

# Sexual Propagation of Cashew (*Anacardium occidentale* L.) Varieties in Bataan, Philippines is Affected by Different Combination of Growing Media

Christian M. Balba<sup>1</sup>, Editha A. Ganado<sup>1</sup> & Cherrilyn E. Ventura<sup>1</sup>

<sup>1</sup> College of Agriculture and Fisheries, Bataan Peninsula State University, Abucay, Bataan, Philippines

Correspondence: Cherrilyn E. Ventura, College of Agriculture and Fisheries, Bataan Peninsula State University, Abucay, Bataan, Philippines. E-mail: [cventura@bpsu.edu.ph](mailto:cventura@bpsu.edu.ph)

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## Abstract

The study was conducted to evaluate the effect of different combinations of growing media on the different varieties of cashew grown in Bataan, Philippines. It aimed to evaluate the number of days to germination, percentage germination, seedling height, number of leaves, leaf area index, and diameter of the stem for the duration of sixty days. It is a two-factor experiment arranged in Completely Randomized Design (CRD) consisting of three Bataan cashew varieties as the Factor A and five combinations of growing media as Factor B with three replications. The experimental treatments were as follow: Factor A (Varieties of Cashew): V<sub>1</sub>-Bataan Variety 1, V<sub>2</sub>-Bataan Variety 2, V<sub>3</sub>-Bataan Variety 3; and Factor B (Soil Media): SM<sub>1</sub>-1 part garden soil, 1 part compost, 1 part sand, SM<sub>2</sub>-1 part garden soil, 1 part compost, ½ part sand, ½ part carbonized rice hull, SM<sub>3</sub>-1 part garden soil, 1 part compost, ½ part sand, ½ part coco coir dust, SM<sub>4</sub>-1 part garden soil, 1 part compost, 1 part carbonized rice hull, and SM<sub>5</sub>-1 part garden soil, 1 part compost, 1 part coco coir dust. Results revealed that Bataan Variety 1 and Bataan Variety 3 were significantly the earliest to germinate while Bataan Variety 1 significantly had the highest success percentage of 92%, highest number of leaves produced (9.81), and the highest recorded leaf area (50.26 mm<sup>2</sup>). For growing media, 1 part garden soil, 1 part compost, 1 part coco coir dust significantly had the tallest plants (30.92 cm) and the most number of leaves. Furthermore, the interaction between varieties and growing media showed no significant difference in all parameters stated. These findings will be useful for the cashew growers, producers, nursery propagators in selecting the best growing media to enhanced their sexual propagation.

**Keywords:** Bataan, growing media, cashew seedlings, cashew varieties

## 1. Introduction

Cashew (*Anacardium occidentale* L.), with a local name of 'kasoy', is one of the many fruit species that are gaining importance in agriculture and commerce in the Philippines, with several economic uses in the food sector as food and feed. It is high in nutrients, and its commercial production can provide a significant source of income for many Filipino farmers in rural areas. It is basically grown all throughout the country and has a great potential for export. Many developing countries regard cashew nut farming and processing to be a vital sector, not only for boosting local economies but also for long-term environmental improvement. In 2019, the Philippines ranked as 5th largest cashew nut producing country in the world which accounts for 6.11% of total world cashew nut production (FAO, 2019).

In the Philippines, total cashew production reached 242,329.32 mt in 2019, with a total planted/harvested area of 28,688.26 hectares (PSA, 2020). Palawan and Mindoro Occidental are the most important cashew-growing areas in the country, accounting for 92% of total production. It is also grown to a lesser extent in Central Luzon (Bataan, Nueva Ecija, and Zambales) and Northern Luzon (Pangasinan and Ilocos Norte), accounting for around 6% and 1% of total production, respectively.

Cashews reproduce both sexually and asexually through seed and vegetative propagation. It is usually propagated through seeds, which results in a great degree of variability. The vast majority of existing cashew farms were established using seed from high-performing mother plants. Due to the substantial income from the variety of products it can produce from nut alone, the production sector's problems must be addressed. These include a limited

supply of plants due to soil problems, and integrated or alternative growing media are being widely considered in many parts of the world as a way to improve total production. The use of suitable growing media is essential for the production of high-quality seedlings. This has an impact on the development of the extensive functioning roots system and its subsequent maintenance. A proper growing medium anchor the plant, serves as a reservoir for nutrients and water, and allows oxygen diffusion to the roots as well as gaseous exchange between the roots and atmosphere outside the root substrate.

In cashew production, the seedling establishment is one of the most important aspects of seedling growth (Hammed & Adeyemi, 2005) wherein in most cases, the crop's field establishment starts in the nursery. The chemical and physical qualities of the growing media play a big role in nursery production of container-grown plants. Seedling performance in the nursery translates to good and encouraging crop establishment in the field. Whereas a lack of understanding of the crop seedlings' growth pattern in the nursery (Hammed et al., 2008) and the nursery's poor growth conditions may have translated into poor field establishment of the crop after transplanting into the field.

There are many different combinations of soil media available for nursery nowadays, but more study is needed to determine which is ideal for nursery management or for growing healthy seedlings for fruit crops like cashew. The foundation of a healthy root system is a good growing medium, which is essential to good nursery management. The different growing media are observed with its influence to seed germination or plant growth for the successful production of the cashew crop and to find the best combinations of growing media for nursery management of fruit crops. With this, the study is conducted to evaluate the growth response of cashew varieties in different combination of growing media in terms of days of germination, success germination, plant height, number of leaves, leaf area and diameter of the stem.

## 2. Method

### 2.1 Experimental Area

The study was conducted in the nursery of the Bataan Peninsula State University-Abucay Campus which is located in Bangkal, Abucay, Bataan, Philippines with a latitude of 14.74°N, longitude of 120.45°E and an elevation of 342.559 meters above sea level.

### 2.2 Experimental Design and Treatments

The study is a two factor experiment arranged in Completely Randomized Design (CRD) with cashew variety as Factor A and growing media as the Factor B. The study was replicated three times with 30 nuts per replication.

The experimental treatments were as follows - Cashew Varieties (Factor A): Bataan Variety 1 ( $V_1$ ), Bataan Variety 2 ( $V_2$ ), and Bataan Variety 3 ( $V_3$ ) while for the Soil Media (Factor B): 1-part garden soil, 1-part compost, 1-part sand ( $SM_1$ ), 1-part garden soil, 1-part compost, ½ part sand, ½ part carbonized rice hull ( $SM_2$ ), 1-part garden soil, 1-part compost, ½ part sand, ½ part coco coir dust ( $SM_3$ ), 1-part garden soil, 1-part compost, 1-part carbonized rice hull ( $SM_4$ ), and 1-part garden soil, 1-part compost, 1-part coco coir dust ( $SM_5$ ).

### 2.3 Cultural Management and Practices

These includes the following:

2.3.1. Collection of seeds. Cashew seeds with different varieties were collected and purchased from the Department of Agriculture (DA) identified cashew farms in Mariveles, Bataan, Philippines. Seeds were collected through picking directly from the mother tree and immediately separated from its matured pseudo-fruit. At the same time, some seeds were gathered from fallen fruits. They were fully matured and of high density (heavy) grade to ensure good germination and vigorous seedlings.

2.3.2. Drying and storage of seeds. As per recommended, cashew nuts were sun-dried for 2 days to attain moisture level of 8-9%. Well dried nuts were stored in sacks tightly to avoid spillage and prevent pest damage. It was then placed in a clean dried storage.

2.3.3. Testing of viable seeds. Cashew seeds were water tested; those that sink were chosen since they had higher viability and germinate quickly.

2.3.4. Sowing seeds. Seeds were sown in individual polyethylene bags containing different combination of growing media. Seeds were sown 5-10 cm deep with stalk end facing upward in a slanting position. These prevented the emerging of cotyledons at the soil surface from being destroyed by pests.

### 2.4 Data Gathered

2.4.1. Average days of germination. It is counting the days it takes a seed to sprout after sowing. This was given in a range to know when to expect to see seedlings.

2.4.2. Success percentage (%). It is an estimate of the viability of a population of seeds. The equation to calculate germination percentage formula is  $GP = \text{seeds germinated}/\text{total seeds} \times 100$ .

2.4.3. Average plant height. The height (cm) of the plants were determined by measuring the plant from the base up to the tip of the longest leaf at 60 days after sowing.

2.4.4. Average number of leaves. These were the number of functional leaves produced on plant that were counted at 60 days after sowing.

2.4.5. Average leaf area index. The length and width of each leaf produced at the longest point were measured. Leaf area was calculated by adopting a formula as suggested for cashew nut by Murthy et al., (1985):  $A = 0.21 + 0.69 P$  (Where, A = Area of the leaf, P = Length x Width of leaf at longest point). The data were collected and calculated at 60 days after sowing.

2.4.6. Average diameter of the stem. This was measured at the midpoint of the plants at 60 days after sowing through the use of Vernier calipers.

### 2.5 Statistical Analysis

All the data gathered from the study were analyzed and tabulated following the Analysis of Variance (ANOVA) for a two-factor experiment in Complete Randomized Design (CRD). Comparison among means was done using Least Significant Difference (LSD). Statistical analyses were performed using a statistical package software, Statistical Tool for Agriculture Research (STAR).

### 3. Results and Discussion

The growth response of three varieties of cashew applied with different combination of growing media is presented in Table 1. The growth parameters gathered in the study includes the days of germination, success percentage, plant height, number of leaves, leaf area index, and diameter of stem. Results revealed a highly significant difference among varieties in terms of days of germination, success percentage, leaf area index while significant difference was recorded in number of leaves. On the other hand, there was no significant difference among varieties in terms of the recorded plant height and diameter of the stem.

Table 1. Growth response of the three varieties of cashew seedlings applied with different growing media

Variety	Days of germination	Success percentage (%)	Plant height (cm)	Number of leaves	Leaf area index (mm <sup>2</sup> )	Diameter of the stem (cm)
Bataan Variety 1 (V <sub>1</sub> )	10.62 <sup>a</sup>	92.00 <sup>a</sup>	29.60 <sup>a</sup>	9.81 <sup>a</sup>	50.26 <sup>a</sup>	6.01 <sup>a</sup>
Bataan Variety 2 (V <sub>2</sub> )	16.17 <sup>b</sup>	69.67 <sup>b</sup>	29.27 <sup>a</sup>	8.98 <sup>b</sup>	42.05 <sup>b</sup>	6.42 <sup>a</sup>
Bataan Variety 3 (V <sub>3</sub> )	11.09 <sup>a</sup>	53.67 <sup>c</sup>	29.31 <sup>a</sup>	9.26 <sup>b</sup>	39.78 <sup>b</sup>	6.34 <sup>a</sup>
F-Test	**	**	ns	*	**	ns
CV (%)	15.06	23.45	11.61	7.39	15.04	12.91

Means with the same letter are not significantly different at 5% level of significance by LSD

In terms of days of germination, Bataan Variety 1 (V<sub>1</sub>) and Bataan Variety 3 (V<sub>3</sub>) were significantly the earliest to germinate while Bataan Variety 2 (V<sub>2</sub>) significantly the longest to propagate. For the success percentage, Bataan Variety 1 significantly had the highest success percentage of 92% as compared to the two varieties (Bataan Variety 2 and Variety 3) with 69.67% and 53.67% success percentage, respectively. In number of leaves, it was also the Bataan Variety 1 which produced the most number of leaves (9.81) as well as the highest leaf area index of 50.26 mm<sup>2</sup> which is significantly higher as compared to Bataan Variety 2 and Variety 3 in the two parameters mentioned. No significant difference in plant height, number of leaves, leaf area index, and diameter of Bataan Variety 2 and Variety 3 in this result is possibly due to the morphological characteristics of the two cashew varieties, wherein it can be observed that the physical appearances of Bataan Variety 2 and Bataan Variety 3 are similar with each other

making them comparable with each other in most of the growth parameters.

On the other hand, although statistically not significant, it can be observed that Bataan Variety 1 had the tallest plant height of 29.60 cm while in terms of diameter of the stem, Bataan Variety 2 had the widest diameter of stem of 6.42 cm.

Meanwhile, another factor used in this study is the combination of different growing media which is presented in Table 2. The growth parameters gathered in the study includes the days of germination, success percentage, plant height, number of leaves, leaf area index, and diameter of stem. Results revealed a significant difference among growing media in terms of plant height, and number of leaves wherein 1-part garden soil, 1-part compost, 1-part coco coir dust (SM<sub>5</sub>) significantly had the tallest plants of 30.92 cm which was comparable to other growing media except for 1-part garden soil, 1-part compost, 1-part sand (SM<sub>1</sub>). In terms of number of leaves, it was also the plants applied with 1-part garden soil, 1-part compost, 1-part coco coir dust which had the most number of leaves (9.85) which is significantly higher to 1-part garden soil, 1-part compost, 1-part sand, and 1-part garden soil, 1-part compost, ½ part sand, ½ part carbonized rice hull (SM<sub>2</sub>) but comparable only with 1-part garden soil, 1-part compost, ½ part sand, ½ coco coir dust (SM<sub>3</sub>), and 1-part garden soil, 1-part compost, 1-part carbonized rice hull (SM<sub>4</sub>). The result of this study corresponds with the study of Usman et al. in 2014, that addition of coco coir to the growing media increased the growth of plant by three times as evident in the result of plant height of plants grown in 1-part garden soil, 1-part compost, 1-part coco coir dust and plants applied with 1-part garden soil, 1-part compost, ½ part sand, ½ coco coir dust which both have coco coir dust as growing media. In the results of the study conducted by Shetty & Melanta (1990), all media containing coir dust resulted in higher survival rate as compared with other media.

Table 2. Effects of different combination of growing media on the growth of cashew seedlings

Growing Media	Days of germination	Success percentage (%)	Plant Height (cm)	Number of leaves	Leaf area index (mm <sup>2</sup> )	Diameter of the stem (cm)
1-part garden soil, 1-part compost, 1-part sand (SM <sub>1</sub> )	13.20 <sup>a</sup>	70.55 <sup>a</sup>	27.16 <sup>b</sup>	8.86 <sup>c</sup>	46.54 <sup>a</sup>	6.07 <sup>a</sup>
1-part garden soil, 1-part compost, ½ part sand, ½ part carbonized rice hull (SM <sub>2</sub> )	13.29 <sup>a</sup>	70.00 <sup>a</sup>	28.86 <sup>ab</sup>	8.88 <sup>bc</sup>	43.50 <sup>a</sup>	6.55 <sup>a</sup>
1-part garden soil, 1-part compost, ½ part sand, ½ coco coir dust (SM <sub>3</sub> )	12.62 <sup>a</sup>	84.44 <sup>a</sup>	29.65 <sup>a</sup>	9.57 <sup>abc</sup>	43.11 <sup>a</sup>	6.34 <sup>a</sup>
1-part garden soil, 1-part compost, 1-part carbonized rice hull (SM <sub>4</sub> )	10.99 <sup>a</sup>	66.67 <sup>a</sup>	30.38 <sup>a</sup>	9.59 <sup>ab</sup>	44.31 <sup>a</sup>	6.24 <sup>a</sup>
1-part garden soil, 1-part compost, 1-part coco coir dust (SM <sub>5</sub> )	13.05 <sup>a</sup>	67.22 <sup>a</sup>	30.92 <sup>a</sup>	9.85 <sup>a</sup>	42.69 <sup>a</sup>	6.08 <sup>a</sup>
F-Test	ns	ns	*	*	ns	ns
CV (5%)	15.06	23.45	11.61	7.39	15.04	12.91

Means with the same letter are not significantly different at 5% level of significance by LSD

As reflected in Table 2, there was no significant difference among growing media in terms of days of germination, success percentage, leaf area index, and diameter of the stem. However, it can be observed that the growing media with 1-part garden soil, 1-part compost, 1-part carbonized rice hull had the shortest days of germination which germinate as early as 10.99 days. In terms of success percentage, it was the plants with 1-part garden soil, 1-part compost, ½ part sand, ½ coco coir dust which obtained the highest success percentage of 84.44% which coincides with the study of Bharathi (1997) and Mamatha (1998) wherein they reported that a medium consisting of sand, coir dust, soil and compost has the maximum graft union success, highest plant height and maximum number of leaves in cashew as mentioned in the study of Sriya et al. (2022). On the other hand, the combination of 1-part

growing media tested in the study. However, although statistically not significant, it can be noted that the earliest days to germinate was revealed in V<sub>3</sub>SM<sub>4</sub> with 10.22 days. Treatments V<sub>2</sub>SM<sub>3</sub> and V<sub>1</sub>SM<sub>3</sub> had the highest success percentage of 100%. Also, V<sub>2</sub>SM<sub>3</sub> had the tallest plant height of 31.36 cm, the most number of leaves with 10.38 was shown in V<sub>1</sub>SM<sub>4</sub>, the highest leaf area index was shown in V<sub>1</sub>SM<sub>1</sub> with 52.70 mm<sup>2</sup>. And lastly, the widest diameter of the stem was attained in V<sub>2</sub>SM<sub>2</sub> with 7.37 cm.

#### 4. Conclusion and Recommendations

Based on the result of the study, Bataan Variety 1 was notable as the leading variety among the acquired data in regards to growth parameters given except in average plant height and diameter of the stem. Moreover, the result showed that among different combination of growing media, 1-part garden soil, 1-part compost, 1-part coco coir dust was the best growing media used to improve plant height and number of leaves and 1-part garden soil, 1-part compost, ½ part sand, ½ coco coir dust with the highest success percentage although it is not significantly different with other soil media. In addition, no significant difference between the interaction of varieties and growing media had been observed in the entire growth parameters.

This study recommends to use Bataan Variety 1 since this variety has the highest success percentage and earliest days to germinate and as observed for the physical characteristics it has the biggest pseudo stem and nuts compared to two varieties. On the other hand, the use of 1-part garden soil, 1-part compost, 1-part coco coir dust growing media combination for greater number of leaves and height of the plants and 1-part garden soil, 1-part compost, ½ part sand, ½ coco coir dust for the highest success percentage despite the fact that it is statistically not significant to other parameters based on the value obtained. This findings suggested the use of appropriate variety and growing media which is be beneficial for cashew growers, producers and nursery propagators for their successful seed propagation.

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