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Quality indicators in *Ochroma pyramidale* seeds from three sites in the Ecuadorian Amazon for reforestation in degraded areas

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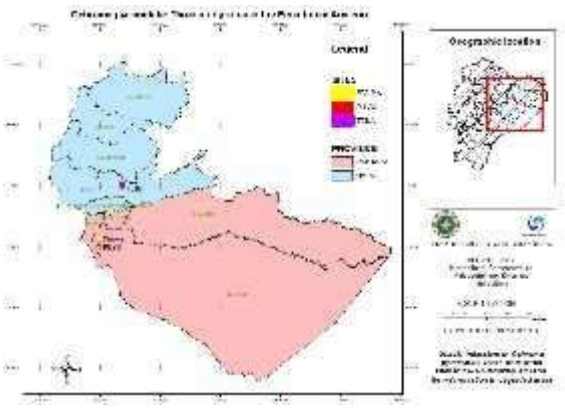
Graphical Abstract



Sites	P	GE	GC	UV	VG
San Juan	98.76	7,36	92.00	90.86	4.08
Fátima	98.03	2.80	70.02	68.64	3.10
Puyo	98.03	2.70	69.50	68.13	3.08

Abstract

Ochroma pyramidale, is a species recognized for its economic and ecological importance, widely used in forest plantation programs. The aim of this work was to evaluate seed quality indicators of *Ochroma pyramidale* in three sites in the Amazon region of Ecuador for reforestation purpose in degraded areas. The results indicated that the seeds of the species in the three study sites are of good quality, expressed through the germinative capacity, germination energy, useful value and germinative vigor, although in San Juan they presented higher values as a reflection of their vitality and exuberant nature.

Introduction

Ochroma pyramidale (Balsa), is a forest species belonging to family Malvaceae, recognized for its high demand in the international market, wide distribution, diversity of uses and very fast growth that produces low density wood, the lowest of the commercial wood in the world (Betancourt, 1968; Espinosa, 2007).

The species is cultivated naturally and for reforestation purposes, especially in the sub-tropical forest of Ecuador, where it is one of the most exploited timber forest resources; for this reason, it is on

of the most economically important forest sectors with a high level of development, from its reforestation to its subsequent transformation, making it one of the highest quality timber in the world (González et al., 2010). It has also been used to enrich agricultural and livestock depleted soils, as well as to rehabilitate degraded areas as a result of frequent burning (Levy and Duncan, 2004).

Ecuador has more than 20 thousand hectares of plantations between natural forests and reforestation of Balsa, whose production is very profitable due to the turn of use of only 4-6 years, according to the quality of the site (Obregón, 2005). These plantations are an excellent option for the investor in the short term and require the increasing availability of a high quality reproductive material to meet the needs of the population.

In many forest programs, inappropriate management practices and use of low quality seed are evident, limiting the success of establishing forest plantations.

The aim of this work was to evaluate seed quality indicators of *Ochroma pyramidale* in three sites in the Amazon region of Ecuador for reforestation in degraded areas.

Materials and Methods

Selection of seeds

Fifty fresh seeds harvested in February 2017 were collected from three sites (San Juan, Fatima and Puyo), corresponding to Pastaza and Napo provinces, in the eastern region of Ecuador.

Germination process

The germination process was recorded by daily physical counting of seed germinated by bags for 46 days. The sowing was carried out in the experimental nursery of the Municipality of Pastaza, located at the entrance of the "Paseo Turístico" (Tourist Route) of Puyo. Polyethylene bags and natural soil mixtures were used with sawdust as a substrate.

Parameters of seed quality

Five indicators were calculated to evaluate seed quality at each site:

- Purity (%)
- Germinative energy (u)
- Germinative capacity (%)
- Useful value (%)
- Germinative Vigor (u)

Results and discussion

Percentage of accumulated germination

Figure 1 shows the percentage of germination accumulated in the three study sites in its germination phase representing the emergence of the radicle. In all three sites a linear behavior with determination coefficients higher than 98% was presented, which indicated a good fit. It is notable that the harvested seeds of the San Juan site presented a higher percentage of accumulated germination and the germination onset was inferior to the rest of the sites.

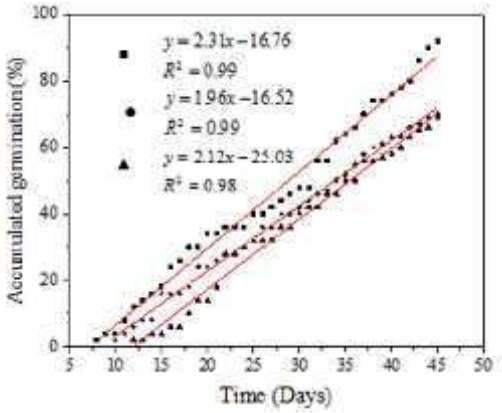


Figure 1. Percentage of accumulated germination of Ochroma pyramidale seeds at three sites.(■) San Juan, (●) Fátima, (▲) Puyo

Table 1 shows a similar behavior in the seed quality indicators. It is representative that at the San Juan site presented greater germinative energy, germinative capacity, useful value and

germinative vigor, as a reflection of a seed of superior quality, which could be an expression of its vitality and exuberant nature, but all the sites, according to the parameters obtained, may be appropriate to obtain good quality reproductive material for the success of the establishment of forest plantations under the dissimilar ecological conditions of the Amazon. As reported by González et al., (2010) the species reached a germinative capacity in all three sites in adequate ranges. These results will increase the genetic variability and the germplasm of species of high ecological and economic importance, which will provide a good quality material to foment sources of exploitation that contribute to eliminate logging of the Amazon jungle.

Table 1. Quality indicators in *Ochroma pyramidale* seeds

Sites	P	GE	GC	UV	VG
San Juan	98.76	7,36	92.00	90.86	4.08
Fátima	98.03	2.80	70.02	68.64	3.10
Puyo	98.03	2.70	69.50	68.13	3.08

Legend: Purity (P), Germinative energy (GE), Germinative capacity (GC), Useful value (UV), Vigor germinative (VG).

It is very important to homogenize the seeds in restoration and conservation plans of tree species in order to maintain genetic variability since the diversity of genes determines their response capacity in their establishment (Barbour *et al*., 2009; Ruíz *et al*., 2011; Ramírez *et al*., 2012).

Conclusions

It was demonstrated that the seeds of *Ochroma pyramidale* species of the three study sites (San Juan, Fatima and Puyo) were a high quality material that will increase the genetic variability for their use in reforestation plans in degraded areas of the Amazon region.

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