



Effects of Substrates and Plant Growth Regulators on the Rooting Performance of Ubi (*Dioscorea Alata* L.) Setts

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This study assessed the rooting performance and initial growth response of Ubi (*Dioscorea alata* L.) setts subjected to different rooting substrates and plant growth regulators (PGRs) under nursery condition. A Completely Randomized Design (CRD) with three replications was conducted to test the most effective substrates (Factor A) and plant growth regulators PGRs (Factor B) Parameters were measured including days to root emergence, rooting success, root length, and survival percentage were analyzed using Analysis of Variance (ANOVA) and the Least Significant Difference (LSD) test. The Substrates were used are loam soil, pre decomposed rice hull, and cocopeat while in plant growth regulators applied were Distilled Water as negative control, Alpha Naphthalene Acetic Acid (ANAA), Aloe Vera Leaf extract, Banana Peel Extract and Green Coconut Water. Results revealed that there was no significant effect on root emergence during the first seven days among substrates but in plant growth regulators, Banana Peel Extract (BPE) significantly aided in breaking the tuber epidermis at the early growth of ubi setts. At the 30 days after planting there were significant differences emerged across all parameters. The Cocopeat substrates proved to be the most effective among treatment, providing optimal moisture retention and low mechanical resistance for root elongation. Among the PGRs, Green Coconut Water significantly performed compared to other treatments in increasing the average number of roots and total rooting success. Furthermore, the combination of cocopeat and green coconut water (S₃P₅) maximized the percent survival of setts. Based on economic perspective, using of green coconut water is recommended as cheap and locally available alternative to synthetic hormones, offering a high return on investment for small scale growers by producing high quality planting materials.

Keyword: *Dioscorea alata* L., rooting performance, cocopeat, green coconut water, plant growth regulators, ubi setts.

INTRODUCTION

Ubi (*Dioscorea alata* L.) also known as Greater yam, an important staple crop rich in carbohydrates, mainly consumed in subtropical and tropical countries. Purple Yam or Ubi a locally name of *Dioscorea alata* L. commonly called globally as water yam, winged yam, guyanan arrowroot, name de agua and ten months yam. The genus *Dioscorea* to which yam belongs approximately about to 600 species (Burkill, 1960). How ever, many research studies that *Dioscorea alata* L. is the most cultivated species and serve as be as used to food in West Africa especially in times of food scarcity (Bahuchet, et. Al., 2001).

In the Philippines, production trends for major root crops such as cassava and potato have shown an upward trajectory. In contrast, annual ubi (yam) production has declined to approximately 14,000 metric tons, leading to unusual imports from Vietnam, as reported by the PSA (2025).



Within the Cagayan Valley, Quirino province has gained recognition for its ube production and processing. Notably, through the efforts of Quirino State University, the province achieved a major milestone in August 2025 by exporting its first batch of ube powder to the United States. However, the industry currently faces a significant scarcity of planting materials caused by the limitations of supply due to annual harvest season.

Ubi sett production serves as a strategic driver for several Sustainable Development Goals (SDGs) such as Sustainable development Goal 1 (No Poverty), it lowers the high cost of planting materials which traditionally accounts for up to sixty percent of production expenses and empowers farmers to establish profitable seed enterprises. In alignment with Sustainable development Goal 2 (Zero Hunger), this method ensures a consistent supply of safe from disease, high quality setts that boost yields and enhance food security. Additionally, Sustainable development Goal 13 (Climate Action) by improving crop resilience against drought and extreme heat, allowing farmers to adapt to volatile weather patterns.

This study addresses the shortage of planting materials caused by seasonal harvest constraints. Specifically, this research focus toward optimizing rooting success by evaluating the combined effect of different substrates and Plant Growth Regulators.

METHODOLOGY

This study employed a factorial experimental design to address the abovementioned parameters. The substrates served as Factor A, while the plant growth regulators (PGRs) served as Factor B. The PGR treatments included P1 (distilled water), which served as the negative control; P2 (alpha-naphthalene acetic acid), which served as the positive control; P3 (Aloe vera leaf extract); and P4 (banana peel extract). For the preparation of materials, the substrates loam soil, pre-decomposed rice hull, and cocopeat were sterilized. The plant extracts, including Aloe vera leaf extract and banana peel extract, were prepared by chopping and blending the materials, while green coconut water was collected separately. Alpha-naphthalene acetic acid and distilled water were purchased from the local market. Ubi setts were obtained from local growers and cut into 200–250 g pieces with intact epidermis, then divided into head, middle, and tail sections. The setts were air dried for at least 24 hours and then submerged in different plant growth regulator solutions (15 liters, diluted) for 1 hour. After planting, samples were monitored to collect data on the abovementioned parameters. Watering of the covered rice straw daily. Days to root emergence were determined by counting the number of roots that emerged at 7 and 30 days after planting. Rooting success, average number of roots per sett, average root length (measured using a ruler), and percent survival were recorded at the end of the 30-day study.

RESULTS AND DISCUSSION

Number of root emergence at 7 Day After Planting

Table 1. Mean Number of Root Emergence 7 DAP of Ubi (*Dioscorea alata* L.) Setts Subjected to Different Rooting Substrate and Plant Growth Regulators

Substrates	Plant Growth Regulators	Substrate x Plant Growth Regulators
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S₁-Loam soil	6.51	P ₁ -Distilled water	4.30 ^b	S ₁ P ₁	3.89 ^b
S₂-Predecomposed rice hull	6.29	P ₂ -ANAA	6.48 ^b	S ₁ P ₂	7.44 ^{ab}
S₃-Cocopeat	6.96	P ₃ -Aloe vera leaf extract	6.41 ^b	S ₁ P ₃	7.33 ^{ab}
		P ₄ -Banana peel extract	9.22 ^a	S ₁ P ₄	7.22 ^{ab}
		P ₅ -Green coconut water	6.52 ^b	S ₁ P ₅	6.67 ^{ab}
				S ₂ P ₁	4.67 ^b
				S ₂ P ₂	6.33 ^{ab}
				S ₂ P ₃	5.00 ^b
				S ₂ P ₄	10.22 ^a
				S ₂ P ₅	5.22 ^b
				S ₃ P ₁	4.33 ^b
				S ₃ P ₂	5.67 ^b
				S ₃ P ₃	6.89 ^{ab}
				S ₃ P ₄	10.22 ^a
				S ₃ P ₅	7.67 ^{ab}
Result	ns		*		*
ANOVA	ns				
CV (%)	40.80				

The table 1, shows the number of roots at 7 days after planting, the results indicate that there is no significant among substrates. In PGR, P₄ (Banana Peel Extract) appear the highest result with 9.22 followed by P₅ (Green Coconut Water) with 6.52, P₂ (ANAA) with 6.48 and lastly, the P₁ Distilled water.

The results indicated that although substrates like loam soil and cocopeat offer essential physical support, they did not significantly influence the root initiation of *Dioscorea alata* setts at 7 Days After Planting. These findings corroborate the research of Adaramola et al. (2014), which suggests that early vegetative development in yams is predominantly governed by the physiological quality of the planting material and hormonal cues rather than the growth medium itself.

Number of root emergence at 30 Day After Planting

Table 2. Mean Number of Root Emergence 30 DAP of Ubi (*Dioscorea alata* L.) Setts Subjected to Different Rooting Substrate and Plant Growth Regulators

Substrates	Plant Growth Regulators	Substrate x Plant Growth Regulators
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S₁-Loam soil	6.64 ^b	P ₁ -Distilled water	7.85 ^b	S ₁ P ₁	5.56 ^d
S₂-Predecomposed rice hull	7.53 ^b	P ₂ -ANAA	9.22 ^b	S ₁ P ₂	4.78 ^d
S₃-Cocopeat	13.47 ^a	P ₃ -Aloe vera leaf extract	8.78 ^b	S ₁ P ₃	7.89 ^{cd}
		P ₄ -Banana peel extract	7.67 ^b	S ₁ P ₄	4.56 ^d
		P ₅ -Green coconut water	12.55 ^a	S ₁ P ₅	10.44 ^{bcd}
				S ₂ P ₁	7.56 ^{cd}
				S ₂ P ₂	6.89 ^{cd}
				S ₂ P ₃	8.78 ^{cd}
				S ₂ P ₄	5.44 ^d
				S ₂ P ₅	9.00 ^{cd}
				S ₃ P ₁	10.44 ^{bcd}
				S ₃ P ₂	16.00 ^{ab}
				S ₃ P ₃	9.67 ^{bcd}
				S ₃ P ₄	13.00 ^{abc}
				S ₃ P ₅	18.22 ^a
Result	**		*		*
CV (%)	43.90				
ANOVA	significant				

The data on table 2 shows the number of emergence at 30 days after planting. S₃ (Cocopeat) compared to S₂ (pre decomposed rice hull) and S₁ (loam Soil). In PGR, P₅ performed highest with 12.55 followed by P₂ (ANAA) with 9.22, P₃ (Aloe Vera Leaf extract), P₁ (Distilled water) and lastly, the P₄ (Banana Peel Extract) with 7.67. In combination of substrates and plant growth regulators, S₃ (Cocopeat) and P₅ (Green Coconut water) appears the most effective among treatments.

The results aligns with findings by Sauter (2013), who noted that as plants move past the initial initiation phase, the requirement for sustained moisture retention in the growth medium increases to support established root architecture. Simultaneously, the effectiveness of the plant growth regulators (PGRs) shifted, with green coconut water becoming the most effective stimulant at this stage with a mean of 12.55 roots. A significant interaction effect was also observed, particularly in the Cocopeat and Green coconut water combination, which achieved a highest root count of 18.22. According to Yong et al. (2009), coconut water is a best source of phytohormones, specifically cytokinin's, which are essential for promoting cell division and elongation during the later stages of vegetative growth. These results suggest that while early initiation can be triggered by various minerals, long-term root proliferation is best sustained through the synergy of a porous substrate and rich in cytokinin natural extract.

Percentage Rooting Success of Ubi Setts



Table 3. Mean Percentage Rooting Success of Ubi (*Dioscorea alata* L.) Setts Subjected to Different Rooting Substrate and Plant Growth Regulators

Treatments	Replication			Total	Mean
	I	II	III		
S ₁ P ₁	70.00	50.00	70.00	190.00	63.33
S ₁ P ₂	80.00	60.00	90.00	230.00	76.67
S ₁ P ₃	80.00	70.00	80.00	230.00	76.67
S ₁ P ₄	70.00	80.00	70.00	220.00	73.33
S ₁ P ₅	80.00	60.00	100.00	240.00	80.00
S ₂ P ₁	80.00	60.00	100.00	240.00	80.00
S ₂ P ₂	60.00	60.00	60.00	180.00	60.00
S ₂ P ₃	50.00	80.00	80.00	210.00	70.00
S ₂ P ₄	50.00	50.00	70.00	170.00	56.67
S ₂ P ₅	100.00	100.00	80.00	280.00	93.33
S ₃ P ₁	70.00	90.00	70.00	230.00	76.67
S ₃ P ₂	90.00	100.00	70.00	260.00	86.67
S ₃ P ₃	70.00	70.00	70.00	210.00	70.00
S ₃ P ₄	70.00	80.00	80.00	230.00	76.67
S ₃ P ₅	100.00	100.00	100.00	300.00	100.00
Grand Total				3420.00	
Grand Mean					76.00
ANOVA					**

The table 3 shows the percentage of rooting success of Ubi setts. This indicates that S₃P₅ (Cocopeat x Green Coconut Water) combination reached the 100 percent rooting success compared to other treatment. At 30 Day After Planting, the Cocopeat as the main medium and green coconut water surpassed other regulators, ultimately leading to a perfect 100% rooting success. These findings are corroborated by Yong et al. (2009), who identified coconut water as an effective natural source of phytohormones necessary for sustained vegetative growth, and Ilesanmi et al. (2021), who highlighted the role of natural phenolic compounds in stimulating physiological responses in yam tubers.

Average number of Roots per Setts

Table 4. Average Number of Roots per Set of Ubi (*Dioscorea alata* L.) Setts Subjected to Different Rooting Substrate and Plant Growth Regulators

Treatments	Replication			Total	Mean
	I	II	III		
S ₁ P ₁	1.70	1.10	2.20	5.00	1.67
S ₁ P ₂	1.00	1.30	2.00	4.30	1.43
S ₁ P ₃	2.90	1.20	3.00	7.10	2.37
S ₁ P ₄	1.20	1.60	1.30	4.10	1.37
S ₁ P ₅	4.30	1.90	3.20	9.40	3.13
S ₂ P ₁	1.90	1.30	3.60	6.80	2.27



S₂P₂	2.20	1.30	2.70	6.20	2.07
S₂P₃	2.00	3.40	2.50	7.90	2.63
S₂P₄	1.80	0.90	2.20	4.90	1.63
S₂P₅	4.60	1.40	2.10	8.10	2.70
S₃P₁	4.00	2.80	2.60	9.40	3.13
S₃P₂	5.30	4.40	4.70	14.40	4.80
S₃P₃	2.30	2.00	4.40	8.70	2.90
S₃P₄	1.80	3.70	6.20	11.70	3.90
S₃P₅	2.50	6.90	7.00	16.40	5.47
Grand Total	124.40				
Grand Mean	2.76				
ANOVA	**				

The table 4 shows the average number of roots per setts. The results indicate that in combination of S₃P₅ (Cocopeat x Green Coconut water) in Replication 3 appear the highest number of roots which mean that significantly influenced the interaction of substrates and plant growth regulators. It is also appeared as the highest Grand Mean of 5.47, followed by the S₃P₂ (Cocopeat x Alpha naphthalene Acetic acid) with 4.80.

This represents a substantial increase compared to the control and other soil combinations. The high performance of cocopeat in this phase is likely due to its superior aeration and moisture-holding capacity, which provides an ideal physical environment for the extension of the root system. This suggests that while natural vigor exists in the setts, the physiological transition from root initiation to establishment is highly dependent on a growth medium that reduces physical resistance and maintains optimal hydration (Sauter, 2013). The effectiveness of green coconut water as a consistent stimulant for root proliferation is supported by Yong et al. (2009), who highlighted its rich composition of cytokinin, auxins, and essential minerals that facilitate sustained cell division and elongation.

Average Length of roots per Ubi Sett

Table 5. Average Length of Roots per Set of Ubi (*Dioscorea alata* L.) Setts Subjected to Different Rooting Substrate and Plant Growth Regulators

Treatments	Replication			Total	Mean
	I	II	III		
S₁P₁	16.87	6.43	28.63	51.93	17.31
S₁P₂	5.10	16.67	17.83	39.60	13.20
S₁P₃	29.67	12.70	40.23	82.60	27.53
S₁P₄	6.67	32.83	13.10	52.60	17.53
S₁P₅	83.20	26.27	26.03	135.50	45.17
S₂P₁	11.73	18.60	41.10	71.43	23.81
S₂P₂	12.87	10.23	30.50	53.60	17.87
S₂P₃	11.13	55.40	36.63	103.17	34.39
S₂P₄	12.70	7.82	19.20	39.72	13.24
S₂P₅	41.53	23.87	11.77	77.17	25.72



S₃P₁	57.83	43.47	36.17	137.47	45.82
S₃P₂	99.50	91.63	124.00	315.13	105.04
S₃P₃	30.17	89.47	17.63	137.27	45.76
S₃P₄	23.50	93.40	58.73	175.63	58.54
S₃P₅	44.33	144.87	293.51	482.71	160.90
Grand Total	1955.53				
Grand Mean					43.46
ANOVA					**

The table 5 presents the average length of roots per setts Subjected to Different Rooting Substrate and Plant Growth Regulators. The results shows that the interaction of S₃P₅(cocopeat x green coconut water) in Replication 3 appears the highest and achieving a mean of 160.90 significantly influenced the ubi roots, followed by combination of S₃P₂ (Cocopeat x green coconut water).

This performance highlights how a highly porous substrate like cocopeat reduces mechanical impedance, allowing roots to elongate freely. The application of green coconut water provided the essential phytohormones, such as cytokinin, required for continued cellular expansion (Yong et al., 2009). The transition from initial root emergence to this advanced elongation stage suggests that the metabolic activity within the yam setts is significantly enhanced by natural stimulants (Ilesanmi et al., 2021).

Percent Survival of Setts

Table 6. Mean Percent Survival of Ubi (*Dioscorea alata* L.) Setts Subjected to Different Rooting Substrate and Plant Growth Regulators

Treatments	Replication			Total	Mean
	I	II	III		
S₁P₁	100.00	100.00	100.00	300.00	100.00
S₁P₂	100.00	100.00	100.00	300.00	100.00
S₁P₃	100.00	100.00	100.00	300.00	100.00
S₁P₄	100.00	100.00	100.00	300.00	100.00
S₁P₅	100.00	100.00	100.00	300.00	100.00
S₂P₁	100.00	100.00	100.00	300.00	100.00
S₂P₂	100.00	100.00	100.00	300.00	100.00
S₂P₃	100.00	100.00	100.00	300.00	100.00
S₂P₄	100.00	100.00	100.00	300.00	100.00
S₂P₅	100.00	100.00	100.00	300.00	100.00
S₃P₁	100.00	100.00	100.00	300.00	100.00
S₃P₂	100.00	100.00	100.00	300.00	100.00
S₃P₃	100.00	100.00	100.00	300.00	100.00
S₃P₄	100.00	100.00	100.00	300.00	100.00
S₃P₅	100.00	100.00	100.00	300.00	100.00
Grand Total				4500.00	



Grand Mean

100.00

The table 6 shows that 100.00% Survival of Ubi (*Dioscorea alata L.*) Setts Subjected to Different Rooting Substrate and Plant Growth Regulators suggests that *Dioscorea alata L.* is exceptionally hardy when propagated via setts, provided that the environment is controlled. Several published studies survival rates can fluctuate between 75% and 95% due to environmental stressors. The perfect survival observed here implies that the rooting substrates provided optimal aeration and moisture retention, while the plant growth regulators successfully stimulated physiological activity without reaching phytotoxic levels.

Cost and Return Analysis

Table 7. Cost and return Analysis of Ubi Setts Subjected to Different Rooting Substrate and Plant Growth Regulators

	Treatment 1 (Distilled Water)	Treatment 2 (ANAA)	Treatment 3 (AVLE)	Treatment 4 (BPE)	Treatment 5 (GCE)
A. Inputs					
3.6 kilogram Ubi setts @ 100.00	360	360	360	360	360
3 kilograms Loam soil	33.33	33.33	33.33	33.33	33.33
3 kilograms pre- decomposed	33.33	33.33	33.33	33.33	33.33
3 kilograms Cocopeat	26.66	26.66	26.66	26.66	26.66
Distilled water @ 15 liters	150.00				
Alpha nephthalene Acetic Acid @ 59 ml		76.14			
AVLE @ .75 liters			100.00		
BPE @.75 liters				100.00	
Green Coconut Extract @ .75 liters					70.00
Propagation boxes @ 2000.00	400	400	400	400	400



20 yard 70 % Sunshade @ 120.00/yard	360	360	360	360	360
3x 6x10Fishnet @ 2000.00	400	400	400	400	400
TOTAL	1763.32	1713.46	1713.32	1713.32	1783.32
B. Labor					
Cleaning 400/MDAY 5 m/ treatment	10.00	10.00	10.00	10.00	10.00
Watering 30 min/@ 30 days	25.00	25.00	25.00	25.00	25.00
TOTAL	35.00	35.00	35.00	35.00	35.00
C. Total expenses	1798.32	1748.46	1748.32	1748.32	1718.32
D. Total Gross Sale @ 30.00/plantlet	2700.00	2700.00	2700.00	2700.00	2700.00
E. Net Income	901	951.54	951.68	951.68	981.68
A. Return on expenses	50%	54.39 %	54.44%	54.44%	57.13%

The table 7 shows that the rooting performance of *Dioscorea alata* setts is significantly influenced between the physical properties of the substrate and the physiological stimulation of plant growth regulators (PGRs). The highest total of expenses was recorded in Treatment 1 which is the with an average total expense of P 1798.32, followed by the Treatment 2 with P 1748.46, Treatment 3 and 4 with P 1748.32 and the lowest which is the Treatment 5 with a total of expense of P1718.32. The highest Total income was recorded in treatment 5 with P 981.68, followed by Treatment 3 and 4 with a same total of P 951.54, Treatment 2 with P 951.54, and lowest is the treatment 1 with 901. The Highest Return on Expenses was noted in Treatment 5 with 57.13%, followed by the Treatment 3 and 4 with 54.44%, Treatment 2 with 54.39%, and the lowest which is the Treatment 1 with 50%. The result suggest that the combination of Cocopeat and green Coconut water can improve both biological performance and profitability in *Dioscorea alata* sett propagation.

CONCLUSIONS AND RECOMMENDATION

Based on the results of the study, the rooting performance and initial growth of Ubi setts are significantly influenced by the choice of substrates and the application of plant growth regulators (PGRs). While initial root emergence (at 7 days) showed no significant variation among

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substrates, the long-term development of the root system is highly dependent on the physical environment and hormonal stimulation. And at the end of study, the combination between Cocopeat and Green Coconut water extract most perform among treatments.

RECOMMENDATION

Based on the result of the study, the following recommendation as follows;

1. It is recommended that farmers can shift from using traditional garden soil to Cocopeat for nursery preparation. It has the ability to retain moisture while remaining loose significantly increases root length and reduces sett rot leading to higher survival rates.
2. Ubi Growers may utilize Green Coconut Water as a cheap and organic alternative to expensive synthetic rooting hormones. Soaking setts in a coconut water solution can improve root density and vigor without increasing production costs. further research should be conducted to find the soaking durations that yield the absolute best rooting results.
3. It is also recommended to test these specific substrates and PGRs on other *Dioscorea* species or different *Dioscorea alata* cultivars to see if the growth response is consistent across the species.
4. A follow-up study is recommended to determine if the best rooting performance observed in the first 30 days in cocopeat directly translates to a significantly higher tuber weight and yield at the final harvest stage
5. further research may be conducted to find the soaking durations that yield the absolute best rooting result.

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