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Synergetic Influence of Jicama(*Pachyrhizus erosus*) Intercropping Schemes on Sweet Corn(*Zea mays convar. saccharata var. rugosa*) under Regenerative Farming Practices

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ABSTRACT

This study, conducted from October 2023 to March 2024 in Labrador, Buug, Zamboanga Sibugay, assessed the impact of jicama intercropping schemes on sweet corn growth and yield under regenerative farming. A 565 m² area was arranged using a Randomized Complete Block Design with four treatments (T1–T4), each replicated four times. Treatments varied in jicama spacing using the quincunx method. T1 (jicama between every corn row) consistently outperformed other setups in plant height, stalk circumference, and corn ear weight and size. While T4 produced the longest ears, it had lower overall yield. Statistical analysis confirmed significant differences among treatments. T1 is recommended as an effective strategy to boost sweet corn productivity in sustainable farming systems.

Keywords : *sweet corn, jicama, intercropping, quincunx, row*

1 INTRODUCTION

The corn (*Zea mays*), also known as maize, trac- es its origins to teosinte, a wild grass native to southern Mexico over 9,000 years ago. Its global journey began in 1493 when Christopher Columbus encountered corn in the Caribbean and introduced it to Europe and North Africa. A naturally occur- ring mutation led to the development of sweet corn, cultivated by Native American tribes. Notably, the Iroquois presented sweet corn to European settlers in 1779, and it quickly became a staple across the United States . Today, corn has evolved into one of the world's most widely grown crops, serving as the second most important crop in the Philippines. Sweet corn is harvested while still immature and consumed as a vegetable, distinguishing it from field corn grown for dry grain. With higher sugar and protein content, sweet corn not only offers superior nutritional value but also enhances soil health through crop rotation. Advances in bio- technology have produced super sweet varieties with desirable traits such as drought resistance and increased nutritional value. Despite its advantages, sweet corn cultivation faces challenges like pest infestations and high input costs, particularly in fertilizer use.

In response, the Philippine government established the Fertilizer and Pesticide Authority un- der Presidential Decree No. 135 to regulate supply and pricing. However, price volatility continues to burden farmers. Intercropping—growing comple- mentary crops together—presents a sustainable strategy to reduce fertilizer dependency, enhance nutrient cycling, and improve land use efficiency . With minimal adjustments to the farmer's corn farming methods and practices, intercropping offers the chance to increase the economic yield of the corn lands. Among potential intercrops, jicama (Pachyrhizus erosus), a nitrogen-fixing tropical legume from the Fabaceae family, offers multiple benefits.

Jicama (*Pachyrhizus erosus*), an underutilized crop of the Fabaceae family, is a tropical vining legume known for producing a large, edible tuber- ous root. Notably, it possesses nitrogen-fixing capabilities, making it valuable in sustainable agri- cultural systems. In addition to its nutritional use, jicama serves multiple purposes—as fodder, green manure, and cover crop—further enhancing its role in agroecological practices. Its roots establish symbiosis with Bradyrhizobium, a nitrogen-fixing soil bacterium prevalent in tropical regions where soils are often nitrogen-deficient. This partnership significantly contributes to soil fertility, particularly when jicama is intercropped with other indigenous legumes. Furthermore, jicama contains rote- none, a naturally occurring compound found in its roots and stems, which functions as a botanical insecticide and herbicide.

In Buug, Zamboanga Sibugay, sweet corn farm- ers operate within a tropical climate well-suited to its cultivation. They often face high input costs and limited access to sustainable practices. Introducing jicama as a companion crop may reduce fertilizer use and promote better pest management, thereby improving yield and economic resilience. Both crops are already present in local markets, offering potential to boost household income and contribute to regional food security.

Intercropping optimizes resources by enabling diverse crops to access water, sunlight, and nutri- ents from different soil depths [10]. This spatial synergy enhances productivity and reduces envi- ronmental strain—principles at the heart of regen- erative agriculture. Varied canopy structures in intercropped systems improve microclimates and minimize waste, making the most of available land.

This study supports multiple Sustainable Development Goals (SDGs), including: (1) No Poverty, (2) Zero Hunger, (8) Decent Work and Economic Growth, (11) Sustainable Cities and Communities, (12) Responsible Consumption and Production, (13) Climate Action, and (15) Life on Land. It also aligns with the 10-Point Agenda of the late MSU President Atty. Basari D. Mapupuno, emphasizing (2) Strengthening Research, Extension, Innova- tion, and Production, (6) Serve as Beacon for Preservation for Cultural Heritage, (8) Increase Income Generation and Improve Fiscal Responsibility, and lastly (10) Implementation of Land Use Plan.

Thus, this study aims to evaluate the growth and yield of sweet corn under various intercropping arrangements with jicama—bridging agricultural sustainability and economic viability in the local context.

2 METHODOLOGY

An experimental area encompassing 565 m², inclusive of irrigation canals, was prepared by manu- ally slashing and cutting existing weeds. The site was subsequently plowed using a Farmall tractor and harrowed twice to ensure uniform tilth. Fur- rows were then formed to facilitate planting. The area was laid out using a Randomized Complete Block Design (RCBD), divided into five blocks (including a control), with each block comprising four treatments. Individual plots measured 5.25 m× 2.75 m.

Prior to planting, bamboo poles were erected to support woven nylon twine, forming a trellis sys- tem for the jicama intercrop. Random numbers, generated via calculator and arranged in ascending order within each block, were employed to ran- domize the plot assignments. The study considered a single factor: the pattern of jicama intercropping with sweet corn.

The experimental treatments were defined as follows:
T0: Sweet corn without intercrop
T1: Jicama intercropped between each row of sweet corn
T2: Jicama intercropped every two rows of sweet corn
T3: Jicama intercropped every three rows of sweet corn
T4: Jicama intercropped every four rows of sweet corn

One viable seed of sweet corn was sown per hill, spaced at 25 cm within rows and 75 cm between rows. Seeds were sown at a depth of 3 cm and covered with 2 cm of soil. Jicama seeds were also sown one per hill, mirroring the corn spacing, and were arranged quincunx (diagonally) in accordance with the respective treatment layouts.

Manual cultivation and weeding were per- formed 20 days after sowing (DAS) using a blunt bolo, followed by hilling-up at 25 DAS to enhance plant stability. Plant sampling was conducted using systematic sampling, wherein 30% of the total plant population per plot was selected by counting every third hill starting from the first in each row— resulting in 26 sample hills per plot.

Harvesting of sweet corn was done manually at 75 DAS. Sample plants were harvested prior to bulk harvests to avoid data contamination. The jicama intercrop was harvested separately at its physiological maturity; however, no data were collected from the intercrop, as the study focused solely on sweet corn response to intercropping schemes.

Data collection was bifurcated into growth and yield parameters. Plant height (cm) was meas- ured from the soil surface to the tip of the longest leaf using a meter stick, while stalk circumference (cm) was recorded at the base of the stem using a tape measure—both at 15, 30, and 75 DAS. Yield data were collected post-harvest, including average ear length and circumference (cm), measured with a tape measure, and average ear weight (g), obtained via weighing scale. Data were tabulated per plot and treatment for analysis.

Growth variables (height and stalk circumfer- ence) were analyzed using repeated-measures ANOVA to account for correlations over time and to assess main and interaction effects of treatment and time. Yield variables (ear length, circumfer- ence, and weight) were evaluated using one-way ANOVA, focusing on treatment effects at a single time point (75 DAS). Where ANOVA indicated significant differences, Tukey's Honest Significant.

Difference (HSD) post hoc test was applied to con- trol the family-wise error rate. Results were summarized using Compact Letter Display (CLD), wherein means sharing a common letter were not significantly different.

3 RESULTS AND DISCUSSIONS

Table 1. Statistical analysis of the different growth parameters.

T	Means of the Different Growth Parameters					
	APH (cm) at 15 DAS	ASC (cm) at 15 DA	APH (cm) at 30 DAS	ASC (cm) at 30 DAS	A P H (cm) at	ASC (cm) at 75D AS)
T_1	31.80^{a}	3.05^{a}	89.50^{a}	6.05	201. 26^{a}	8.32^{a}
T_2	26.33^{b}	2.62^{b}	88.02^{b}	5.78	197. 98^{b}	7.66^{b} c
T_3	27.29^{b}	2.64^{b}	87.77^{b}	5.81	197. 83^{b}	7.78^{b}
T_4	30.50^{a}	3.02^{a}	88.04^{b}	6.01	198. 02^{b}	7.83^{b}
T_0	19.73^{c}	2.05^{c}	85.70^{c}	5.58	196. 21^{c}	7.43^{c}
p-v	0.000 0**	0.00 00**	0.001 7**	0.068 8ns	0.00 00**	0.00 00**
CV %	6.23	5.68	1.06	3.81	0.42 17	1.93

Legend: T- Treatments, APH- Average Plant Height,
ASC- Average Stalk Circumference.
Means with the same letter are not significantly Different: ns- Not Significant, **- Highly Significant

The results of the analysis of variance (ANOVA) indicate that the growth parameters measured at earlier stages—namely, average plant height and stalk circumference at 15 days after sowing (DAS), as well as stalk circumference at 75 DAS— exhibited statistically significant differences among the treatment groups, as reflected by p-values less than 0.01. This suggests that the applied treatments had a measurable impact on early plant develop- ment and stem girth at maturity. Conversely, the p-value for plant height at 75 DAS was 0.421, indicating no statistically significant difference among treatments for this parameter at the final stage of observation. Similarly, plant height at 30 DAS presented a p- value of 0.068, which is above the conventional threshold for ($p > 0.05$), suggesting a lack of treatment effect at this intermediate growth point.

The post hoc comparisons, denoted by super- script letters accompanying the mean values, eluci- date the specific differences among treatment groups for the growth parameters with significant ANOVA results. Treatments labeled with different letters are significantly distinct from each other. For instance, at 15 DAS, T1 and T4 both received the letter ―a‖ for plant height, signifying they are statistically similar yet distinct from T2, T3 (―b‖), and T0 (―c‖). A similar pattern is observed in stalk circumference at 15 DAS, where T1 and T4 again outperform other treatments. These distinctions reveal that T1 and T4 consistently promote superior early growth, particularly in height and stem girth, whereas the control group (T0) consistently shows the lowest performance, indicating the efficacy of the applied treatments during the initial phases of plant development.

Treatments	Means of the Different Yield Parameters		
	Corn Ear Weight in grams	Corn Ear Length in cm	Corn Ear Circ. in cm
T1	593.06^{a}	29.25^{ab}	21.86
T2	490.62^{b}	28.25^{ab}	21.35
T3	490.62^{b}	27.39^{b}	21.60
T4	439.59^{bc}	31.00^{a}	21.40
T0	415.97^{c}	23.81^{c}	21.31
p-value	0.003**	0.0066 **	0.59^{ns}
CV (%)	7.80	7.77	2.6

Table 2. Statistical analysis of the different yield parameters

Means with the same letter are not significantly different: ns- Not Significant, **- Highly Significant

The analysis of variance (ANOVA) revealed statistically significant differences among the treatment groups for corn ear weight and corn ear length, with p-values of 0.003 and 0.0066, respectively. These values fall below the 0.05 significance threshold, indicating that the treatments had a substantial impact on these yield components. In contrast, corn ear circumference showed no significant variation among treatments, as denoted by a p value of 0.59, suggesting uniformity in this parameter regardless of treatment.

Post hoc comparisons, as reflected in the superscript groupings, provide insight into specific treatment differences. For corn ear weight, Treatment 1 (T1) achieved the highest yield and was significantly different from all other treatments. Treatments 2 (T2) and 3 (T3) were statistically similar but still superior to Treatment 4 (T4) and the control (T0), which recorded the lowest values. In terms of corn ear length, T1 and T4 shared statistical similarity and surpassed T0 significantly. T2 and T3 formed a mid-tier group with no significant differences from each other but remained distinct from T0. No grouping annotations for corn ear circumference corroborate the ANOVA result indicating non-significance among treatments.

The study demonstrated that intercropping jicama (*Pachyrhizus erosus*) between rows of sweet corn significantly enhanced vegetative growth and yield performance, particularly under Treatment 1. This configuration consistently outperformed other setups, showing marked improvements in plant height, stalk circumference, and key yield traits such as ear weight and length, across multiple growth stages. Although ear circumference remained unaffected, the overall agronomic benefits of this intercropping arrangement were evident.

These findings affirm the potential of **Treatment 1** as an effective intercropping strategy, particularly within similar agroecological settings. The superior performance observed is likely due to reduced competition for resources and improved spatial configuration, allowing for efficient light interception, water use, and nutrient uptake.

Importantly, these results contrast with earlier work by **Rodillas (2003),** which reported negligible effects of legume intercropping on corn yield. The divergence suggests that **species selection and spatial arrangement**—as also emphasized by **Santos et al. (2020)—**are crucial factors in determining the success of intercropping systems. The compatibility of root architectures and synchronized nutrient demands between sweet corn and jicama may explain the synergistic outcomes observed in this study.

Recent literature supports these findings. **Kumar et al. (2021)** demonstrated that intercropping maize with nitrogen-fixing legumes such as cowpea and soybean enhanced early vegetative growth and grain yield due to improved nitrogen availability and resource-use efficiency. Similarly, **Amoah et al. (2022)** reported increased maize ear length and weight under legume intercropping, attributing gains to biological nitrogen fixation and better microclimatic conditions. The early vegetative improvements noted in this study—such as plant height at 15 DAS and stalk circumference—are also consistent with the work of **Chen and Zhang (2023),** who attributed similar outcomes to synergistic root interactions in tropical legume-maize intercropping.

Despite its underrepresentation in legume research, **jicama** emerges here as a viable intercrop. Its nitrogen-fixing capacity is particularly valuable in low-input systems. **Velasco and Ramirez**

(2022), in their evaluation of underutilized legumes in tropical agriculture, highlighted jicama's role in enhancing soil fertility and reducing synthetic fertilizer dependency.

In light of these findings, it is **strongly recommended** that **Treatment 1—intercropping jicama between sweet corn rows—be adopted** to optimize crop productivity and promote sustainable agriculture. Beyond yield improvements, this practice contributes to broader sustainability goals. As noted by the **FAO (2023),** intercropping strategies are increasingly recognized for their role in climate-resilient farming. By boosting productivity, enhancing resource use efficiency, and supporting soil health, this approach aligns with multiple **Sustainable Development Goals (SDGs),** particularly those related to food security, ecological stewardship, and climate adaptation.

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