

Silicon Mitigates the Attack of Pests and Diseases on Ipê-Roxo (*Handroanthus impetiginosus*) Seedlings

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Abstract. Background: Silicon in plants is a structuring element that promotes water and saline stress tolerance and decreases transpiration. The silica accumulated in the cuticle establishes a physical barrier and helps fight against pests and diseases. The present study aimed to evaluate the development of ipê-roxo (*Handroanthus impetiginosus*) seedlings in different environments, and the application of potassium silicate and its efficiency in mitigating the attack of pests and diseases. Methods: The experiment was carried out in an agricultural greenhouse and under full sun with silicic doses of 0 and 7.15 mg per plant in a completely randomized design arranged in a 2×2 factorial scheme, with 6 replications of 4 seedlings per plot. Plant height, chlorophyll, stem diameter, number of leaves, shoot dry matter, root dry matter, total dry matter, height-diameter ratio, root-shoot ratio, root-plant ratio, Dickson quality index, disease severity, and pest intensity were evaluated. Results: Silicon application did not confer biometric qualities to the seedlings. The application of silicon conferred 24.6% higher protection against disease severity at a 90% probability level. The protected environment promoted 48.8% more protection against the attack of pests on the seedlings. The silicon application decreases the intensity of pests in the protected environment by 36.3%. Seedlings in a protected environment increase the production of chlorophyll but are 29.6% more susceptible to the severity of diseases. The full sun promoted greater diameters, phytomass, and Dickson quality index by 18%, 73%, and 195%, respectively. Conclusions: The best *Handroanthus impetiginosus* seedlings were obtained under full sun. Silicon mitigated the attack of pests and diseases on *Handroanthus impetiginosus* seedlings.

Keywords. Bignoniaceae Family; Shading; Silicate.

INTRODUCTION

Handroanthus impetiginosus of the Bignoniaceae family, a tree species native to Brazil that can reach from 20 to 35 meters in height, is mainly known as ipê-roxo (Silva et al. 2015). Its wood is used in the furniture industry, and the bark has pharmacological properties (Ferreira et al. 2017), but visually, the appearance of the canopy confers a rare beauty that stands out in landscaping projects when in full bloom. It is one of the most produced native species in nurseries for landscaping in urban afforestation and recovery programs for degraded forest ecosystems.

Handroanthus impetiginosus quality seedling production is very important to establish commercial production, as pharmaceutical industries explore the species as an adult because it contains compounds in

its bark that have anti-inflammatory activities (Koyama et al. 2000), antioxidant compounds (Park et al. 2003), antibacterial agents (Park et al. 2005; Park et al. 2006), and substances with acaricidal potential (Jeon and Lee 2011).

Obtaining quality seedlings requires, respectively, adequate phytotechnical and phytosanitary management. These aspects give robustness and sanity to the plants for their initial post transplantation growth since, from the seed collection to the final destination of the seedling, the phytosanitary quality must be prioritized, as a result, healthy seedlings. Silicon application in seedlings aims to promote rigidity to epidermal tissues and decrease pest attack and tolerance to certain diseases (Ma and Yamaji 2008; Guntzer et al. 2012; Islam et al. 2020; Kendra and Nayaka 2022).

According to Silveira and Higashi (2003), using phosphite and silicon may decrease the severity of bacteriosis and improve the quality of forest nurseries seedlings, maintaining uniformity.

Silicon is efficient in plant development, morphology, and structure during growth, mainly in plants that accumulate this element (Silva et al. 2019), as well as tolerance to water stress, saline stress, and decreased perspiration (Oliveira et al. 2019; Zhang et al. 2020; Zuffo and Aguilera 2020). Silicon is used as a biologically active and important element in agriculture due to leaf application in the form of potassium silicate (Coskun et al. 2019), as the benefits of K_2SiO_3 for plants are known (Debona et al. 2017). Silicon in foliar application promotes more resistant, erect leaves, better use of incident radiation (Mendonça et al. 2013), and prevents chlorophyll oxidation in high light conditions (Cavalcanti-Filho et al. 2018).

The exogenous application of silicon (Si) potentiates plants against biotic and abiotic stresses (Vulavala et al. 2016; Rastogi et al. 2021; Ahmed et al. 2023), regulates genes related to photosynthesis, protecting it, in addition to protecting chloroplasts (Rastogi et al. 2021), increases antioxidant defenses and decreases oxidative stress, limiting the production of reactive oxygen species (ROS) (Ahmed et al. 2023). The accumulation of Si in the aerial part of plants varies considerably between species and the transport, mediated by transporter or by passive diffusion, is radial (Mitani and Ma 2005). Si fertilization in potato cultivation under water stress conditions increased Si only in the tuber skin, suggesting greater lignification and suberization. However, the putative Si transporter (StLsi1) was detected twice as much in leaves and roots with fertilization and 5 times more in leaves under Si drought conditions (Vulavala et al. 2016). The higher density of a radial transporter associated with a xylem transporter is responsible for the high accumulation of Si in rice (Mitani and Ma 2005), and the combination of Si with bioagents improves the performance of plants under water stress (Costa et al. 2023).

In studies with different silicon concentrations, orchids showed greater growth at concentrations of 0.5 and 2.0 mg/L of calcium silicate in a culture medium, in a growth chamber (Soares et al. 2012). In Dorneles et al. (2018), potatoes cultivated in a nutrient solution with a concentration of 0.5 mm Si ($NaSiO_3$) promoted the best growth parameters. Foliar application of Si at concentrations of 0.5 and 1.0 g/L of potassium silicate increased photosynthesis and

productivity of soybean, corn, and cotton (Souza-Júnior et al. 2022). In sorghum cultivation, concentrations of 0.88 g/L of stabilized silicic acid and 0.84 g/L of potassium silicate, in foliar applications, increased plant growth, reduced water loss by transpiration, and had a positive impact on gas exchange at the phenological stages V4 and V8 (4 and 8 fully expanded leaves, respectively) and R1 (beginning of flowering) (Oliveira et al. 2019).

In addition to proper phytosanitary management in seedling production, another important aspect is the production environment. This environment can be protected or not with adequate micrometeorological conditions that aim to provide a favorable environment for the initial growth of the plants. No reports were found in the literature on the application of silicon in the formation of ipê seedlings. Given the above, the present study aimed to evaluate the development of ipê-roxo (*Handroanthus impetiginosus*) seedlings in different environments and the application of potassium silicate and its efficiency in mitigating the attack of pests and diseases.

MATERIALS AND METHODS

The experiment was conducted in an experimental area of the State University of Mato Grosso do Sul (UEMS) in Cassilândia from 2017 October 17 to 2018 March 1. The region is located at an altitude of 516 m, $-51^{\circ}44'03''W$, and $-19^{\circ}06'48''S$ (CASSILANDIA-A742 automatic station). The climate in this region is tropical with a dry season.

Two environments were evaluated, one in full sun (A1), where the seedlings were placed on wooden pallets so as not to come into contact with the ground, at an approximate height of 40 cm; and in an agricultural greenhouse (A2), measuring 18 m \times 8 m \times 4 m (144 m²), covered with a 150-micron, low-density polyethylene (LDPE) film and a LuxiNet 42/50 aluminized thermo-reflective screen, movable, under LDPE film.

The silicon source used was the Protect Silifol[®] product (Tatu Agronegócios, São José do Rio Preto, Brazil) (12% silicon and 12% potassium (K_2O), density of 1.43 g/mL) in doses of 0 and 2.0 mL diluted in 2.4 L of water and applied with the aid of a manual sprayer at 90 and 120 days after sowing (DAS). Approximately 50 mL of potassium silicate solution was applied to each seedling, corresponding to 7.15 mg of Si per plant.

For producing *Handroanthus impetiginosus* seedlings, polyethylene plastic bags (15 × 25 cm) were used, with a capacity of 1.8 L, containing a substrate composed of 50% soil, 30% cattle manure, and 20% super fine vermiculite. Substrate characteristics were: pH (CaCl₂) = 4.6; Ca = 2, Mg = 3.4, Al = 0.15, K = 0.36 (cmolc/dm³); Cu = 0.5, Fe = 159, Zn = 47 (mg/dm³); organic matter (OM) = 36.1 (g/dm³); cation exchange capacity (CEC) = 9.3 (cmolc/dm³); base saturation = 65.2%; base ratio: Ca/CEC = 21.6%, Mg/CEC = 36.7%, H + Al/CEC = 37.8%.

The plastic bags from the agricultural greenhouse were arranged on benches 1.4 m wide by 3.5 m long and 1 m high from the ground, in full sun on wooden pallets. Three seeds were sown per 1.8 L plastic bag on 2017 October 17. After forming 3 definitive leaves, thinning was performed (with scissors), always leaving the seedling more developed.

At 130 DAS, plant height (AP) in centimeters, chlorophyll by the SPAD index (CH) (or relative chlorophyll index), stem diameter (SD) in millimeters, and number of leaves (NL) were collected. Also, shoot dry matter (SDM), root dry matter (RDM), and total dry matter were evaluated; the values were given in g/plant. The height-diameter ratio (HDR), shoot-root ratio (SRR), root-total ratio (RTR), and the

Dickson quality index (DQI) were determined, the latter being obtained through the DQI calculation: $DQI = (MST/[PH/SD] + MSA/RDM)$.

The level of disease severity and pest attack was also evaluated. As there are no diagrammatic scales in the literature for determining these levels, a scale was proposed according to the different degrees of manifestation of diseases and pest attacks (Figure 1), based on the diagrammatic scales proposed by Belasque Júnior et al. (2005) and Cunha et al. (2001), for citrus and coffee, respectively. For this, percentage levels of pest attacks and incidence of diseases on leaves were determined, with levels 0%, 25%, 50%, 75%, and 100% of leaves showing symptoms of pest and disease attack. Grades were allocated according to percentages, corresponding to 1, 2, 3, 4, and 5, respectively. The evaluations of pests and diseases were carried out separately, that is, one for disease and another for pest attack, always consulting the literature for better identification (Auer 2001).

The pests found on the seedlings of ipê-roxo seedlings in the present study were cochineal (*Ceroplastes sinensis*), pasture leafhopper (*Mahanarva fimbriolata*), silverleaf whitefly (*Bemisia tabaci*), and chrysomelids (Coleoptera: Chrysomelidae). The diseases incident on the ipê-roxo seedlings in the present study



Figure 1. Proposed diagrammatic scale for assessing disease severity and pest attack on *Handroanthus impetiginosus* seedlings. Scale proposed by the authors. (Adapted from Cunha et al. [2001] and Belasque Júnior et al. [2005]).

were wire blight (*Ceratobasidium ochroleucum*) and brown scab (*Apiosphaeria guaranitica*).

The seedlings were irrigated twice daily, in the morning and afternoon, when necessary. Mineral fertilization was performed according to substrate analysis at 45, 90 and 135 DAS, using the NPK 05:20:20 formulation.

During the experiment, at 10:00 a.m., photosynthetically active radiation ($\mu\text{mol m}^2/\text{s}$) was measured in the cultivation environments (Model MP-200, Apogee Instruments, Inc., Logan, UT, USA) (Figure 2). The air temperature ($^{\circ}\text{C}$), relative air humidity (%), and global radiation (W/m^2) were recorded in data logger MOD.CDR-550 (Instrutherm[®], São Paulo, Brazil) every 10 minutes. Ambiance data were compared in a randomized block design with 5 repetitions

(each repetition was a month of collection, from October to February). The precipitation was 95 mm (October), 365.80 mm (November), 308.20 mm (December), 259.00 mm (January), and 133.20 mm (February), with a total accumulated of 1161.20 mm (INMET Sonabra).

The experiment was carried out in a completely randomized design (CRD), in a 2×2 factorial scheme (2 environments \times 2 silicon doses), with 6 replications of 4 seedlings each. Data were subjected to analysis of variance (F -test) and means compared by LSD test at 5% probability. Disease data were also subjected to the LSD test at 10% probability. Disease severity and pest intensity data were transformed into the square root of $(x + 0.5)$.

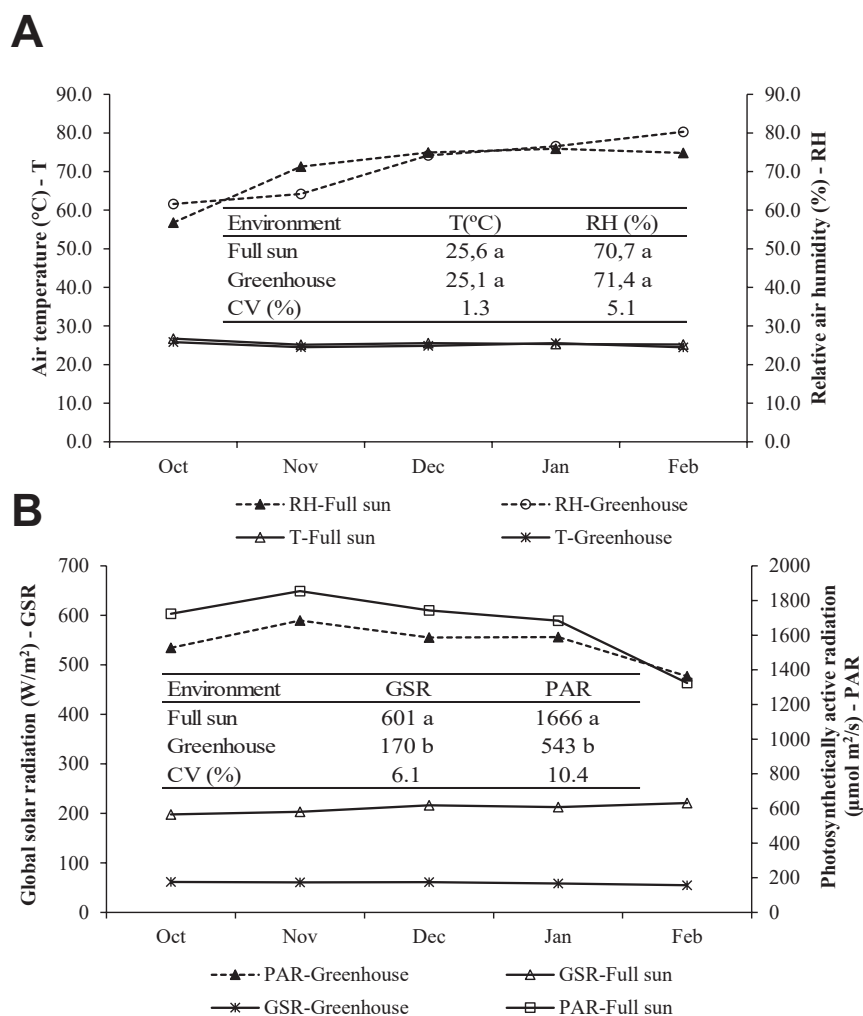


Figure 2. (A) Air temperature (T, $^{\circ}\text{C}$) and relative humidity (RH, %); (B) Photosynthetically active radiation (PAR, $\mu\text{mol m}^2/\text{s}$) and global solar radiation (GSR, W/m^2) in production environments of *Handroanthus impetiginosus* seedling. CV = coefficient of variation.

RESULTS

The air temperature and relative humidity in the analyzed period were very similar in both environments, not differing significantly, even with great differences in radiation (Figure 2A).

Global solar radiation and photosynthetically active radiation in the full sun cultivation environment were 3.5 and 3.1 times higher than in the protected environment (Figure 2B).

Taller plants with smaller diameters and a greater relationship between these 2 variables (height-diameter ratio) were observed in the protected environment, and silicon did not influence these variables (Figure 3A).

The measured environmental conditions (Figures 2) associated with the rainfall in the period promoted

Handroanthus impetiginosus plants with a higher number of leaves (Figure 3A), dry matter (Figures 3B and 4A), and Dickson quality index (Figure 4B) in the full sun environment. These variables were not influenced by silicon application, and it failed to influence the severity of diseases at a 5% level of significance and the biometric relationships of dry matter (Figure 3B).

Both the Dickson quality index (Figure 4B) and dry matter of the *Handroanthus impetiginosus* seedlings (Figures 3B and 4A) were not influenced by the application of silicon, and the best seedlings were formed in full sun. With a significance level of 10%—that is, with a 90% probability of occurrence—it was observed that silicon could minimize the severity of

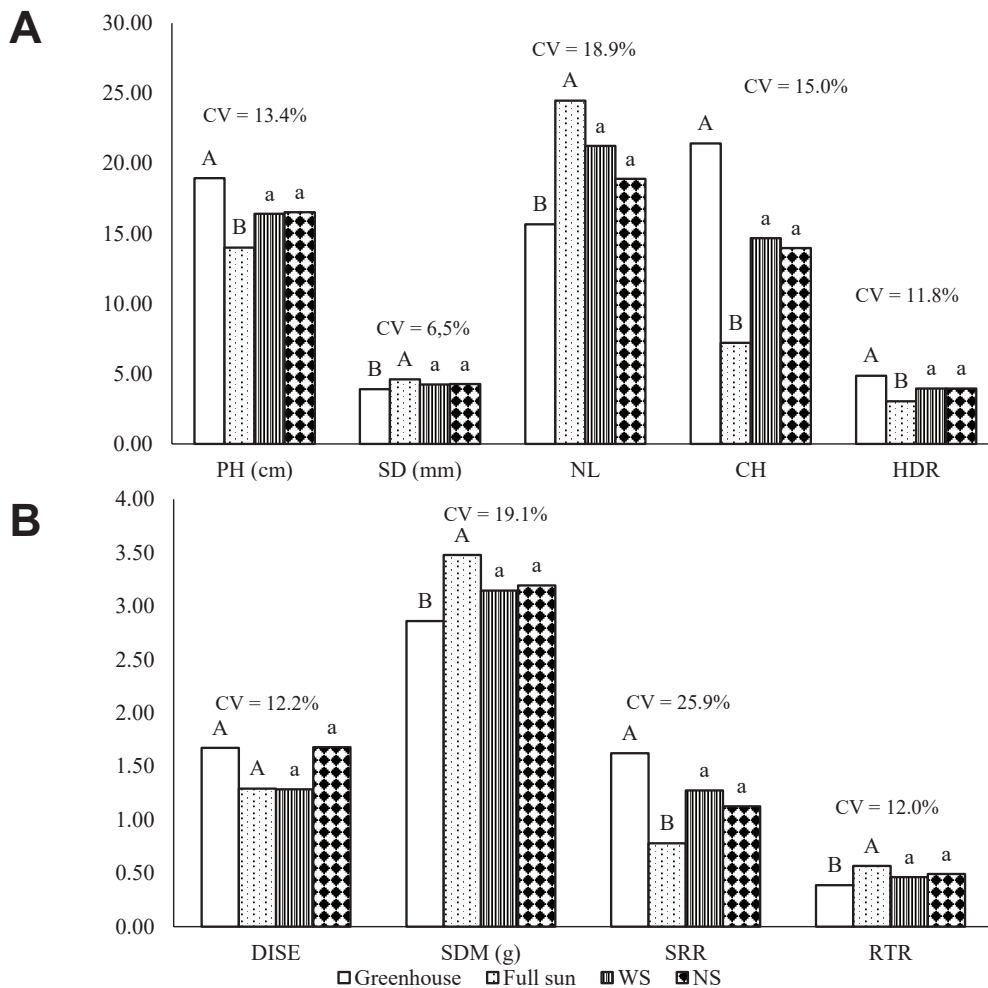


Figure 3. (A) Plant height (PH, cm), stem diameter (SD, mm), number of leaves (NL), relative chlorophyll index (CH), and height-diameter ratio (HDR); (B) The severity of disease (DISE), shoot dry matter (SDM, g), shoot-root ratio (SRR), and root-total ratio (RTR) of *Handroanthus impetiginosus* seedlings in production environments. Uppercase letters compare the environments for each variable. Lowercase letters compare the silicon doses for each variable. LSD test at 5% significance. WS = with silicon; NS = no silicon; CV = coefficient of variation.

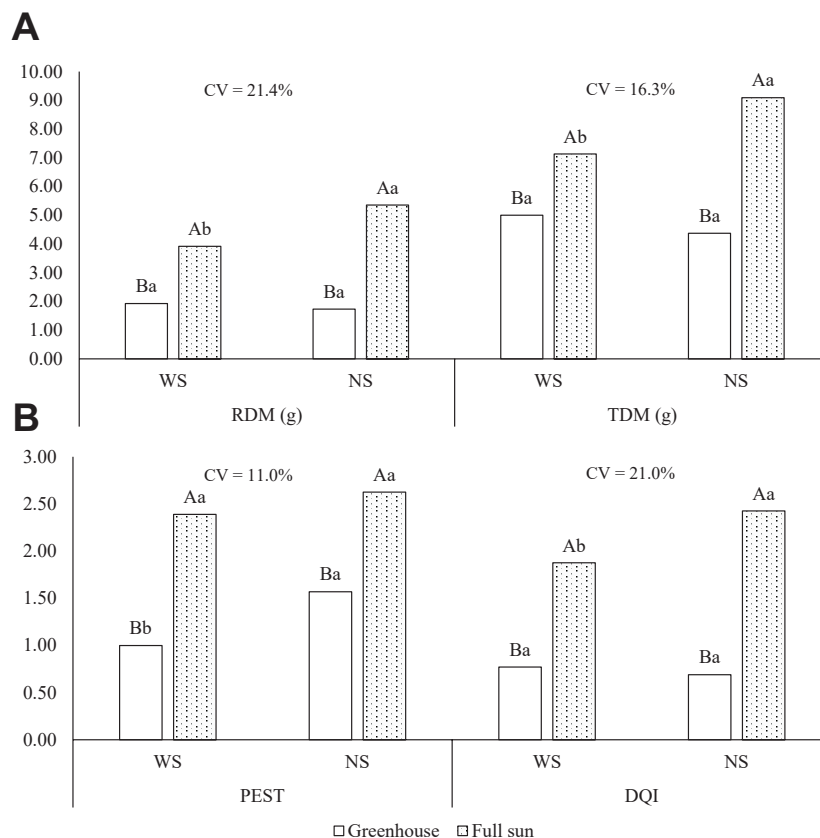


Figure 4. (A) Root dry matter (RDM) and total dry matter (TDM); (B) Intensity of pest attacks (PEST) and Dickson quality index (DQI) of *Handroanthus impetiginosus* seedlings in environments of cultivation and application of silicon. LSD test at 5% significance. Uppercase letters compare the environments inside the silicon for each variable. Lowercase letters compare the silicon within the environments for each variable. WS = with silicon; NS = no silicon; CV = coefficient of variation.

diseases in *Handroanthus impetiginosus* seedlings and that greenhouse seedlings were more susceptible (Figure 5).

DISCUSSION

In hot climate regions, such as the one in the present study, the temperature inside the protected environment is strongly related to the precipitation of the period, and the greater and better distributed over time, the more similar the monthly averages of internal and external temperatures (Silva et al. 2021b) as verified in the present study. In winter, the average monthly temperatures also tend to balance the internal and external environments (Paula et al. 2017). The more the irrigation system is used inside the environment covered with low-density polyethylene film, the more the thermal amplitude between it and the outside decreases.

The variation and reduction of global solar radiation and photosynthetically active radiation inside

production environments, with significant differences, are related to the type of plastic covering film associated or not with the shading screen, as well as the individual use of the shading screen in coverage (Paula et al. 2017; Silva et al. 2021a; Silva et al. 2021b).

Solar radiation, air temperature, and relative humidity are the main environmental factors that influence plant physiology (Lambers and Oliveira 2019). The average temperatures of both environments (25 °C) were within the appropriate conditions for the production of *Handroanthus impetiginosus* seedlings, which allowed the proper functioning of the stomata, carbon dioxide (CO₂) assimilation, and the catalytic activity of Rubisco (Bhatla and Lal 2018), thus, radiation conditions, as well as precipitation, were the ones that most influenced the formation of *Handroanthus impetiginosus* seedlings, altering their photosynthetic activities. Direct effects of solar radiation on plant photosynthesis affect energy absorption and transfer and cause changes in CO₂ assimilation, stomatal

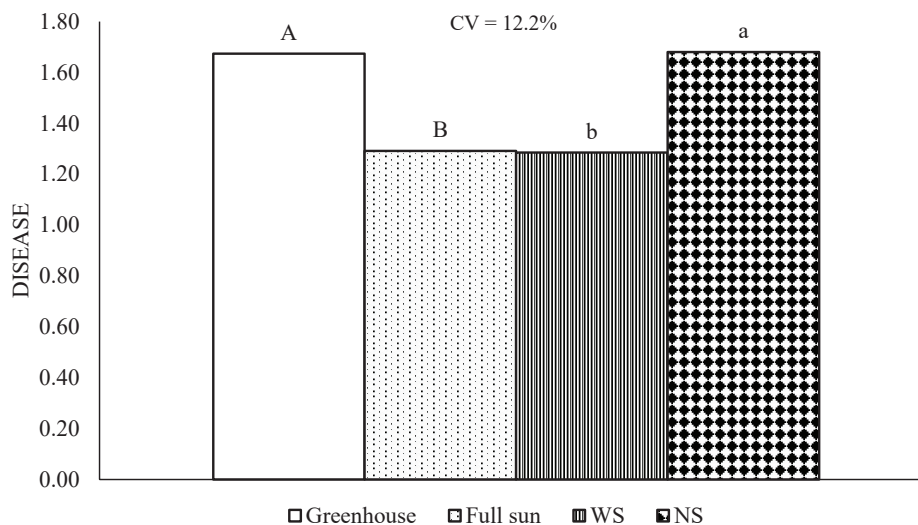


Figure 5. Severity of disease (DISEASE) in *Handroanthus impetiginosus* seedlings in production environments and application of silicon. Uppercase letters compare the environments for each variable. Lowercase letters compare silicon for each variable. LSD test at 10% significance. WS = with silicon; NS = no silicon; CV = coefficient of variation.

conductance, transpiration, carboxylation, stomatal conduction, and the difference between external and internal temperatures of environments (Cruces et al. 2017; Ribeiro and Coêlho 2021).

Larger plants, with smaller diameters and a greater relationship between these two variables, show that the protected environment had excessive shading and impaired seedling growth, as this excess promotes disorganized plant growth in search of light (Taiz et al. 2017), tending to etiolation and the plants show an inadequate coefficient of robustness.

Silicon did not influence the growth and development of *Handroanthus impetiginosus* seedlings, as verified in *Eucalyptus benthamii* seedlings (Schultz et al. 2012) and corn cultivation (Freitas et al. 2011). Silicon (Si) has been widely reported to increase the growth and yield of many important plant species (Guntzer et al. 2012), however, it did not influence the growth of *Handroanthus impetiginosus* seedlings. Silicon did not improve the quality of *Handroanthus impetiginosus* seedlings, unlike what was seen in tomato (Cao et al. 2015; Shi et al. 2016; Nunes et al. 2019) and sorghum (Ahmed et al. 2014) cultivation and in the mitigation of stress in corn (Freitas et al. 2011; Munaro and Simonetti 2016; Miranda et al. 2018).

As for pest attacks, both with and without silicon application, the protected environment mitigated the incidence of pests compared to the full sun

environment due to the barriers imposed by the side screens. The application of silicon had a positive effect on the intensity of pest attack only in the protected environment, having no effect in the environment in full sun, and due to the physical mechanism, the plant incorporates the deposition of Si below the cuticle, which prevents the entry of pathogens and the activity food of insect pests (Islam et al. 2020). As with *Handroanthus impetiginosus* seedlings in the protected environment, the supply of Si in rice plants reduced the damage caused by the yellow stem borer, as it increased the Si content and caused the insect to have less preference for the plant (Ranganathan et al. 2006). Similar results occurred in sugarcane, where calcium silicate was beneficial for the plant, being resistant to *Diatraea saccharalis* (Anderson and Sosa 2001).

With a significance level of 10%—that is, with a 90% probability of occurrence—it was observed that silicon was able to minimize the severity of diseases in *Handroanthus impetiginosus* seedlings, as it influences the increase in physical blockages due to the deposition of Si in the cuticles and biochemical blocks by increasing enzymatic activities (Islam et al. 2020), in addition, it improves structural integrity and increases tolerance to disease, drought, and mineral toxicity (Kendra and Nayaka 2022).

The seedlings in the greenhouse were more susceptible, as in protected environments, diseases proliferate

more quickly and can become more destructive (Vida et al. 2004). The diseases incident on the *Handroanthus impetiginosus* seedlings in the present study were white-thread blight (*Ceratobasidium ochroleucum*) and brown crust (*Apiosphaeria guaranitica*). However, a disease considered to be very important and severe that occurs in ipês, called rust, caused by fungi of the genus *Prospodium* (Figueiredo and Passador 2008), was not detected.

Seedlings in full sun were less susceptible to disease severity, as there is a greater exchange rate of air in an open environment, greater control by natural enemies, and, in the present study, the contribution given by silicon, which together mitigated the severity of diseases in this environment. In a protected environment, there is greater disease dissemination due to shading and local humidity, conditions more favorable to pathogens, especially brown crust, powdery mildew, and sooty mold (Wielewski et al. 2002).

The severity of the diseases is more aggressive in cultures of *Handroanthus impetiginosus* seedlings without silicon application, as the application brought positive and beneficial results for the species, as Si has the potential to form a double layer of cuticle, resulting in barrier protection against disease-causing pathogens (Ma and Yamaji 2008), as already observed in the induction of resistance of *Eucalyptus benthamii* to the incidence of powdery mildew (Schultz et al. 2012) and reduction of anthracnose in common bean with an application of calcium silicate (Moraes et al. 2006). Applications of liquid potassium silicate resulted in reduced powdery mildew severities in strawberries (Kanto et al. 2006) and grapes (Yildirim et al. 2002). Leaf and root applications of Si reduced powdery mildew severity on cucumber leaves (Lee et al. 2000). Liang et al. (2005) observed that silicon contributes to rice resistance to pests and diseases.

In addition to the activities previously described the participation of silicon, encompassing the direct action on the increase in resistance caused by the disposition of this element in plant tissues, is also observed in the action regarding the activation of specific genes, also related to the increase of resistance of plants to different environmental factors. In this sense, the presence of silicon modulates or increases the expression of genes related to plant defense against stresses caused by salinity, the presence of heavy metals, water deficit, diseases, and pests (Zhu et al. 2019; Sourì et al. 2021), acting in a complex way in

the plant defense of practically all forms of stress that can affect plants in the different growing conditions.

Knowledge about the genes that comprise the absorption and translocation of silicon in different plant species is also an important tool for plant genetic improvement since the increased expression of these genes will result in the entire range of responses mentioned above, improving the conditions for the development of species of agricultural interest, cultivated under different environments (Zargar et al. 2019).

CONCLUSION

The best *Handroanthus impetiginosus* seedlings were formed in full sun, with greater diameters, phytomass, and Dickson quality index, and the application of silicon did not influence the biometric variables. The protected environment promoted greater protection against pest attacks and increased the production of chlorophylls but allowed greater susceptibility to the severity of diseases in the *Handroanthus impetiginosus* seedlings. The silicon application decreases the intensity of pests in the protected environment and confers protection against disease severity at a 90% probability level. Silicon mitigated the attack of pests and diseases on *Handroanthus impetiginosus* seedlings.

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Résumé. Contexte: Le silicium dans les plantes est un élément structurant qui favorise la tolérance au stress hydrique et salin et diminue la transpiration. La silice accumulée dans la cuticule constitue une barrière physique et aide à lutter contre les parasites et les maladies. La présente recherche visait à évaluer le développement de semis d'ipe-Roxo (*Handroanthus impetiginosus*) sous différents environnements, ainsi que l'application de silicate de potassium et son efficacité à atténuer l'attaque des ravageurs et des maladies. Méthodes: L'expérience a été réalisée dans une serre agricole ainsi qu'en plein soleil avec des doses de silice de 0 et 7,15 mg par plante selon un plan complètement aléatoire disposé dans un schéma factoriel 2×2 , avec 6 répétitions de 4 plantules par parcelle. La hauteur des plantes, la chlorophylle, le diamètre des tiges, le nombre de feuilles, la matière sèche des pousses, la matière sèche des racines, la matière sèche totale, le ratio hauteur-diamètre, le ratio racine- pousse annuelle, le ratio racine-plante, l'indice de qualité de Dickson, la sévérité des maladies et l'intensité des ravageurs ont été évalués. Résultats: L'application de silicium n'a pas conféré de qualités biométriques aux plantules. L'application de silicium a conféré une protection plus élevée de 24,6% contre la sévérité des maladies pour un niveau de probabilité de 90%. Le milieu protégé a favorisé une protection accrue de 48,8% contre l'attaque des ravageurs sur les semis. L'application de silicium diminue l'intensité des ravageurs dans le milieu protégé de 36,3%. Les semis en milieu protégé ont augmenté la production de chlorophylle mais se sont avérés 29,6% plus sensibles à la sévérité des maladies. Le plein soleil a favorisé l'augmentation des diamètres, de la masse foliaire et de l'indice de qualité de Dickson de 18%, 73% et 195%, respectivement. Conclusions: Les meilleures plantules de *Handroanthus impetiginosus* ont été obtenues en plein soleil. Le silicium a atténué l'attaque de ravageurs et de maladies sur les plantules de *Handroanthus impetiginosus*.

Zusammenfassung. Hintergrund: Silizium in Pflanzen ist ein strukturgebendes Element, das die Toleranz gegenüber Wasser- und Salzstress fördert und die Transpiration verringert. Die in der Kutikula gespeicherte Kieselsäure bildet eine physische Barriere und hilft bei der Bekämpfung von Schädlingen und Krankheiten. Ziel der vorliegenden Studie war es, die Entwicklung von Ipê-roxo-Sämlingen (*Handroanthus impetiginosus*) in verschiedenen Umgebungen sowie die Anwendung von Kaliumsilikat und dessen Wirksamkeit bei der Abschwächung von Schädlings- und Krankheitsbefall zu bewerten. Methoden: Der Versuch wurde in einem landwirtschaftlichen Gewächshaus und unter voller Sonne mit Silikatdosen von 0 und 7,15 mg pro Pflanze in einem vollständig randomisierten Design durchgeführt, das in einem 2×2 faktoriellen Schema angeordnet war, mit 6 Wiederholungen von 4 Sämlingen pro Parzelle. Bewertet wurden Pflanzenhöhe, Chlorophyll, Stammdurchmesser, Anzahl der Blätter, Spross-Trockenmasse, Wurzel-Trockenmasse, Gesamt-Trockenmasse, Höhen-Durchmesser-Verhältnis, Wurzel-Trieb-Verhältnis, Wurzel-Pflanze-Verhältnis, Dickson-Qualitätsindex, Krankheitsschwere und Schädlingsintensität. Ergebnisse: Die Anwendung von Silizium verlieh den Sämlingen keine biometrischen Qualitäten. Die Anwendung von Silizium führte mit einer Wahrscheinlichkeit von 90% zu einem um 24,6% höheren Schutz vor schweren Krankheiten. Die geschützte Umgebung bot einen um 48,8% höheren Schutz gegen den Befall der Setzlinge mit Schädlingen. Die Anwendung von

Silizium verringert die Intensität der Schädlinge in der geschützten Umgebung um 36,3%. Die Sämlinge in geschützter Umgebung produzieren mehr Chlorophyll, sind aber um 29,6% anfälliger für die Schwere von Krankheiten. Die volle Sonne förderte größere Durchmesser, Phytomasse und Dickson-Qualitätsindex um 18%, 73% bzw. 195%. Schlussfolgerungen: Die besten Sämlinge von *Handroanthus impetiginosus* wurden bei voller Sonne erzielt. Silizium milderte den Angriff von Schädlingen und Krankheiten auf *Handroanthus impetiginosus*-Sämlinge.

Resumen. Antecedentes: El silicio en las plantas es un elemento estructurante que promueve la tolerancia al estrés hídrico y salino disminuyendo la transpiración. La sílice acumulada en la cutícula establece una barrera física y ayuda a luchar contra plagas y enfermedades. El presente estudio tuvo como objetivo evaluar el desarrollo de plántulas de lapacho (*Handroanthus impetiginosus*) en diferentes ambientes, y la aplicación de silicato de potasio y su eficiencia en la mitigación del ataque de plagas y enfermedades. Métodos: El experimento se realizó en invernadero agrícola y a pleno sol con dosis silicícolas de 0 y 7.15 mg por planta en un diseño completamente al azar dispuesto en un esquema factorial 2×2 , con 6 repeticiones de 4 plántulas por parcela. Se evaluó la altura de planta, la clorofila, el diámetro del tallo, el número de hojas, la materia seca de los brotes, la materia seca de la raíz, la materia seca total, la relación altura-diámetro, la relación raíz-brote, la relación raíz-planta, el índice de calidad de Dickson, la severidad de la enfermedad y la intensidad de la plaga. Resultados: La aplicación de silicio no confirió cualidades biométricas a las plántulas. La aplicación de silicio confirió un 24,6% más de protección contra la gravedad de la enfermedad a un nivel de probabilidad del 90%. El ambiente protegido promovió un 48,8% más de protección contra el ataque de plagas a las plántulas. La aplicación de silicio disminuye la intensidad de las plagas en el entorno protegido en un 36,3%. Las plántulas en un ambiente protegido aumentan la producción de clorofila, pero son un 29,6% más susceptibles a la gravedad de las enfermedades. El pleno sol promovió mayores diámetros, fitomasa e índice de calidad Dickson en un 18%, 73% y 195%, respectivamente. Conclusiones: Las mejores plántulas de *Handroanthus impetiginosus* se obtuvieron a pleno sol. El silicio mitigó el ataque de plagas y enfermedades en las plántulas de lapacho.