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Varietal Performance of Sweet Potato (*Ipomoea batatas* l.) Planted in Between Mulberry (*Morus alba* l.) Trees

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Abstract: This study, conducted at the Sericulture Research Area of Don Mariano Marcos Memorial State University, evaluated the performance of ten sweet potato (*Ipomoea batatas* L.) varieties intercropped with mulberry (*Morus alba*) trees. The tested varieties- SP 36, SP 35, Swerte, Kalbooy, SP 25, Bokod, Bengueta, Honey Perpetua, Rovisa, and Tinapay were sourced from the Philippine Root Crops Training Center. The research aimed to assess varietal adaptability, growth, and yield potential under the partial shade of mulberry plantations. Significant differences were observed in vine length, number of tubers per plant, and secondary vine development, indicating varied growth responses. However, computed yield per plot showed no significant differences, suggesting comparable productivity across varieties. The minimal number of non-marketable tubers further confirmed produce quality. These findings demonstrate that sweet potato can be successfully integrated into mulberry-based agroforestry systems without compromising yield, offering a sustainable and diversified land-use strategy for farmers.

Keywords: Agroforestry system; Bengueta; Mulberry trees; Sweet potato.

INTRODUCTION

Sweet potato (Ipomoea batatas L.) is a highly versatile and resilient root crop cultivated across tropical and subtropical regions worldwide. In the Philippines, it plays a vital role in enhancing rural food security, nutrition, and income generation due to its adaptability to diverse soil types and climatic conditions (Loebenstein & Thottappilly, 2009; Maghirang, 2018). With increasing efforts to address global food insecurity and poverty, sweet potato has gained prominence as a strategic crop that supports sustainable agriculture and contributes to the United Nations Sustainable Development Goals, particularly SDG 1 (No Poverty) and SDG 2 (Zero Hunger).

Sweet potato is known for its morphological and varietal diversity. In the Philippines, varieties are typically characterized by long, tapering tuberous roots with skin colors ranging from yellow, orange, red, purple, and beige, and flesh colors from white to deep orange and purple. Varieties with red, pink, or orange flesh tend to be sweeter and moister compared to white or pale-yellow ones (Philippine Statistics Authority, 2021). These varietal differences affect not only the crop's taste and appearance but also its agronomic performance, marketability, and nutritional value. High-yielding and well-adapted varieties can increase production, improve farmer incomes, and support more resilient food systems.

Varietal identification and selection are crucial in optimizing sweet potato production. Traditionally, this has been based on visual observation, but advancements in technology, including image processing, have improved variety recognition (Unajan et al., 2017; Abidin et al., 2017). Growth habits of sweet potato can vary from erect to semi-erect and spreading, with maturing periods ranging from three to ten months (Schnell et al., 2020). Selecting the appropriate variety for a given environment, especially when intercropped with tree species, is essential for achieving optimum productivity.

Mulberry (Morus alba), a fast-growing, hardy perennial from the Moraceae family, is widely known for its role in sericulture as the exclusive feed for silkworms (Bombyx mori). In addition to silk production, mulberries also offer edible fruits, medicinal properties, and timber for various uses (Ghosh et al., 2017; Bao et al., 2016; Zhou et al., 2015). Mulberry grows well in a range of soil conditions—from fertile, porous soils to marginal and degraded lands (Han, 2007; Srivastava et al., 2003). Its deep-rooted, woody perennial nature and high biomass potential make it ideal for planting in degraded or pollutant-contaminated areas and contribute to water and soil conservation efforts.

Agroforestry, and specifically the practice of growing trees on farmland alongside crops, has well-established research evidence of its potential to reduce deforestation and forest degradation at a landscape scale (Wagayen, 2024). It supports biodiversity, improves soil fertility, reduces erosion, and contributes to climate resilience (Nair, 1993; Leakey, 2014; Centeri, 2022). Intercropping sweet potato with mulberry trees represents an innovative agroforestry practice that aligns with global goals for food security, sustainable livelihoods, and ecological restoration (Fonteyne et al., 2022; CIFOR-ICRAF, 2023). Research shows that agroforestry systems combining root crops and trees can enhance land productivity, soil organic matter, and carbon sequestration while providing year-round food and income (Montagnini & Nair, 2004; Akanbi et al., 2004).

Despite these benefits, successful crop-tree integration depends on careful varietal selection and management to mitigate challenges such as light competition, root zone interference, and nutrient dynamics. In particular, sweet potato varieties differ in shade tolerance, growth performance, and adaptability under the partial canopy of tree-based systems. Thus, understanding varietal responses within a mulberry-based agroforestry context is essential for optimizing yield, improving land-use efficiency, and supporting smallholder resilience (Gurmu et al., 2015; Laurie et al., 2015).

Sweet potato is locally known as “camote” in the Philippines and has evolved from being a subsistence crop to a valuable income-generating commodity. It is widely processed into flour, wine, snacks, and feed, increasing its demand in formal markets (Delmo, 2010; Ozturk et al., 2012). As a rich source of carbohydrates, fiber, and essential vitamins (A, C, E, B1, B2, folate), sweet potato helps combat malnutrition and provides an affordable alternative to rice and corn (Zannou et al., 2017; Belen et al., 2018).

Integrating sweet potato with mulberry in an agroforestry system, particularly in areas like Northern Philippines where Morus alba is widely promoted through institutional programs, can enhance farmers’ economic and environmental resilience (Anislag & Gavina, 2022). Intercropping improves land productivity, diversifies income, conserves soil, and enhances food and nutritional security—crucial for vulnerable communities in both upland and lowland areas. However, research is needed to identify sweet potato varieties that thrive under these conditions and evaluate their interactions with mulberry trees in terms of yield, survival, and environmental responses.

This study aims to evaluate the performance of selected sweet potato varieties intercropped with mulberry trees under tropical agroforestry conditions. Specifically, it seeks to identify the sweet potato variety with the highest survival rate and determine the variety with the most favorable growth and yield performance.By integrating agroecological principles with varietal selection, this study contributes to the advancement of sustainable, diversified farming systems that support livelihoods, environmental protection, and food security in the Philippines.

MATERIALS AND METHODS

Experimenal Site and Design

The study was conducted in a newly pruned mulberry (Morus alba) plantation, with sweet potato (Ipomoea batatas) intercropped between the rows over a total area of 189 m². A Randomized Complete Block Design (RCBD) was employed, consisting of three blocks with 10 sweet potato varieties and 10 sample plants per variety per block, resulting in a total of 30 experimental plots. Each plot measured 2 m × 1 m, with 0.75 m alleys between plots and 1 m between blocks.

The sweet potato varieties tested were:

V1 – SP 36
V2 – SP 35
V3 – Swerte
V4 – Kalbooy
V5 – SP 25
V6 – Bokod
V7 – Bengueta
V8 – Honey Perpetua
V9 – Rovisa
V10 – Tinapay

Materials and Planting Procedures

A total of 300 sweet potato cuttings (10 per plot) were obtained from the Northern Philippines Root Crops Research and Training Center (NPRCRTC) in La Trinidad, Benguet. Field tools such as a rotavator, shovel, bolo, pruning shears, steel tape, weighing balance, and other materials were sourced from the Agroforestry Nursery of DMMMSU-NLUC, Bacnotan, La Union.

The field was manually cleared of weeds and pruned mulberry trees prior to double-pass rotavation. Plot layout followed measured specifications. Sweet potato cuttings were planted at a 40 cm × 40 cm spacing in a slanting position, ensuring that two nodes were covered with soil.

Watering was applied immediately after planting to aid establishment.

Crop Management and Harvesting

Weeding was done as necessary to reduce competition with the main crop. Mulberry trees were re-pruned one month after sweet potato planting to manage shading. Sweet potato was harvested between 90 and 120 days after planting. Vines were cut at 30 cm above ground and set aside under shade for data collection. Storage roots were manually harvested using a bolo, cleaned, and prepared for evaluation.

Data Analysis

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The Shapiro-Wilk Normality Test was conducted to assess the normality of the data gathered. Results revealed that all the data were normally distributed. All data were then tested using the Analysis of Variance (ANOVA) in Randomize Complete Block Design (RCBD). If the data were found to be significantly different, then comparison among treatment means were employed using the Tukey's Honest Significant Difference (HSD) test. All data were analyzed using RStudio Statistical Software v. 2024 (R Core Team, 2024).

RESULTS AND DISCUSSION

Growth and Yield of Sweet Potato Varieties Weight (g) of Tubers Per Plant

The mean weight of tubers per plant of the different varieties of sweet potato is presented in Table 1. The weight of tubers per plant ranged from 210.83 g to 337.87 g. While there was a numerical variation among the varieties, statistical analysis revealed that these differences were not significant, as shown by the results of the Analysis of Variance (ANOVA). This suggests that tuber yield, in terms of weight per plant, remains consistent across the tested varieties under the prevailing environmental and management conditions.

Table 1. Weight (g) of Sweet Potato Tubers Per Plant

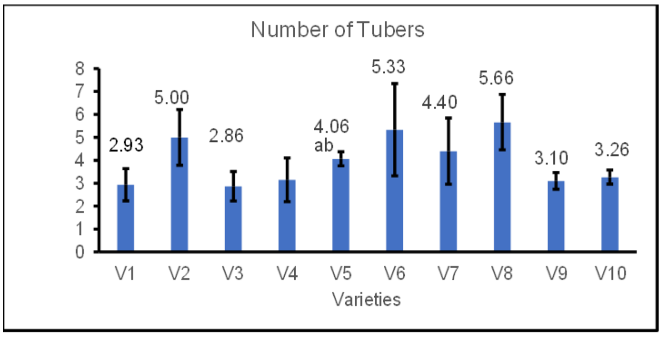
Sweet Potato Varieties	Weight of Tubers (g) /Plant +
V_1-SP 36	210.83
V_2-SP 35	336.05
V_3-Swerte	295.47
V_4-Kalbooy	254.98
V_5-SP 25	305.93
V_6-Bokod	305.13
V_7-Bengueta	331.67
V_8-Honey Perpetua	337.87
V_9-Rovisa	268.50
V_{10}-Tinapay	276.00

+=not significant at $p<0.05$

The observed mean tuber weights fall within the expected range for sweet potato varieties, aligning with varietal yield characteristics reported in the literature. For instance, the Bureau of Plant Industry (2020) notes that commonly cultivated sweet potato varieties in the Philippines, such as NSIC Sp-35, NSIC Sp-31, and NSIC Sp-25, typically produce tuber weights per plant ranging from 200 g to 350 g under normal cultivation conditions. NSIC Sp-36 is recognized for its moderate yield and disease resistance, producing approximately 300–350 g of tubers per plant, while NSIC Sp-31 yields slightly less but is valued for its early maturity and adaptability (Bureau of Plant Industry, 2020; Maghirang, 2018).

Number of Tubers Per Plant

The mean number of sweet potato tubers per plant is presented in Figure 1. Among the varieties evaluated, V8 – Honey Perpetua recorded the highest mean tuber number per plant (5.67), significantly comparable to V6 – Bokod (5.33) and V2 – SP 35 (5.00). In contrast, V1 – SP 36 had the lowest mean number of tubers (2.93), comparable to V3 – Swerte (2.87) and V10 – Tinapay (3.27). These varieties produced significantly fewer tubers than the higher-performing varieties, as confirmed by the results of the Analysis of Variance (ANOVA), which revealed significant differences among the treatments.



*=Significant at $p<0.05$. Means followed by same letters are not significantly different based on Tukey's HSD test. Error bars represent sta ndard deviation.

Fig. 1. Number of Tubers Per Plant

The observed differences in the number of tubers per plant can be attributed to genotypic variability among the varieties, particularly in traits related to tuber initiation, root branching capacity, and assimilate partitioning. Varieties such as Honey Perpetua, Bokod, and SP 35 are likely characterized by vigorous root systems, enhanced adventitious root development, and higher photosynthetic efficiency, leading to increased tuber initiation and development. According to Woolfe (1992), sweet potato varieties with extensive root proliferation and early tuber initiation typically produce more tubers, even if total weight may not differ significantly.

On the other hand, the low number of tubers observed in varieties like SP 36, Swerte, and Tinapay may be due to genetic predisposition to produce fewer but larger tubers, a trait valued for certain market preferences. Some sweet potato varieties naturally allocate more assimilates toward fewer tubers, favoring bulk over quantity (Loebenstein & Thottappilly, 2009). This may also be influenced by the hormonal balance within the plant, especially cytokinins and auxins that regulate root enlargement and branching.

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Environmental uniformity and cultural practices across treatments minimized external variability, allowing varietal traits to distinctly influence tuber formation. Thus, the significant differences in tuber number emphasize the importance of genotype selection based on specific production goals—whether for total yield, tuber size, or number. For example, smallholder farmers aiming for volume harvests may benefit from varieties like Honey Perpetua, while markets requiring fewer but larger roots might prefer Tinapay or Swerte (Smith, 2019).

The results also support previous findings that varietal selection is a key factor influencing root crop productivity (Villamayor et al., 2019). It reinforces the need for site specific varietal recommendations and further breeding work to optimize root formation traits for different growing conditions.

Weight of Marketable Tubers (g) Per Plot

Presented in Table 2 is the weight of marketable tubers of the different sweet potato varieties grown between mulberry (Morus alba) plantations were also assessed to determine whether varietal differences influenced productivity under intercropping conditions. Statistical analysis showed that there were no significant differences ($p > 0.05$) in the weight of marketable yields among the varieties.

Table 2. Weight of Marketable Tubers (g) Per Plot

Sweet Potato Varieties	Weight of marketable Tubers (g) Per Plot $^{+}$
V1-SP 36	192.77
V2-SP 35	289.78
V3-Swerte	247.95
V4-Kalbooy	159.80
V5-SP 25	286.27
V6-Bokod	284.10
V7-Bengueta	294.20
V8-Honey Perpetua	302.73
V9-Rovisa	223.50
V10-Tinapay	215.33

$^{+}$=not significant at p<0.05

Although the mean yield values differed numerically across the varieties, the variations were not statistically sufficient to establish significant differences. This indicates that the intercropping environment with mulberry allowed for relatively uniform growth and tuber development, regardless of varietal genetic differences.

These findings are aligned with the results of Cruz et al. (2018), who reported that sweet potato varieties often exhibit comparable marketable yields when environmental conditions and cultural practices are well managed, even in diversified cropping systems. Similarly, Santos and dela Cruz (2020) observed that in intercropped and agroforestry-based setups, resource-sharing dynamics like light interception and soil nutrient competition are often more influential than varietal identity when it comes to yield outputs, especially in the early cropping cycles.

Computed Yield Per Plot (kg) of Sweet Potato Varieties

Presented in table 3 is the computed yield per plot of different sweet potato varieties. The statistical analysis revealed that there was no significant difference in the computed yield per plot among the ten different varieties of sweet potato evaluated in this study. This outcome suggests that, under the prevailing environmental conditions and standardized management practices, all varieties exhibited comparable productivity in terms of total yield.

Table 3. Computed Yield Per Plot (kg) of Sweet Potato Varieties

Sweet Potato Varieties	Computed Yield (kg) Per Plot^{+}
V_1-SP 36	6.33
V_2-SP 35	10.08
V_3-Swerte	8.86
V_4-Kalbooy	7.65
V_5-SP 25	9.18
V_6-Bokod	9.15
V_7-Bengueta	9.95
V_8-Honey Perpetua	10.14
V_9-Rovisa	8.06
V_{10}-Tinapay	8.28

+=not significant at $p<0.05$

The lack of significant variation in yield performance implies that the genetic potential of the different sweet potato varieties was uniformly expressed, possibly due to the uniformity of soil fertility, water availability, pest management, and other cultural practices applied throughout the experimental plots. According to Lebot (2019), environmental conditions and field management often have a stronger influence on sweet potato yield than genetic differences, especially when varieties are cultivated under optimal conditions.

This finding is also consistent with the work of Laurie et al. (2015), who observed that when sweet potato varieties are grown under similar agro-ecological conditions, yield variations are often minimized, making varietal differences less pronounced. It further reinforces the idea that external factors such as soil structure, moisture regulation, pest control, and nutrient management play significant roles in sweet potato productivity (Villordon et al., 2014).

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Given that no significant differences were recorded in computed yields per plot, the results suggest that any of the tested varieties can be a viable choice for farmers operating under similar conditions, provided that recommended agronomic practices are properly implemented.

CONCLUSION

This study was conducted at the Sericulture Research Area of Don Mariano Marcos Memorial State University to evaluate the performance of ten sweet potato (Ipomoea batatas L.) varieties intercropped between rows of mulberry (Morus alba) trees. Varieties included SP 36, SP 35, Swerte, Kalbooy, SP 25, Bokod, Bengueta, Honey Perpetua, Rovisa, and Tinapay, sourced from the Philippine Root Crops Training Center, Baguio City.

In conclusion, V8-Honey Perpetua, V6-Bokod, and V2-SP 35 demonstrated superior tuber yield, while V5-SP 25, V1-SP 36, V10-Tinapay, and V6-Bokod exhibited vigorous vine growth. Tinapay, SP 25, and Swerte showed high adaptability with an 80% survival rate, indicating their suitability for local agro-climatic conditions. Furthermore, the results revealed that intercropping sweet potato with mulberry did not adversely affect mulberry growth, highlighting its potential as a sustainable and income-enhancing land-use system.

Significant differences were observed in the number of tubers per plant, vine length, and number of secondary vines, suggesting varying adaptability and growth responses among varieties. However, yield per plot and gross income (ranging from PHP 19.18 to PHP 36.33 per 10-plant plot) did not significantly differ, indicating uniform productivity across varieties. The low percentage of non-marketable tubers also points to generally good-quality produce.

The findings highlight the viability of integrating sweet potatoes in a mulberry-based agroforestry system without compromising yield, supporting sustainable agriculture and contributing to SDG 1 (No Poverty) and SDG 2 (Zero Hunger).

Conflict of Interest

There are no conflicts of interest declared by the authors.

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