Seedling quality from six *Pinus* species produced in polyethylene bag

T. Pineda Ojeda[1], E. Flores Ayala[1], A. Flores*[2], E. Buendía Rodríguez[1], V. Guerra de la Cruz[3], F. Islas Gutiérrez[1]

[1]Cevamex, INIFAP, Mexico, **[2]Cenid-Comef, INIFAP,** Mexico, **[3]SE-Tlaxcala, INIFAP,** Mexico

Introduction

Reforestation programs in Mexico are a strategy for increasing forest areas and reducing forest land degradation. In 2011, the program reforested 350,000 ha and ranked the country among the four with a higher amount of trees planted. However, low seedling survival rate is an important problem, which is associated to poor seedling quality.

Despite some works about plant quality parameters in Mexico, the knowledge is still limited due to the variability in conditions, species and production processes in nurseries.

The present work aimed to evaluate the plant quality of six pine species produced in a nursery in polyethylene bags.

Materials and methods

We choose 90 seedlings of the genus *Pinus* (15 plants by species) from Heroes Bicentennial Forest Nursery of Tecámac, state of Mexico, Mex. Plants were produced in forest soil and polyethylene bags.

We measured seedling's basal diameter (at the root neck (DC)) (Figure 1), height (Alt), slenderness index (IE = Alt/DC), aerial dry biomass and dry root biomass ratio (BSA/BSR) and Dickson's quality index (ICD) in *P. greggii* Engelm., *P. leiophylla* Schltdl. & Cham., *P. pseudostrobus* Lindl., *P. ayacahuite* Ehren., *P. hartwegii* Lind., and *P. cembroides* Zucc. plants.

Figure 1. Measuring of seedling basal diameter.

We evaluated the morphological attributes based on the Mexican Norm NMX-AA-170-SCFI-2016 (Secretaría de Economía, 2016) and Rodríguez-Ortiz *et al.* (2020).

Results

For DC, all of the species but *P. ayacahuite*, had higher values than that of Mexican Norm NMX-AA-170-SCFI-2016. *P. hartwegii* had the higher quality than the other species in this variable (Table 1).

Table 1. Mean values of size and plant quality of six pine species produced at Heroes Bicentennial Forest Nursery.

Species	DC[¶]	Alt	IE	BSA/BSR	ICD
P. ayacahuite	3.7	16.2	4.4	1.9	0.9
P. cembroides	4.6	15.9	3.5	1.5	1.1
P. greggii	5.0	36.5	7.5	4.6	0.7
P. hartwegii	9.2	18.4	2.0	2.6	2.2
P. leiophylla	6.1	28.4	3.8	5.0	0.9
P. pseudostrobus	4.8	20.7	4.4	8.3	0.5

[¶]DC: basal diameter at the root neck (mm), Alt: height (cm), IE: slenderness index , BSA: aerial dry biomass, BSR: dry root biomass and ICD: Dickson's quality index.

In Alt, *P. greggii* and *P. leiophylla* had higher values than that of Mexican Norm, whereas *P. ayacahuite* and *P. pseudostrobus* showed lower height than those established in the Norm (Table 1).

For IE, all the species but *P. greggii*, had values <6 (Table 1), which means that plants present high quality and more posibilities to survive due to resistance to frosts and drying (Haase, 2008; Escobar-Alonso y Rodríguez, 2019).

Regarding BSA/BSR, *P. cembroides, P. ayacahuite and P. hartwegii* showed lower values (Table 1), this means high quality of seedlings due to a good balance between BSA and BSR (Haase, 2008), and greater chances of success during the plantation in sites with low precipitation (Thompson, 1985).

During the analysis of ICD, *P. hartwegii* showed the highest value, while *P. greggii* and *P. pseudostrobus* the lowest ones. *P. cembroides*, *P. ayacahuite*, and *P. leiophylla* showed medium ICDs. In general all the species but *P. pseudostrobus,* showed high quality with ICD values > 0.5 (Rodríguez-Ortiz *et al.*, 2020).

Based on all of the variables evaluated, four species (*P. hartwegii*, *P. cembroides*, *P. leiophylla* and *P. ayacahuite*) had the higher quality of seedlings which suggests better possibilities to grow up in sites with harsh enviromental conditions.

Conclusions

For reforestation programs to succeed in degraded areas, plants with high quality must be used. Good morphological traits help plants to survive in harsh conditions. However, nurserymen do not usually have quality references to evaluate different pine species they produce, since these values are scarce in the country (Rueda et al., 2014).

Overall, the results showed that *P. cembroides* and *P. greggii* had the higher plant quality while *P. ayacahuite* the lowest quality, whereas *P. hartwegii*, *P. leiophylla* and *P. pseudostrobus* had rather medium plant quality.

This information is keystone when analyzing seedling survival in the reforestation areas based on the characteristics of the sites. Therefore, it could help to make timely decisions during plantations management, particularly for the species evaluated.

Literature cited

Escobar-Alonso, S. y D. A. Rodríguez T. 2019. Estado del arte en la investigación sobre calidad de planta del género *Pinus* en México. Revista Mexicana de Ciencias Forestales, 10(55): 4–38. DOI: 10.29298/rmcf.v10i55.558.

Haase, D. L. 2008. Understanding forest seedlings quality: Measurements and interpretation. Tree Planter´s Notes, 52 (2): 24-30.

Rodríguez-Ortiz, G., R. D. Aragón-Peralta, J. R. Enríquez-del Valle, A. Hernández-Hernández, W. Santiago-García y G. V. Campos-Angeles. 2020. Calidad de plántula de progenies selectas de *Pinus pseudostrobus* Lindl. var. oaxacana del sur de México. Interciencia, 45(2): 96–101.

Secretaría de Economía. 2016. Norma Mexicana NMX-AA-170-SCFI-2016. Certificación de la operación de viveros forestales.

Thompson, B. E. 1985. Seedling morphological evaluation. What can you tell by looking? In: M. L. Duryea (Ed.). Evaluating seedling quality: principles, procedures and predictive abilities of major tests. Oregon State University. Corvallis, OR, USA. pp. 59–71.

INIFAP
Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias