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Silicon fertilization effects in *Pinus devoniana* Lindl. in nursery stage

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ABSTRACT

Objective: To evaluate the effect of applying silicon products on morphological variables, quality indices, and mineral content of *Pinus devoniana* seedlings during the nursery stage.

Design/Methodology/Approach: Four-month-old nursery seedlings produced on substrate were used. These were supplied with silicon in soluble powder applied on the substrate, and foliar liquid presentation and then evaluated in their morphological variables, foliar mineral content, and quality indices.

Results: The application of soluble silicon powder had a positive effect on stem length; while the stem diameter was favored by both applications, which improves its storage capacity. Regarding plant biomass production, the application of soluble silicon powder resulted in higher values of aerial biomass, while root production was favored by foliar liquid application. Plant quality was not affected by the silicon application from either the soluble powder or the liquid; however, the liquid foliar application had the best effect for determining variables of the species. The silicon application did not affect other essential element absorption.

Limitations/Implications of the study: The results and conclusions are limited to *Pinus devoniana* plants in their nursery stage under the described management and substrate conditions.

Findings/Conclusions: The silicon application favored growth, and did not affect the plant's quality or other elements' absorption. The soluble powder was positive for stem length, and the foliar application for root development benefited the stem diameter.

Keywords: Preconditioning, plant quality, fertilization, *Pinus devoniana*.

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INTRODUCTION

In Mexico, conservation programs for the *Pinus* genus are not efficient (Sánchez *et al.*, 2008), which is why reforestation is the best option (Sáenz, 2004). In this sense, *Pinus devoniana* Lindl. stands out for its economic and ecological importance, as well as its wide usage in reforestation programs (Perry *et al.*, 2000). In addition to the above, the

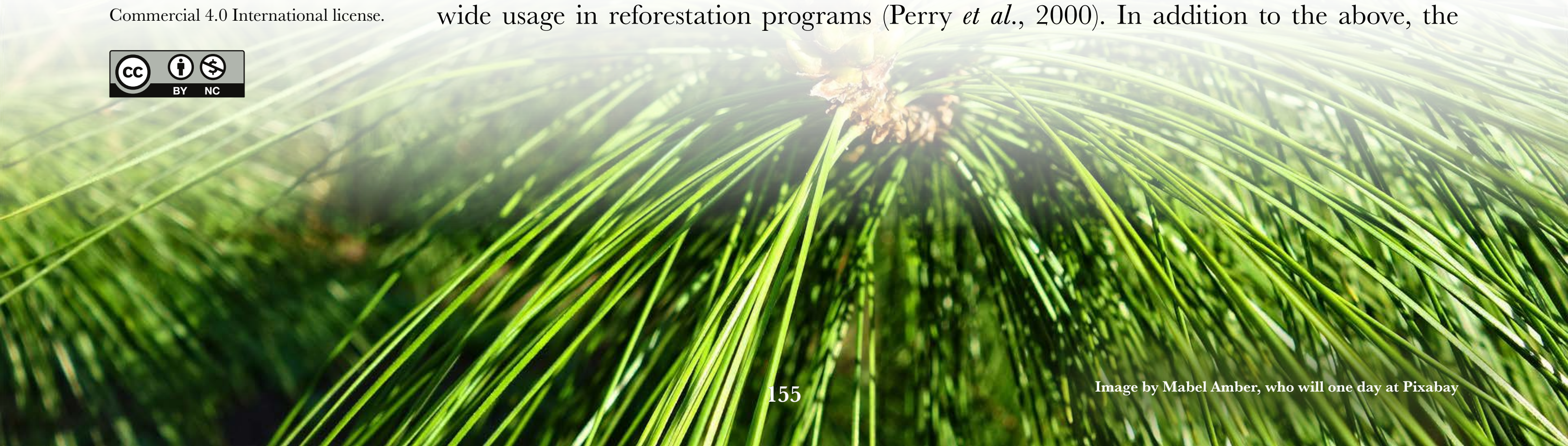

Image by Mabel Amber, who will one day at Pixabay preconditioning stage in the nursery is essential for these plants, because the best quality ones are selected for their morphological and physiological characteristics (Ramírez and Rodríguez, 2004), which will depend on their genetic characteristics and the techniques implemented in the nursery (Prieto *et al.*, 2009).

In this sense, the main evaluated morphological attributes were the stem height, neck diameter, height-diameter relationship, biomass, and leaf and root area (Escobar and Rodríguez, 2019); among the physiological attributes, the macronutrients concentration (nitrogen, phosphorus, potassium, among others) and micronutrients (iron, manganese, zinc, among others) were evaluated (Quiroz *et al.*, 2009).

Therefore, silicon is among the mineral elements that can help produce plants with adequate morphological and physiological quality; a beneficial element, Si contribution is expected to improve plant quality (Ma *et al.*, 2001). However, its optimal requirement is not yet well defined, nor is its physiological effect on different quantities (Tubana *et al.*, 2016). In the active form, absorption is reported in the 2 to 9 pH range (Epstein, 1994) by the roots in a monosilicic acid $Si(OH)_4$ solution (Loué, 1988).

In agriculture, this element can stimulate growth (Loaiza, 2003), and productivity, since it contributes to P, Ca, Mg, K, and B availability (Epstein and Bloom, 2005). For this reason, it is necessary to develop technologies and implementation of silicon-based fertilizers, which help plants during their first years of life after their planting in the field. The objective of this research was to evaluate the effect of silicon-based product applications on the morphological, physiological variables, and quality indices of *Pinus devoniana* Lindl plants during their nursery stage.

MATERIALS AND METHODS

Study site

The experiment took place at Valle de Ameca S. P. R. de R.L. Forest Nursery, located at 20° 33’ N and 104° 3’ W, 1235 m altitude, in Ameca, Jalisco state, Mexico. The local climate is semi-warm, subhumid with summer rain, medium humidity, temperatures ranging from 16-24 °C, and 800 to 1100 mm annual precipitation (INEGI, 1999).

Plant production for evaluation

For the experimental work, four-month-old *Pinus devoniana* Lind seedlings were evaluated. Their initial morphological characteristics and mineral content are shown in Table 1.

Table 1. Morphological characteristics and leaf mineral content of assessed *Pinus devoniana* seedlings.

Morphological characteristics					
Height (cm)	**Diameter (mm)**	**Air weight (g)**	**Air vol. Aéreo (cm^3)**	**Root weight (g)**	**Root vol. Raíz (cm^3)**
4,8±1,3	2,8±0,05	0,6±0,03	2,9±0,04	0,4±0,14	13,2±0,29
Leaf mineral content					
N (%)	**P (%)**	**K (%)**	**Mn (mg kg^{-1})**	**Fe (mg kg^{-1})**	**Zn (mg kg^{-1})**
1,8±0,07	0,24±0,01	0,84±0,02	416,3±0,17	427±0,27	69±0,49

Vol.: volume; N: nitrogen; P: phosphorus; K: potassium; Mn: manganese; Fe: iron; Zn: zinc.

The seedlings were produced in 60-cavity polystyrene trays, 160 cm^3 per cavity, at Valle de Ameca forest nursery. The substrate for germination and plant production was a mixture of 50% peat moss type peat, 49% pine bark (less than 5 mm), and 1% agrolite; with 84% total porosity, 22% aeration porosity, 62% water retention capacity, 27 mm particle size (weighted average diameter) and 0.26 g cm^{-3} apparent density.

The production conditions followed nursery protocols. The plants were kept under 50% shade mesh and fertilized with 7-40-17 Multicote™ (N-P-K) fertilizer formula, applied throughout the initial growth phase (from 15 to 120 days after germination). After 120 days, only silicon and continuous irrigation were applied to all plants.

The plants' morphological characteristics and foliar mineral content at the beginning of the experiment, shown in Table 1, were assessed 120 days after germination.

Experiment establishment and treatment application

For the experimental silicon fertilization (SiO_2), the Silik-Tek® commercial fertilizer was applied in two presentations, soluble powder and liquid. These were diluted in different concentrations according to the treatments. The liquid form was foliar applied, while the powder presentation was applied diluted directly to the substrate. Five treatments, described in Table 2, were considered.

The treatments were distributed in a 2^2 factorial design; with random sampling, consisting of 4 repetitions with 30 experimental units per treatment. The control was not supplied with silicon. In the treatments, 6 applications were done, one every 15 days, for three months (February-April). The plants were kept in growth beds under 50% netting; irrigation was daily applied in a uniform and localized manner.

For both presentations, the dosage was done following the commercial product recommendations. Furthermore, considering that higher plants contain between 0.1 and 10% silicon based on their dry weight, a lower dose of 100 mg/L and 0.1 mL/L and a higher dose of 300 mg/L and 0.3 mL/L were used to have a better evaluation range.

Growth variables, quality indices, and mineral content

After six months, including the 90 days of treatment application (February-April), in May, the morphological evaluation was done through destructive sampling. 30 plants were randomly selected per treatment, removed from their trays, the substrate containing their roots also removed and their aerial structures separated from the root. Their length (cm)

Table 2. Treatment distribution for silicon application (SiO_2).

Treatment	Silicon business presentation (SiO_2)	Silicon dosage
T0	Witness (No silicon)	0
T1	Solid (Via substrate)	100 mg/L
T2	Solid (Via substrate)	300 mg/L
T3	Liquid (Via foliar)	0.1 mL/L
T4	Liquid (Via foliar)	0.3 mL/L

Note: The control (T0) refers to the plants that were maintained under the same management conditions in the nursery, without silicon fertilization.

and stem diameter (mm) were measured. The length was evaluated with a millimeter ruler from the neck to the apical bud. The diameter was assessed at the base of the stem (above the root collar) with a digital vernier. Aerial and root biomass was determined in dry weight (g), for which the aerial parts and root were separated, the evaluated plants were extracted from their tray and immersed in water to remove excess substrate; they were subsequently placed in paper bags and placed in a 70 °C oven for 72 h until constant weight. Finally, they were separately weighed on a Sartorius® analytical balance with a 1 mg precision.

With the morphological variables, the following quality indices were determined:

a) Robustness index (RI): evaluates the relation between the height (cm) and the diameter at the root neck (mm) (Prieto *et al.*, 2009):

$$RI = \frac{Height\ (mm)}{Root\ neck\ diameter\ (mm)}$$

b) Ratio: aerial dry weight/root dry weight (Thompson, 1985):

$$R\ RDW \mid ADW = \frac{Root\ dry\ weight\ (g)}{Aerial\ dry\ weight\ (g)}$$

c) Dickson quality index (DQI): evaluates the morphological plant characteristics; the higher the index values, the better the plant quality (Dickson *et al.*, 1960):

$$DQI = \frac{Total\ dry\ weight\ (g)}{\frac{Height\ (mm)}{Diameter\ (mm)} + \frac{Dry\ weight\ of\ aerial\ part\ (g)}{Dry\ weight\ of\ root\ (g)}}$$

d) lignification index (Prieto *et al.*, 2004b):

$$LI = \left(\frac{Total\ dry\ weight\ (g)}{Total\ fresh\ weight\ (g)}\right)100$$

The foliar concentration of essential macro and micronutrient elements was quantified in dry plant needles, each sample consisted of 150 needles (experimental unit). Leaf analyses were conducted using different techniques and equipment; Nitrogen was determined following the micro-kjeldahl method. Phosphorus and potassium were assessed via wet digestion in a (LAMBDA 850) spectrophotometer; the microelements were determined by atomic absorption, in a 240F Varian equipment.

Statistical analysis

A normality test was performed (Chi-square and Shapiro-Wilk W statistic). Subsequently, the data were subjected to an analysis of variance (ANOVA) on all the evaluated growth and leaf mineral content variables using the Statgraphics Centurión XVII (Statgraphics, 2014) statistical software.

RESULTS AND DISCUSSION

Growth variables

The analysis of variance showed significant differences between treatments ($p \leq 0.05$), which indicates that *Pinus devoniana* plants in the nursery stage pretreated with silicon product, have a different response according to the silicon product presentation, form of application, and dose delivered, evidenced by the results reported here regarding the evaluated morphological variables (Table 3).

In this sense, it is important to mention that species with tussock-type growth such as *Pinus devoniana*, *Pinus montezumae* Lamb., and *Pinus engelmannii* Carr. (Calderón, 2006; Prieto *et al.*, 2018), they first develop their storage capacity during their first years (stem diameter and root volume) rather than height growth (stem length), already been described in other works (Ávila *et al.*, 2014; Rosales *et al.*, 2015). This is because there is little elongation of the epicotyl, greater needle production and elongation, as well as a greater increase in stem diameter, which was also recorded in this research. Despite this, important results were found that will help make decisions in nursery management and plant preparation of species with this growth type, so that they achieve higher plant quality before transplant to the field.

Regarding the stem length and its relation to the control treatment (T0), the soluble silicon powder applied to the substrate (T1 and T2) were the ones with the highest values (8.1 and 8.2 cm, respectively), followed by the high-dose foliar application (T4, reaching 7.8 cm); while the foliar low-dose treatment (T3) showed the lowest value for this variable (6.1 cm) (Table 3). Also, regarding stem diameter, silicon treatments showed positive results regardless of the dose, presentation, or form of application (T1, T2, T3, and T4), with a significant statistical difference compared to the control (T0) which had the lowest value (5.2 mm). This means that the silicon application favors the storage capacity that will be essential for its subsequent adaptation to field conditions. In addition, a larger stem

Table 3. Stem length and diameter, aerial and root biomass production.

Tratamiento	Length (cm)	Diameter (mm)	Biomass (g)	
			Aerial	Root
T0	$7{,}8 \pm 0{,}76^{b}$	$5{,}2 \pm 0{,}02^{c}$	$1{,}9 \pm 0{,}01^{c}$	$1{,}3 \pm 0{,}01^{c}$
T1	$8{,}1 \pm 0{,}70^{ab}$	$6{,}3 \pm 0{,}07^{a}$	$3{,}5 \pm 0{,}13^{a}$	$1{,}4 \pm 0{,}03^{bc}$
T2	$8{,}2 \pm 0{,}13^{a}$	$6{,}3 \pm 0{,}07^{a}$	$2{,}3 \pm 0{,}04^{b}$	$0{,}9 \pm 0{,}02^{d}$
T3	$6{,}1 \pm 0{,}78^{d}$	$6{,}2 \pm 0{,}04^{b}$	$1{,}5 \pm 0{,}03^{d}$	$1{,}5 \pm 0{,}03^{b}$
T4	$7{,}4 \pm 0{,}86^{c}$	$6{,}4 \pm 0{,}06^{a}$	$1{,}7 \pm 0{,}07^{cd}$	$2{,}6 \pm 0{,}09^{a}$

Different letters in the same column indicate significant differences. *No significant differences were found, according to the Tukey ($P < 0{,}05$).

diameter has been related to better vigor and higher survival. In this matter, similar plants with diameters greater than 5.0 (mm) show greater bending and pest resistance, and better plant quality (Mexal and Landis, 1990; NMX-AA-170-SCFI-2016; Prieto *et al.*, 2009). In different species, it has been shown that a larger root neck diameter in tussock-type growth species favors the adaptation of plants to the planting site (Tsakaldimi *et al.*, 2013).

Regarding the aerial biomass accumulation, significant differences ($p \leq 0.05$) were observed between the treatments as shown in Table 3, finding that the highest averages were presented in the treatments with diluted silicon powder to the substrate (T1 and T2), with values of 3.4 and 2.3 g, respectively. The foliar application treatments showed no positive effect on the aerial structures (T3 and T4), the control treatment (T0) showed a better effect than the latter (1.9 g). The above demonstrates that the generated aerial biomass is related to the water storage capacity that occurs with growth since the stem functions not only as support and conduction (Casas, 2001) but as a storage organ. In this sense, larger stem diameter and aerial biomass were recorded due to the contribution of the plant needles in the treatments with substrate applications (T1 and T2). This shows that the roots had greater silicon solution absorption and translocation to the aerial structures via the substrate than the silicon absorption via foliar, possibly due to the waxy epidermis physical barrier of the plant needles that limited foliar solution absorption.

On the other hand, regarding root biomass production, there were significant differences in the application route and the dose, where the foliar application treatments of silicon at both doses (T3 and T4) reported the highest values (1.5 and 2.6 g, respectively). This shows that the silicon absorbed from the foliar application mobilizes to the plant's root along with the photosynthates. The treatments applied to the substrate (T1 and T2) did not favor root development like the control (T0), reflected in its lower biomass, even in high dose (T2) substantially affecting its growth (0 .9 g). Based on the above, García *et al.* (2015), when evaluating *Pinus engelmannii* Carr. growth under various environmental conditions and fertilization during the preconditioning stage, found that the root biomass was greater in outdoor and outdoors plus fertilization conditions, resulting in 1.3 and 1.2 g, respectively. This is corroborated by our results, where fertilization with both doses generated a greater total biomass. Berendse *et al.* (2007) and Camargo and Rodríguez (2006) mention that plants under low fertilization regime allocate greater biomass to the roots to promote greater growth.

Quality indices

All treatments presented significant differences ($p \leq 0.05$), which is reflected in the reported values (Table 4).

In general, silicon applications did not affect the quality of the plants; however, the foliar treatments (T3 and T4) presented the highest values for the evaluated quality indices (Table 4).

The ratio index between root dry weight and aerial dry weight (RDW/ADW) evidenced the biomass production relation which reflects the development of the plant in the nursery (Sáenz *et al.*, 2014). In this sense, an equal-to-one ratio indicates that the aerial weight is equal to the root weight. However, if the value is less than one, it implies that the root weight

Table 4. Quality indices in *Pinus devoniana* Lindl.

Tratamiento	R: PSA/PSR	ICD	IR	IL
T0	1,5±0,01[b]	0,19±0,01[c]	1.6±0,14[a]	19±0,11[d]
T1	2,5±0,04[a]	0,18±0,00[c]	1.3±0,05[b]	23±0,29[c]
T2	2,6±0,02[a]	0,26±0,00[b]	1.1±0,05[d]	25±0,15[b]
T3	1,0±0,00[c]	0,36±0,01[a]	1.0±0,07[e]	27±0,30[a]
T4	0,7±0,01[d]	0,35±0,00[a]	1.2±0,04[c]	25±0,08[b]

Different letters in the same column indicate significant differences. *No significant differences were found, according to the Tukey ($P<0,05$). R: PSA/PSR (ratio: air dry weight / root dry weight), ICD (quality index Dickson), IR (Robustness index), IL (lignification index).

is greater than the aerial dry weight; on the contrary, greater than one value indicates that the aerial dry weight is greater than the root weight (Rodríguez, 2008).

The treatment that reported the best plant ratio was treatment T3 (1.0), while treatments T2 and T0 had greater than one value, indicating that their plants would have lower underground biomass production (2.6 and 2.5, respectively). Rueda *et al.* (2012), evaluating *P. devoniana* plant quality produced in nurseries in Jalisco state, presented values of 7.5 to 2.0, respectively, which indicates it is a robust species and bending resistant. Likewise, Rosales *et al.* (2015) and García *et al.* (2015) in *P. engelmannii* Carriére found reported values of 3.2 to 6.1; however, Rueda *et al.* (2014) recommend a <2.0 value for this index.

The Dickson index evaluates the best morphological parameters, since it shows the balance between the distribution of biomass and robustness, indicating that the higher the index, the better the plant quality (Birchler *et al.*, 1998). In this sense, significant differences were observed between the treatments, finding that the treatments that presented the highest values were T3 and T4 with 0.36 and 0.35, respectively, while the lowest values were obtained in the treatments T0 and T1 with 0.19 and 0.18, respectively; the results agree with what was found by Bautista *et al.* (2018), where *Pinus greggii* Engelm., with controlled delivery fertilization presented values of 0.26 to 0.22. In agreement, with Reyes *et al.* (2005), high values indicate good balance and development of the plant, which evaluates different combinations of morphological parameters (Dickson *et al.*, 1960).

The robustness index relates the plant height and the root neck diameter, being an indicator of the plant's resistance to wind relating to their survival. Its value should be less than 6, since a lower value indicates better quality plants with shorter and more robust trees, while greater than 6 values show growth in height and diameter inequality, generating long but thin stems (Prieto *et al.*, 2009). In addition to the above, significant differences were present, the highest values were reported in treatment T0 followed by T1 with (1.6 and 1.3, respectively), while the lowest values were reported in T4, T2, and T3. with (1.2, 1.1, and 1.0, respectively). These concur with results reported by Sáenz *et al.* (2014) evaluating *Pinus devonia* Lindl plant quality with 1.2 values. This relation between plant height and diameter indicates that the lower its value, the shorter and thicker it will be, which is favorable for environments with humidity limitations (Rodríguez, 2008).

The lignification index assesses the percentage of dry weight in relation to the water supply in the plants, indicating their pre-conditioning level, since values between 25 and

30% represent optimal lignin values in conifers (Prieto *et al.*, 2009). Therefore, significant differences were found, where the optimal value was observed in treatments T2, T3, and T4 (25, 27 and 25%, respectively). In addition to the above, the found values provide an estimate of the robustness degree a plant needs to tolerate water stress. At the plantation site, the only treatment with foliar fertilization and a high dose is the one within the reported values. However, the two low-dose treatments with two fertilizations were close to that mentioned above. Prieto *et al.* (2004a) and Ávila *et al.* (2014), when evaluating the moisture availability reduction as preconditioning, *P. engelmannii* had values of 29.2, 22.9 and 24.3%, which is related to the results obtained here.

Leaf mineral content

In the macronutrients and micronutrients foliar mineral content, as shown in Table 5, significant statistical differences were found, except for the phosphorus content. In this sense, fertilization in the nursery is of utmost importance since it affects one of the most important critical components in developing high-quality plants in a nursery (Landis and Dumroese, 2009).

In the nitrogen content, significant differences were observed between treatments, the highest accumulation percentage occurred in T3 at 1.8%, followed by treatments T0, T1, and T2 with 1.7, 1.5, and 1.4% values respectively. While the lowest accumulation was in T4 with 1.2%. According to Landis (1985), the N range in this treatment was slightly below the established values. Gutierrez *et al.* (2015), when evaluating the pH of irrigation water (8 and 5.5) and fertilization (50-123-73 of N, P, K), in *Pinus cembroides* Zucc., the four evaluated treatment values of 1.6 to 1, 5, found that these coincide with that was reported here, where fertilization with silicon in both doses did not affect this element absorption.

There were no significant differences in the phosphorus content, this mineral ranged from 0.29 to 0.27% between treatments. Compared to that reported by Landis (1985), all treatments had minimum concentrations. In this sense, fertilization and both doses did not affect this mineral concentration in the plants.

In the potassium concentration, significant differences were present, where the highest value was found in T3 with 0.88%, followed by treatments T1, T2, and T4 with

Table 5. Foliage nutrient content in *Pinus devoniana* Lindl.

Tratamiento	N	P *	K	Mn	Fe	Zn
	%			mg kg^{-1}		
T0	1,7±0,21^{ab}	0,28±0,01	0,82±0,01^{b}	299±14^{ab}	99±2,3^{b}	31±0,61^{a}
T1	1,5±0,12^{ab}	0,28±0,00	0,84±0,02^{ab}	308±6,5^{ab}	129±7,2^{a}	26±0,63^{ab}
T2	1,4±0,07^{ab}	0,27±0,01	0,83±0,02^{ab}	293±8,5^{b}	103±1,4^{b}	23±0,34^{b}
T3	1,8±0,30^{a}	0,29±0,01	0,88±0,01^{a}	316±12^{ab}	113±3,2^{ab}	27±0,88^{ab}
T4	1,2±0,05^{b}	0,28±0,01	0,83±0,02^{ab}	327±6,3^{a}	111±7,2^{b}	30±3,00^{a}
Rango (Landis, 1985)	1,3 a 3,5	0,20 a 0,60	0,70 a 2,5	100 a 250	40 a 200	30 a 150

Different letters in the same column indicate significant differences. *No significant differences were found, according to the test Tukey ($P<0,05$).

concentrations of 0.84, 0.83, and 0.83, respectively, the lowest value was for treatment T0 with 0.82%.

These results are within the ranges recommended by Landis (1989), for this mineral, slightly above the minimum value. In addition to the previous, our results agree with what is established for grass-growing species. Muñoz *et al.* (2015), when evaluating plant quality in a nursery at Zitácuaro municipality, Michoacán state, found that *P. devoniana* had a 0.68% value, considered of low quality. Based on the obtained results, Escobar and Rodríguez (2019) propose a starting point to refine and reduce nutritional variables, given the great diversity of Mexican forest species.

There were significant differences between treatments in the evaluated contents of micronutrients. Manganese concentrations had significant differences, T4 with 327 mg kg^{-1} was the treatment with the highest value, followed by T3, T0, and T1 (316, 299, and 308 mg kg^{-1}, respectively), the lowest value occurred in T2 with 293 mg kg^{-1}. Landis (1985) mentions that the recommended concentrations for this micronutrient range from 100 to 280 ppm. The results in all treatments exceed the optimal values, which might indicate a greater accumulation of this element with silicon fertilization in both doses, as well as in the control treatment, since the plants use micronutrients at low concentrations, as is the case of potassium, which functions as an organic structure constituent (Toro and Quiroz, 2007).

Significant differences were found in the iron content, where the highest concentration occurred in treatment T1 with 129 mg kg^{-1}, followed by T3 with 113 mg kg^{-1}, while the lowest occurred in T4, T2 and then the control (111, 103, and 99 mg kg^{-1}). Those results obtained here are within the concentrations recommended by Landis (1985), which range from 40 to 200 ppm. When evaluating plants falling in a *P. devoniana* nursery Bernaola *et al.* (2015) found that the iron content in 1 and 5 L containers with fertilization had 299 and 94 ppm, respectively, while without fertilization in 1 L and 5 L containers, the values ranged from 123 to 126 ppm.

Zn concentrations reported significant differences between treatments, T0 and T4 had the highest values with (31 and 30 mg kg^{-1}, respectively), followed by T3 and T1 with 27 and 26 mg kg^{-1}, each. While the lowest value occurred in T2 with 23 mg kg^{-1}. According to Landis (1985), only T0 and T4 with high foliar fertilization were within the minimum optimal, while the other treatments reported low absorption of this microelement. According to Foucard (1997), this micronutrient insufficiency generates mottled chlorosis in young leaves, followed by necrosis and leaf fall.

CONCLUSIONS

Supplying *Pinus devoniana* seedlings silicon when produced in trays and a forest substrate mixture during their nursery preconditioning stage favors their growth, does not affect their quality or other essential elements absorption, and its application will depend on the expected effect.

Applying a soluble silicon powder product directly to the substrate favors the length, stem diameter, and aerial biomass. The foliar application of silicon favored the stem diameter and root biomass. The low soluble powder dose to the substrate and the high foliar liquid dose applied showed the best growth results for the species in the benefited variables.

The quality indices revealed that the foliar liquid silicon application showed the highest Dickson index values; while the shoot/root ratio (ADW/RDW) was the application of soluble powder to the substrate and the treatment without silicon. The robustness was higher in the control, while for the lignification index, all silicon treatments were higher.

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