RESEARCH ARTICLE OPEN ACCESS

Influence of Sowing Nuts Method in the Emergency of *Cocos nucifera* L. Plantlets

Balderas-Palacios Feliciano Gerardo[1], Herrera-Cool Gilbert José[2]*, González-Acuña Irma Julieta[1], Cortazar-Ríos Matilde[2], Ramírez-Jaramillo Genovevo [3], Ramírez-Silva Jorge Humberto[3], Baldeas-Alba Itzel Abigail[1].

[1]Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP), Campo Experimental Santiago Ixcuintla, CIRPAC,México

. [2]INIFAP, Campo Experimental Chetumal, CIRSE. México.

[3]INIFAP, Campo Experimental Mocochá, CIRSE, México. * Email: herrera.gilbert@inifap.gob.mx

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Abstract:

The propagation of the coconut palm seedling is basically from the nut, its germination and emergency process are very slow and some do not emerge. Studies report only 40% of emergency. The objective of the research was to determine the best planting position of seedlings on seedbeds. The study was established in 2017 in the state of Nayarit, México. The treatments were T1: coconut without husk and emerged embryos (WHE), T2: horizontal position opposite to that found in the field (HP), T3: initial horizontal position to that found in the field (IH) and T4: vertical position of the seeds (VP). The variables evaluated were emergency days, leaf length, leaf width, stipe perimeter and emergency percent. The treatments were organized in a completely randomized experimental design with four treatments and four replicates per treatment. The VP and IH treatments, showed statistical difference (P> 0.05) and turned out to be the best as compared with the other treatments. The treatment WHE was discarded since having just 10 percent of emergency. The treatment HP was also eliminated due to a late emergency speed and low seedlings vigor. Seeds in vertical position (VP) showed the best emergency percentage and agronomic characteristics in respect with other treatments.

Keywords **—seedling quality, coconut palm, increase, emergency, nut, seedbed.**

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I. INTRODUCTION

Coconut (*Cocos nucifera* L.) is one of the most important and useful crops of tropical palms (Ignacio & Miguel, 2021). The fruit, water and byproducts sale go on increase (Divya*et al*., 2022). Another uses of coconut are in medicine, biofuels, handcrafts, feeding production among others (Kumar &Kunhamu, 2022; Limones& Fernández, 2016). This palm is currently cultivated in more than 80 countries in the tropics, among these are India, Indonesia, the Philippines and Brazil, which contributing 76.48% of world production in an area of 9,060,079 million hectares (FAOSTAT, 2018). Many works in this species have based their studies in breeding programs around the world (Perera *et al*., 2009; Pierre *et al*., 2011; Batugal*et al*., 2009). However, the characterization and selection of the nuts from improved varieties and their parents, represent a genetic resource that can produce a vigorous plant for its propagation and cultivation (Sudha *et al*., 2021; Soto *et al*., 2003). The banks of genes are a fundamental basis for establishing solid improvement programs and generating new

genotypes from seedlings (FAO, 1999). Within plant improvement programs, characterization from the seedbed and in the nursery, together with the evaluation of germplasm, are essential activities for both the conservation and use of plant genetic resources (Nair, 2021; Martial *et al*., 2019; Yang *et al*., 2018).

An adequate characterization of the agronomic and morphological traits of plant genetic resources is necessary to facilitate the use of germplasm by genetic breeders (Upadhyaya *et al*., 2008), who, with the morphological characterization, intend to observe attributes that differentiate the plants studied, based on qualitative and quantitative variables of high heritability (Checa*et al*., 2011).

The germination and emergence process of coconut are very slow, sometimes it takes six months or more until the outbreak appears (Braun *et al*., 2020). In the coconut palm, the embryo has to travel about 7 to 11 centimeters, which is the thickness of the thick fibrous layer of the mesocarp (Nair, 2021).

During this journey, the nut germinates, although sometimes, due to the lack of adequate conditions, it does not emerge (He *et al*., 2021). There are studies that have shown low germination rates in some seedlings, with only 40% emergence (Manivannan*et al*., 2018; Alvarado *et al*., 2013).

The low percentage of emergence in the coconut tree could be due mainly to two factors. The first factur is the physiological effects (Cui *et al*., 2020; Hebbar*et al*., 2020; Prakash *et al*., 2019) and the second could be position of the nut that was not the initial one (Norsazwan*et al*., 2020; Adie *et al*., 2019; Royo-Esnal*et al*., 2019; Bareke, 2018), which can alter the emergence process. Due to above mentioned the objective of the present study was to determine the horizontal and vertical planting position technique of the coconut seeds in the seedbeds in order to obtain quality seedlings and facilitate the logistics of planting in the definitive field.

II. MATERIALS AND METHODS

Establishment of experiment

The study was established in 2017 on in a plot located in Instituto Nacional de InvestigacionesForestalesAgrícolas y Pecuarias (INIFAP) Santiago Ixcuintla Experimental Field in Nayarit. Hybrid nuts were the result of crossing the Malayan Dwarf Yellow with the Pacific Creole Tall.

Preparation of the nuts and planting in seedbeds

The seedbed had dimensions of 30 x 150 x 400 cm of deep, wide and long respectively, the bottom was filled with 10 cm of substrate, then, nuts were put on that substrate (TNAU, 2014) and subsequently the covered to three quarters of its height with the same substrate. In this experiment, earthworm humus of Californian red worm (*Eisenia foetida* S.) was used as biofertilizer. The humus was produced with the decomposition of cattle manure, with household waste and plant pruning residues. Nutrition was applied in the seedbed each fifteen days per four months.

Treatments and experimental design used

Treatments were T1: without husk-coir and with emerged embryo (WHE), T2: horizontal position opposite to that found in the field (HP), T3: initial horizontal position to that found in the field (IH) and T4: vertical position of the nut (VP). WHE refers to nuts that had the husk removed and some had germinated, in respect to HP refers to initial position found in the field and then which were put in opposite position in seedbeds. IH were the seeds planted with the initial position found in field and VP were the nuts planted vertically. The variables evaluated were days to emergence, leaf length, leaf width, stipe perimeter and emergency percentage.

Data analysis

Data were recording at the beginning of seeds emergence for six months after planting. The treatments were organized in a completely randomized experimental design with 4 treatments

and 4 repetitions per treatment. The results were submitted to an analysis of variance and Means test ($P \leqslant 0.05$) with the Minitab software.

III. RESULTS AND DISCUSSION

To establish a coconut plot is important to consider the seed position in seedbeds before planting in field. This implies an important action in seed germination process.

Days to seedling emergence

Statistical differences were found (P>0.05) between the four treatments evaluated in emergence days. Treatment WHE manifested emergence from the first day of sowing. This response could be to the previously removed husk. Despite to obtain this positive response, is important to mention that emerge embryos was low with 10% furthermore that labour cost implies high cost before planting. On the other hand, time to plant in field is the same that other treatments which could say that is not recommendable to make this practice in seed establish moment.

Effect of development on planting position in coconuts

In respect to development of plants, treatment VP presented significative statistical differences (P>0.05), the emergence days obtained were 14.2 days (Figure 1). These results indicate the effectiveness of the speed of emergence with sowing in a vertical position, which is considered the best way to plant in seedbeds the coconut seeds.

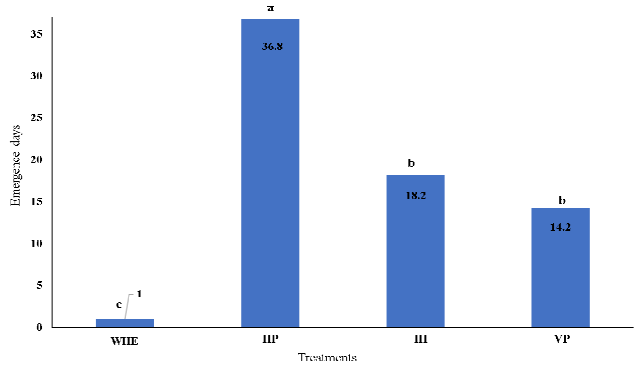

Figure 1. Emerge days of coconut seeds in different position in seedbeds.

The HP treatment was the latest observed, furthermore the days of seeds emergence were up to 37 days after sowing. In this treatment was observed that there were nuts even emerged up to 70 or 80 days and others that did not emerged. This could indicate that care must be taken when collecting the nuts that are in the field and try to mark them if you want to plant in a horizontal position. The results of this study are related to what was mentioned by Méndez *et al*., 2007, indicating that the seed can be adversely affected during transport and storage, increasing the risk of remaining in the opposite position, and therefore causes that the emergence to be later and less vigorous.

Phenological development obtained in seedlings

For the leaf length variable, it was found that treatments T1 (WHE) and T3 (IH) were statistically similar with 70.6 and 73.3 cm long, respectively, followed by treatment 4 (VP) with 65 centimeters, and finally the lowest value obtained was in treatment 2 (HP) with 51 cm (Figure 2.), this last value obtained is due to the expenditure of energy, which makes the embryo to turn 180 degrees, and the nut can emerge weakly. Results of the present study coincide with what was obtained by (Aye *et al*., 2004, Rahman *et al*., 2014, Saleem *et al*, 2014.) when mentioning that seeds with hard and thick mesocarp, come to hinder their germination and emergency.

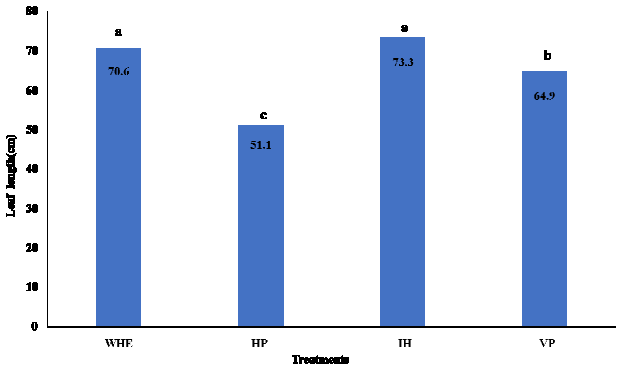

Figure 2. Leaves length (cm) response obtained in positions sowing treatments of coconut.

The variable, leaf width, did not show statistically significant difference (P>0.05) between treatments,

however, treatment 2 (HP) showed the lowest data with 8.5 cm of leaf width, contrarily that we obtained with other treatments which showed 10 cm of average leaf width. In respect to stipe perimeter our results showed significative statistical differences (P<0.05) between treatments evaluated. The treatment 2 (HP), was the one that registered the smallest thickness, with only 5.6 cm, against 6.9 cm, as the average of the rest of the treatments (Figure 3).

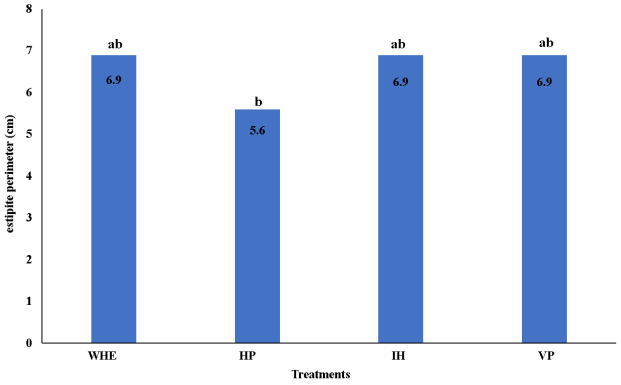

Figure 3. Stipe perimeter obtained in in positions sowing treatments of coconut.

Emergence percentage obtained in coconut seedlings

For the variable percentage of emergence, Treatment 1 (WHE) showed 10% of embryos germinated. On the other hand, Treatments 4 (VP) and 3 (IH) showed average of 76% of embryos germinated. In respect to treatment 2 (HP), it showed the lowest data with 53% of embryos germinated (Figure 4.), in addition, this treatment registered the lowest data in the variables perimeter of the stipe, length and width of the leaf, which were lower than the rest of the treatments. Similar responses were reported by Alvarado *et al*. (2013). These authors indicate that some seeds had 40% of emergence. On the other hand, Rueda *et al*. (2014) mentioned that plant quality is not only determined by the genetic characteristics of the nut, but also by the techniques used for its propagation in the seedbeds.

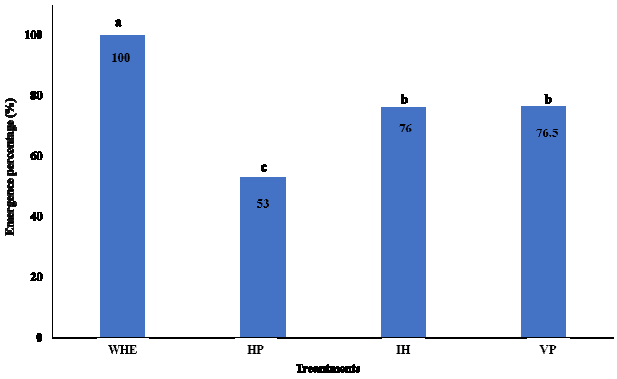

Figure 4. Emergence percentage obtained in in positions sowing treatments of coconut.

Results of the present study indicate that the percentage of emergence of coconuts can be increased with the vertical position of planting in the seedbeds. This response could be possible due to the root development. It was possible to observe that the primary roots of the coconut come out through the active orifice, which descend by gravity when is located at the apex of the seed. Furthermore, the secondary roots appear later, and together they grow downwards and to the sides. This root development, generated by position, prevents the radicle from turning 180 degrees and turning under the coconut seed. When the coconut seed is planted in the opposite position to the initial one, some nuts do not present plumule emergence and usually die. With the information obtained, it can be suggested that it is not necessary to carry out the practice of scarifying the nuts, as some author suggest. Coconut seeds can germinate and emerge under a warm and humid environment. The only requirement necessary is good humidity which could be supply in rainy season or through permanent irrigation. Results of the present study are agree with Alfonso and Ramirez (2008) mentioned. They indicated that the primary roots are responsible for plant fixation mention and water absorption.

IV. CONCLUSIONS

The coconut seeds sowing in vertical position (VP) improve root system, speed of emergence initiation and plant vigor. Furthermore, a higher percentage of seedling emergence in can be obtained. Other advantages are the quantity of seeds that can be accommodate in seedbeds, as well as, labor savings.

AKNOWLEGEMENTS

The authors express their gratitude to FORDECYT, for financing the project "Promotion of the coconut value chain to increase its competitiveness and contribute to socio-economic development in the South Pacific region and other producing states", and this study is part of it.

CONFLICT OF INTEREST

Authors declare that they have not any conflict of interest.

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