Effect of spraying with Nano zinc and salicylic acid on the chemical traits and dry matter content of dwarf Tecoma stans seedlings

Isra'a Khalid Ahmad 1 Zeyad Mohammed Abdulrazzaq 2
1,2Department of Horticulture and Landscaping, College of Agriculture, University of Anbar, Iraq

1Email: isr23g5001@uoanbar.edu.iq ; 2Email: zeyadmohammed@uoanbar.edu.iq
Corresponding Author, Email: isr23g5001@uoanbar.edu.iq 1 ; zeyadmohammed@uoanbar.edu.iq 2

Abstract

The experiment was conducted in a protected facility lathhouse affiliated with the Department of Horticulture and Landscape Engineering, University of Anbar, from April to December 2024. This study aimed to study the effect of spraying nano-zinc (Zn) (0, 50, and 100 mg L-1) and salicylic acid (S) (0, 50, 100, and 150 mg L-1) on the chemical growth traits and dry matter content of dwarf Tecoma stans seedlings. The experiment was designed according to a randomized complete block design (RCBD) with three replicates, and the results were analyzed according to a 5% LSD. The results showed significantly excelled when dwarf Tecoma seedlings were sprayed with 100 mg L-1 nano zinc (Z2) and 100 mg L-1 salicylic acid (S2) as single agents in leaf N, P, K, and Zn content, relative total chlorophyll content, leaf carbohydrate content, flower beta-carotene content, and dry weight of root compared to the control treatments (Z0 and S0), which yielded the lowest significant differences for the same traits. The interaction treatment Z2S2 also yield ecelled in leaf carbohydrate and K content, and Z2S0 yielded superiority in leaf zinc content compared to the control treatment Z0S0, which yield the lowest significant differences. However, no significant differences were observed in the interaction treatments for the remaining studied traits .

Keywords: Nanofertilization, Growth Regulators, Tecoma stans, Chemical Content

Introduction

Tecoma shrubs comprise 80-85 genera and 810-86 plant species. Tecoma belongs to the Bignoniaceae family. The genus Tecoma includes fourteen species, including Stans, which is characterized by its low incidence of various diseases and insect pests. They are also evergreen shrubs with a long flowering period, rapid growth, and high tolerance to various environmental and climatic conditions. They have been successfully cultivated in many countries, and their native habitat is the tropical and subtropical regions of South and Central America [25] Tecoma is characterized by the beauty of its bright yellow flowers, which are fragrant and large and trumpet-shaped, and its glossy green leaves, which enhance its beauty, making it an attractive addition to garden decorations. It is also planted in groups or singly to highlight its aesthetic value as an ornamental tree. Furthermore, it contains many active compounds extracted from most parts of the plant. Its richness in these substances has given it a significant advantage in its medicinal uses [5,6,14] Tecoma shrubs can be propagated both seed-wise and vegetative under controlled temperatures of 20–30°C and 85% relative humidity by semi-woody cuttings with regular watering [7]. Zinc plays an important role in respiration, plant pigment synthesis, energy production, and carbon

ISSN 2072-3857

metabolism, all of which enhance crop growth, nutritional content, efficiency, and nutrient uptake [24] Spraying it on the vegetative system significantly increases most vegetative, floral, and chemical traits, according to [4] Salicylic acid plays an important role in promoting growth and increasing water absorption by enhancing root growth, which increases nutrient uptake. It also improves acid-stimulated photosynthesis and reduces transpiration, which enhances plant hydration and biomass[2,20].Therefore, the research aims to identify the effect of spraying dwarf Tecoma seedlings grown in protected environments lathhouse with nano-zinc and salicylic acid, and the interaction between them, on chemical growth traits and plant dry matter content .

Materials and Methods

The experiment was conducted in a protected facility (lathhouse) affiliated with the Department of Horticulture and Landscape Engineering, College of Agriculture, University of Anbar, from April to December 2024. It included foliar spraying with three concentrations of nano zinc oxide (ZnO) (0, 50, and 100 mg L-1) and four concentrations of salicylic acid (S) (150, 100, 50, and 0 mg L-1). Seedlings were sprayed in the early morning on April 16, May 6, September 16, and October 16, 2024. Salicylic acid was sprayed four times, one day after the first spray. Nitrogen, phosphorus, and potassium contents in dwarf Tecoma leaves were estimated according to the method mentioned by [8] The total chlorophyll content of leaves was estimated according to the method of [9] and zinc was estimated according to the method of [12] the percentage of carbohydrates in leaves was determined using [13] method, the beta-carotene content of flowers was determined according [1], and the dry weight of shoots and roots was estimated according to [3] method. The experiment was designed according to a randomized complete block design with three replicates. At the end of the experiment, data were collected and analyzed using the 5% LSD test [5.[

Results:

Leaf Nitrogen Content (%): Table 1 indicates that spraying with 100 mg L-1 nano-zinc (Z2) yielded the highest leaf nitrogen content in treatment Z2, reaching 0.45%, while the control treatment Z0 yielded the lowest leaf nitrogen content, reaching 0.41%, which was not significantly different from treatment Z1. When spraying plants with salicylic acid, the 100 mg L-1 (S2) treatment significantly outperformed the control treatment, yielding the highest leaf nitrogen content, reaching 0.47%, while the control treatment S0 yielded the lowest, reaching 0.39%. The same table indicates no significant difference between the interaction treatments.

ISSN 2072-3857

Table 1: Effect of nano-zinc and salicylic acid sprays and their interaction on leaf nitrogen content (%) of Tecoma dwarf seedlings

average S	Z_2	Z_1	Z_0	
0.39	0.41	0.39	0.37	S_0
0.43	0.46	0.41	0.42	S_1
0.47	0.49	0.48	0.46	S_2
0.43	0.45	0.41	0.41	S_3
	0.45	0.42	0.41	average Z
0.01				LSD Z
0.02				LSD S
N.S				LSD Z*S

Phosphorus content in leaves (%): Treatment Z2 (nano-zinc spray) yielded the highest leaf phosphorus content, reaching 0.20%, while the control treatment Z0 yielded the lowest leaf phosphorus content, reaching 0.15%, which did not differ significantly from treatment Z1, as shown in Table 2. Salicylic acid spray treatments demonstrated the superiority of treatment S2, yielding the highest leaf phosphorus content, reaching 0.22%, compared to treatment S0, which yielded the lowest leaf phosphorus content, reaching 0.14%, which did not significantly differ from treatment S1, which yielded 0.16%. Regarding the interaction between the two study factors, the table showed no significant differences.

Table 2: Effect of nano-zinc and salicylic acid sprays and their interaction on leaf phosphorus content (%) of Tecoma dwarf seedlings

average S	Z_2	Z_1	Z_0	
0.14	0.17	0.14	0.11	S_0
0.16	0.17	0.15	0.15	S_1
0.22	0.23	0.21	0.20	S_2
0.18	0.21	0.18	0.15	S_3
	0.20	0.17	0.15	average Z
0.02				LSD Z
0.03				LSD S
N.S				LSD Z*S

Potassium content in leaves (%): The nano-zinc Z2 treatment excelled on, providing the highest potassium content in leaves, reaching 1.14%, while the control treatment Z0 provided the lowest potassium content in leaves, reaching 1.02%. When spraying plants with salicylic acid, the S2 treatment ecelled,

ISSN 2072-3857

providing the highest percentage, reaching 1.14%, compared to the S0 treatment, which provided the lowest potassium content in leaves, reaching 1.03%. This did not significantly differ from the S1 treatment, which provided 1.06%, as shown in Table 3. The table also indicates that the interaction treatment Z2S1 significantly outperformed, providing the highest potassium content in leaves, reaching 1.18%, which did not significantly differ from the Z2S2 treatment, compared to the control treatment Z0S0, which provided the lowest potassium content in leaves, reaching 0.93% .

Table 3: Effect of nano-zinc and salicylic acid sprays and their interaction on leaf potassium content (%) of Tecoma dwarf seedlings.

average S	Z_2	Z_1	Z_0	
1.03	1.14	1.02	0.93	S_0
1.06	1.18	1.01	1.00	S_1
1.14	1.14	1.17	1.09	S_2
1.09	1.11	1.12	1.04	S_3
	1.14	1.08	1.02	average Z
0.04				LSD Z
0.04				LSD S
0.07				LSD Z*S

Zinc percentage in leaves (%): The results of Table 4 show that spraying plants with nano-zinc gave the highest percentage of zinc in leaves in treatment Z2, reaching 45.10%, while the percentage decreased to its lowest level in the control treatment Z0, reaching 28.52%. The table also shows that spraying leaves with salicylic acid increased the percentage of zinc in leaves, reaching 14.32% in treatment S2, which did not significantly differ from treatment S3. Meanwhile, treatment S0 gave the lowest percentage of zinc in leaves, reaching 35.72%, which did not significantly differ from treatment S1. The results of the table indicate significant differences between the interaction treatments. Treatment Z2S0 gave the highest percentage of zinc in leaves, reaching 49.13%, while the control treatment Z0S0 gave the lowest percentage, reaching 26.13%.

ISSN 2072-3857

Table 4: Effect of nano-zinc, salicylic acid, and their interaction on leaf zinc content (%) of Tecoma dwarf seedlings.

average S	Z_2	Z_1	Z_0	
35.72	49.13	31.88	26.13	S_0
35.79	45.70	34.15	27.53	S_1
41.32	44.70	48.37	30.90	S_2
38.61	40.87	45.47	29.50	S_3
	45.10	39.97	28.52	average Z
2.54				LSD Z
2.94				LSD S
5.09				LSD Z*S

Total chlorophyll content of leaves (mg 100g-1 fresh weight): The results of Table 5 confirm that spraying with nano zinc led to a significant increase in the total chlorophyll content in leaves in treatment Z2, which was given 122.5 mg 100g-1 fresh weight, which did not significantly differ from treatment Z1. However, it decreased in the control treatment Z0, reaching 114.3 mg 100g-1 fresh weight. When spraying plants with salicylic acid, treatment S2 was distinguished by giving the highest total chlorophyll content in leaves, reaching 127.1 mg 100g-1 fresh weight. Meanwhile, the total chlorophyll content decreased in the control treatment S0, reaching 114.7 mg 100g-1 fresh weight, which did not significantly differ from treatments S1 and S3. The results of the table show no significant differences between the interaction treatments in this trait.

Table 5 Effect of nano-zinc, salicylic acid and their interaction on leaf total chlorophyll content (mg/l00g-1 fresh weight) of Tecoma dwarf seedlings

average S	Z_2	Z_1	Z_0	
114.7	117.0	118.7	108.6	S_0
116.6	119.3	119.8	110.6	S_1
127.1	130.8	130.5	120.0	S_2
119.6	123.0	117.8	117.9	S_3
	122.5	121.7	114.3	average Z
5.18				LSD Z
5.98				LSD S
N.S				LSD Z*S

Leaf Carbohydrate Percentage (%): Spraying nano-zinc on the vegetative system increased the leaf carbohydrate percentage in treatment Z2, reaching 11.52%, while the control

ISSN 2072-3857

treatment Z0 produced the lowest leaf carbohydrate percentage, reaching 10.13%. Spraying with salicylic acid produced the highest leaf carbohydrate percentage, reaching 11.53%, while treatment S0 produced the lowest, reaching 10.29%, as shown in Table 6. The table indicates significant differences between the interaction treatment Z2S2 and the other treatments, as it produced the highest leaf carbohydrate percentage, reaching 12.29%, while the control treatment Z0S0 produced the lowest carbohydrate percentage, reaching 9.340%.

Table 6: Effect of nano-zinc and salicylic acid sprays and their interaction on leaf carbohydrate percentage (%) of Tecoma dwarf seedlings.

average S	Z_2	Z_1	Z_0	
10.29	11.41	10.13	9.340	S_0
10.74	11.35	11.09	9.800	S_1
11.53	12.29	11.58	10.71	S_2
10.80	11.02	10.71	10.67	S_3
	11.52	10.88	10.13	average Z
0.36				LSD Z
0.41				LSD S
0.71				LSD Z*S

Relative beta-carotene content in flowers (%): Table 7 shows that nano-zinc spraying increased the percentage of beta-carotene in flowers, reaching its highest level in treatment Z2, yielding 33.74%, while the control treatment Z0 yield the lowest level of beta-carotene, at 22.13%. Salicylic acid spraying, however, yielded the highest level of beta-carotene in treatment S2, yielding 33.94%, compared to the control treatment S0, which yielded the lowest level, at 23.36%. The table also indicates significant differences between the interaction treatments. Treatment Z2S2 yielded the highest level of beta-carotene in flowers, at 39.07%, while treatment Z0S0 yielded the lowest level, at 19.87% .

ISSN 2072-3857

Table 7: Effect of nano-zinc spraying, salicylic acid, and their interaction on the relative beta-carotene content in flowers(%)

average S	Z_2	Z_1	Z_0	
23.36	28.73	21.47	19.87	S_0
27.19	36.97	23.87	20.73	S_1
33.94	39.07	38.73	24.03	S_2
30.46	30.20	37.30	23.87	S_3
	33.74	30.34	22.13	average Z
1.59				LSD Z
1.83				LSD S
3.18				LSD Z*S

Dry weight of the vegetative growth (g): Table 8 shows that spraying with nano-zinc at a concentration of 100 mg L-1 (Z2) produced the highest dry weight of the vegetative growth , reaching 100.3 g, which did not differ significantly from treatment Z1, which yielded 94.12 g. while, Z0 (the control treatment) produced the lowest dry weight, reaching 76.14 g. When spraying with salicylic acid, treatment S2 produced the highest dry weight of the vegetative growth , reaching 105.0 g, which did not differ significantly from treatment S3, which yielded 95.02 g. Meanwhile, treatment S0 (the control treatment) produced the lowest dry weight, reaching 72.42 g. The table shows no significant differences between the interaction treatments

.

Table 8: Effect of nano-zinc and salicylic acid sprays and their interaction on the dry weight of the vegetative growth (g(

average S	Z_2	Z_1	Z_0	
72.42	79.95	66.68	70.63	S_0
88.34	101.1	91.80	72.11	S_1
105.0	116.0	114.2	84.83	S_2
95.02	104.2	103.8	76.97	S_3
	100.3	94.12	76.14	average Z
13.50				LSD Z
15.58				LSD S
N.S				LSD Z*S

ISSN 2072-3857

Dry weight of the root system (g): The results of Table 9 showed that spraying with nano zinc gave the highest dry weight of the root system in treatment Z2, reaching 22.42 g, which did not significantly differ from treatment Z1, while the dry weight of the root system decreased in treatment Z0, reaching 14.60 g. The results of the table showed that spraying with salicylic acid at a concentration of 100 mg L-1 (S2) gave the highest dry weight of the root system, reaching 22.53 g, compared to the control treatment S0, which gave the lowest weight, reaching 9216 g, which did not significantly differ from treatment S1. The table showed significant differences between the interaction treatments in treatment Z2S2, which was distinguished by giving the highest dry weight of the root system, reaching 24.53 g, while the interaction treatment Z0S0 (the control treatment) gave the lowest dry weight of the root system, reaching 11.49 g .

Table 9 Effect of nano zinc and salicylic acid sprays and their interaction on the dry weight of the root system (g(

average S	Z_2	Z_1	Z_0	
16.92	21.50	17.77	11.49	S_0
18.82	23.72	18.85	13.89	S_1
22.53	24.53	24.17	18.90	S_2
18.93	19.93	22.74	14.13	S_3
	22.42	20.88	14.60	average Z
1.67				LSD Z
1.93				LSD S
3.33				LSD Z*S

Discussion

The results showed a positive effect of nano-zinc spraying on the chemical characteristics and dry weight of dwarf Tecoma plant. Zinc spraying at 100 mg L-1 (Z2) significantly outperformed the percentage of nitrogen, phosphorus, potassium, zinc, total chlorophyll, and carbohydrates in leaves. It also outperformed the percentage of beta-carotene in flowers and the dry weight of the vegetative and root systems. This is consistent with what [4] found. Nitrogen plays an important role in cell division and the formation of energy compounds (such as ATP), which promotes the growth of roots, stems, and leaves. Therefore, nitrogen balance is considered a prerequisite for healthy plant growth. This is consistent with [15]). Phosphorus contributes to increasing the size and branching of roots and strengthening them, especially lateral and fibrous roots. This helps increase the efficiency of roots in absorbing nutrients, which in turn affects plant growth and development. This element participates in the breakdown of carbohydrates resulting from photosynthesis, which is accompanied by the release of energy needed to carry out all vital processes. It is involved in the formation of some energy-rich compounds such as ATP,

ISSN 2072-3857

cytosine triphosphate (CTP), and guanosine-5'-triphosphate (GTP) [23]. The reason for the increased chlorophyll content of plant leaves is attributed to the role of nano-fertilizer particles in increasing the speed of enzymatic activities, leading to improved biological activities and thus stimulating the division of chloroplasts [2]. [21]attributed zinc to its role in enhancing membrane stability, enzyme synthesis, and the biosynthesis of chlorophyll, protein, and carbohydrates. It also improves root growth, auxin metabolism, detoxifies reactive oxygen species, and reduces abiotic stresses. This played an effective role in increasing chlorophyll and carbohydrate content in the plant.

The results also demonstrated the positive effect of salicylic acid spraying on the chemical traits under study in the Tecoma plant, with spray treatments at a concentration of 100 mg L-1 (S2) outperforming the control group. This is consistent with the findings of [7,16,17[

[14]indicated that salicylic acid plays a role in increasing the plant's content of endogenous hormones such as gibberellins and auxins, thereby increasing cell division and elongation, increasing the emergence of secondary roots, and increasing the density of the vegetative system. This leads to increased nutrient absorption efficiency, which positively impacts the increase in fresh and dry weights and other chemical traits.

Conclusion

Spraying dwarf Tecoma seedlings grown in a protected environment (lathhouse) with nano-zinc and salicylic acid at a concentration of 100 mg L-1 had a positive effect on the plant's chemical characteristics. However, increasing the salicylic concentration sprayed on the plant had a negative effect on the plant's chemical characteristics. Therefore, appropriate concentrations of nano-micronutrients and growth regulators must be determined and selected before spraying dwarf Tecoma seedlings to achieve the best results in improving plant chemical growth characteristics and increasing their dry matter content .

References

.1
Abbas, Mu'ayyad Fadhel and Mohsen Jalab Abbas. 1992. Practical Care and Storage of Fruits and Vegetables. College of Agriculture, University of Basra. Ministry of Higher Education and Scientific Research, Iraq. 440 pages

.2 Abdel Latef, A. A. H., Abu Alhmad, M. F., & Abdelfattah, K. E. (2017). The possible roles of priming with ZnO nanoparticles in mitigation of salinity stress in lupine (Lupinus termis) plants. Journal of Plant Growth Regulation, 36, 60-70 .

.3 Abdul Albass, F. A. (2021). Effect of spraying with salicylic acid and the leaves extract of Moringa on the vegetative and flowering growth of common snapdragon (Antirrhinum majus L.). Plant Cell Biotechnology and Molecular Biology, 22(33&34), 145–154.

.4 Al-Hadithi Mustafa Ayada Adai and Raed Ibadah Nasser Al-Hasnawi. 2017 Response of olive seedlings to zinc and manganese spraying. (1). Vol. 44, No. Zagazig J. Agric.Res.

.5 Al-Mohammadi, Shaker Musleh, and Fadhel Musleh Al-Mohammadi. 2012. Statistics and Experimental Design. Osama

ISSN 2072-3857

Publishing and Distribution House. Amman, Jordan.
.6 Al-Sahhaf, Fadhel Hussein. 1989. Applied Plant Nutrition. University of Baghdad - Ministry of Higher Education and Scientific Research. Bayt Al-Hikma for Publishing, Translation, and Distribution - Higher Education Press in Mosul - Iraq. 258 pages.
.7 Al-Shalah, N. A. A. (2022). Sunflower Response to Biofertilization and Nano-Zinc Spraying on Growth, Yield, and Some Qualitative Traits (Master's Thesis). College of Agriculture, University of Karbala.
.8 Amir Reza Tavakoli ،Abdolhossein Aboutalebi Jahromi1 ،Vahid Rowshan Sarvestani and Abdolrasoul Zakerin1 (2023) The Effect of Nano-complex Salicylic Acid-zinc on Vegetative and Phytochemical Characteristics of Thymus daenensis Celak. Journal of Medicinal Plants and By-products 1: 37-46
.9 Anand ،M and R. Basavaraju. 2021a. A review on phytochemistry and pharmacological uses of Tecoma stans (L.) Juss. ex Kunth. Journal of Ethnopharmacology ،Vol. 265 ،113270.
.10 Anand ،M. ،& Basavaraju ،R. (2021b). GC analysis of different parts of Tecoma stans (L.) Juss. ex Kunth for fatty acid composition. Current Botany ،12 ،16–21. https://doi.org/10.25081/cb.2021.v12.6605
.11 Ashok, A. D. and Ravivarman J. (2020). Efficacy of naphthalene acetic acid on root promotion on vegetative propagation of Tecoma stans under mist chamber of semi-arid tropic region. Journal Pharmacogn. Phytochem, 9: 3000 - 3002.
.12 Bahargava, B. S. and Raghupathi, H. B. 1999. Analysis of plant materials for macro and micronutrients. pp. 49-82. In: Methods of analysis of soils, plants, water and fertilizers, H. L. S. Tandon (eds.), Binng Printers. L-14, Lajpat Nagar New Delhi
.13 Bajracharya, D. 1999. Experiments in plant physiology. Narosa Publishing House New Delhi Madras Bombay Calcutta.pp.51-53.
.14 Basit, A., Shah, K., Rahman, M. U., Xing, L., Zuo, X., Han, M., Alam, N., Khan, F., Ahme, I., & Khalid, M. A. (2018). 15. Salicylic acid an emerging growth and flower inducing hormone in marigold (Tagetes sp. L.). Pure and Applied Biology (PAB), 7(4), 1301-1308 .
.15 Chen, L.-H., Xu, M., Cheng, Z., & Yang, L.-T. (2024). Effects of nitrogen deficiency on the photosynthesis, chlorophyll a fluorescence, antioxidant system, and sulfur compounds in Oryza sativa. International Journal of Molecular Sciences, 25(19), 10409 .
.16 Es-sbihi, F. Z., Hazzoumi, Z., & Amrani Joutei, K. (2020). Effect of salicylic acid foliar application on growth, glandular hairs and essential oil yield in Salvia officinalis L. grown under zinc stress. Chemical and Biological Technologies in Agriculture, 7(1), 1–11. https://doi.org/10.1186/s40538-020-00192-6
.17 Hana Salar Abdullah, Kifaya Ghazi Saeed Al-Saad, and Osama Ibrahim Ahmed. 2018 Effect of salicylic acid spraying on the growth and flowering of three varieties of Chrysanthemum indicum L. The Third International Scientific Conference on Agricultural Sciences - Postgraduate Studies.
.18 Haynes, R. J. (1980). A comparison of two modified Kjeldahl digestion techniques for multi-element plant analysis with conventional wet and dry ashing methods.Communications in Soil Science and plant Analysis ,11(5),459-467.
.19 Joslyn, M.A.. 1970. Method in Food Analysis, Physical, Chemical and Instrumental

Methods of Analysis. 2nd ed. Academic Press, New York and London.

.20 Jumaah, M. S., Abdulrazzaq, Z. M., & Abdul_Majeed, A. H. (2021). Role of green spaces and their impact on climate design and ecosystem efficiency. In IOP Conference Series: Earth and Environmental Science (Vol. 761, No. 1, p. 012055). IOP Publishing.

.21 Kırgeç, Y.; Batı-Ay, E.; Açıkgöz, M.A. The Effects of Foliar Salicylic Acid and Zinc Treatments on Proline, Carotenoid, and Chlorophyll Content and Anti-Oxidant Enzyme Activity in Galanthus elwesii Hook. Horticulturae 2023, 9, 1041. https:// doi.org/10.3390/horticulturae9091041

.22 Kumari, P., Tsomu, T., Singh, A. K., Singh, R. P., Maying, B., & Tasung, A. (2025). Impact of salicylic acid and kinetin on morpho-physiological traits, flowering patterns and seed yield in Salvia splendens. Journal of Applied Horticulture, 27(1), 113–117. https://doi.org/10.37855/jah.2025.v27i01.22

.23 Malhotra H., Vandana, Sharma, S., & Pandey, R. (2018). Phosphorus nutrition: plant growth in response to deficiency and excess. Plant nutrients and abiotic stress tolerance, 171-190.

.24 Nandi ,R., Hasim, R., Nitin ,C., Animesh ,G.B., and Gora, C. H. 2020. Effect of Zn and B on the Growth and Nutrient Uptake in Groundnut. Current Journal of Applied Science and Technology. 39(1): 1-10.

.25 Rana ،N.; S. Singh; A.K. Dhakad and K.K. Dhat. 2023. Coding phenological growth stages of yellow bells (Tecoma stans (L.) Juss. ex Kunth) based on BBCH scale and its implications for urban greening. Current Plant Biology ،34 ،100284.

ISSN 2072-3857