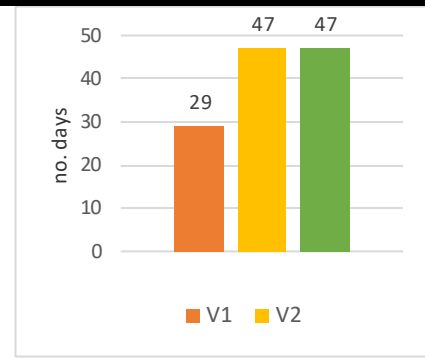

Fig. 5. Flowering duration (no. days)

CONCLUSIONS

Foliar treatments with daminozide (Alar 85 SG) 0.3% and 1% in Indian lilac (*Lagerstroemia indica*) grown in pots induced some changes in characters influencing the ornamental value of the plants.

The effect of Alar treatments was directly proportional to the increase of concentration, in terms of reduction of plant height, increase of number of branching, earliness of flower buds and onset of flowering and prolongation of flowering duration of the plants.

Other characters, such as inflorescence length, number of inflorescences / plant, number of flowers/inflorescence, density of flowers in inflorescences and flowering capacity of plants were favoured by treatments with Alar 85 SG 0.3% concentrations, with a tendency to decrease the effect at higher concentrations.

The results recommend that treatment with Alar 85 SG 0.3% (V_2).

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