Agricultural Development
Vol. 10, No. 4, 57-64, 2025
ISSN(E) 2576-683X
DOI: 10.55220/25766740.v10i4.384

Exploring the Potential of Novoecijanotake (*Collybia Reinakeana*) Cultivation Alongside Lettuce (*Lactuca Sativa*)

Kyssha C. Formento[1]
Daneala Jozel B. Milla[2]
Justine Bea A. Montiero[3]
Lovely A. Suaze[4]
Leilidyn Y. Zurbano[5]

[1,2,3,4,5]*Agribusiness Management Department Polytechnic University of the Philippine, Lopez, Quezon, Philippines, 4316.*
Email: kysshaa@gmail.com
Email: milladanealajozel@gmail.com
Email: montierojustinebea@gmail.com
Email: lovisuaze0212@gmail.com
(✉ Corresponding Author)

Abstract

Novoecijanotake is an edible mushroom with nutritional and medicinal benefits, while lettuce is a widely consumed leafy vegetable. The research aimed to determine the effects of intercropping these two crops on growth, yield, soil fertility, and economic viability. A field experiment was conducted in Barangay Biga, Gumaca, Quezon, from March 2024 to January 2025, using a Randomized Complete Block Design (RCBD) with three treatments: intercropping lettuce and Novoecijanotake, lettuce alone, and Novoecijanotake alone. Growth parameters, yield, soil conditions, and return on investment were measured. Results showed that lettuce grown alone had the highest yield and better growth compared to intercropping, where competition for resources limited lettuce growth. Mushroom growth was similar in both intercropping with lettuce and Novoecijanotake and Novoecijanotake alone, indicating that intercropping did not significantly benefit mushroom development. The economic analysis revealed that monocropping lettuce had the highest ROI (425%), while intercropping had a lower profit margin (50%). Overall, the study concluded that intercropping lettuce with Novoecijanotake is not ideal due to their differing growth requirements and competition for essential resources, while the mushrooms contributed to nutrient cycling. Future studies are recommended to explore other mushroom species or optimize intercropping techniques to improve compatibility and productivity.

Keywords: Crop yield, Soil fertility, Intercropping, Lettuce (*Lactuca sativa*), Mushroom cultivation, Novoecijanotake (*Collybia reinakeana*), Nutrient cycling, Sustainable farming.

1. Introduction

Collybia reinakeana was a widely found and edible mushroom. It thrives as a saprophyte, breaking down organic matter. Its distinct characteristic was its large fruiting bodies, which consist of long stalks supporting broad caps. This unusual size has captured the attention of many Filipinos. As a tropical species, it thrives in decomposing leaf litter, particularly in piles of bamboo leaves, rain tree leaves, or rice straw. Its natural growth period runs from September to February, coinciding with sporadic rainfall during this time. This mushroom was widely found in the Philippines and had not been reported anywhere else. It had been observed in Leyte, Romblon, Southern Tagalog, Central Luzon, and Pangasinan. Its presence in various regions suggests that it was not limited to the previously reported areas of Laguna and Puncan, Carranglan in Nueva Ecija. In 1997, a study by Reyes and his team revealed the biological and physiological characteristics of the Puncan, Carranglan strain, leading to its successful cultivation. This mushroom was known for its nutritional and medicinal properties, making it a valuable nutraceutical.

The cultivation of Novoecijanotake alongside lettuce presents a novel exploration into sustainable agriculture and the potential synergies between edible mushroom cultivation and vegetable production. It holds promise not only as a nutritious food source but also for its potential antibacterial properties (Reyes et al., 2017). This research endeavors to delve into the symbiotic relationship between *C. reinakeana* and lettuce, aiming to elucidate how their co-cultivation might enhance nutrient uptake, soil health, and overall crop yield.

Understanding the environmental factors influencing the growth and nutrient content of lettuce was paramount in optimizing their cultivation alongside Novoecijanotake. The significant impact of soil type and light intensity on leaf nutrient levels in lettuce, underscoring the importance of soil management practices and light exposure in maximizing crop productivity. By integrating this knowledge with the cultivation requirements of *C. reinakeana*, this research aimed to design an integrated farming system that optimizes resources utilization and promotes ecological sustainability.

By combining the cultivation of Novoecijanotake mushrooms with lettuce, a mutually beneficial relationship was form, lettuce, with its fast growth creates an ideal environment for mushroom growth by providing shade and retaining moisture, which were crucial for the development of *C. reinakeana*. Additionally, the deep root system of lettuce helps in absorbing nutrients, enriching the soil with essential elements like nitrogen and phosphorus that are essential for the optimal growth of both crops. In return, *C. reinakeana* efficiently utilizes organic matter from lettuce residues, improving soil fertility and promoting nutrient cycling. Additionally, incorporating the cultivation of Novoecijanotake promotes biodiversity and ecological adaptability in agricultural systems. By considering the specific nutrient requirements of Novoecijanotake and lettuce, like nitrogen, phosphorus, and organic matter, this inter-cropping method helps them grow well and produce a good yield without wasting resources. In general, combining Novoecijanotake with lettuce in farming shows a lot of potential for being a sustainable and productive way to tackle the various issues that come with modern agriculture.

2. Materials and Methods

2.1. Research Design

This study was experimental research, in which field trials were involved to observe the growth and interaction of both species where novoecijanotake and lettuce are cultivated together.

2.2. Test Crop to be Used in the Study

Curly Green Lettuce Seeds was used from East West. A high- yielding crispy, delicious loose-leaf type lettuce variety that produces bright green, tender leaves in just 35-45 days after planting. The researcher used rice grain (palay) as mother spawn seed to inoculate *Collybia reinakeana*. A robust, saprothropic mushroom that produces small to medium sized, brown caps, smooth and dry surfaces and white to light tan gills that are free or slightly attached and was harvested in 4-5 months.

2.3. Treatments and Layout of the Experiment

This study was arranged in Randomized Complete Block Design with 3 treatments replicated 3 times. Treatment 1, which is an intercrop of lettuce and Novoecijanotake; Treatment 2, which is lettuce alone; and Treatment 3, which is Novoecijanotake alone.

2.4. Plot Preparation

The experimental area was consisting of 9 plots, each measuring 2 meters by 1 meter. These plots were carefully arranged to accommodate the different treatments and replications in a randomized manner, ensuring unbiased data collection. Within each plot, lettuce and novoecijanotake was planted according to the designated treatments, with varying ratios of novoecijanotake to lettuce. The layout allows for systematic observation of plant growth, yield, and nutritional content throughout the experiment.

2.5. Crop Planting

The study area was prepared by clearing the land and ensuring proper soil preparation. Then, seeds of lettuce were sown in rows with a spacing of 20 centimeters between plants. For the cultivation of novoecijanotake mushrooms, a substrate mixture consisting of sawdust and organic matter were prepared and inoculated with mushroom spawn. The prepared substrate then was placed and covered with a layer of soil. Both crops were regularly watered and monitored for growth progress throughout the study period. Data on growth parameters such as plant height, leaf development, and mushroom colonization was recorded at regular intervals to track the progress of the experiment.

2.6. Soil Analysis

The salinity of the soil before and after planting and the N, P, K, Moisture content and pH contents of each treatment sample were analyzed at Lipa Regional Soils Laboratory.

2.7. Cultural Management Practices

Installing physical barriers such as row covers or netting to protect crops from heavy rain and minimize water damage. Row covers could also serve as a barrier against flying pests like cabbage moths. Effective water management that includes proper irrigation to prevent both drought and waterlogging. Regular weeding to reduce competition for nutrients, while monitoring for pests and diseases ensures early detection and treatment and timely harvesting for optimal yield and quality of lettuce.

2.8. Data to be Gathered

2.8.1. Growth

In terms of growth of lettuce and novoecijanotake requires a method according to their distinct traits of each species. Data was measured various parameters using a ruler. For lettuce, measurements such as plant height and leaf area were recorded at regular intervals. Additionally, the number of leaves per plant was counted. For mushrooms, measurements will include cap diameter and stem length of the mushroom. These measurements would provide valuable insights into the growth and development of each crop.

2.9. Yield

Lettuce and novoecijanotake was harvested at maturity, weigh the harvested lettuce from each plot separately, and calculate the yield per plot in kilograms or another suitable unit. Lettuce typically matures around 35-45 days after planting and novoecijanotake about 120-160 days. Since lettuce have a shorter growing period compared to novoecijanotake, they may be ready for harvest earlier. However, while they can be grown together, their different maturity times mean they may not reach full harvest simultaneously. This difference in growing periods should be considered to plan for staggered harvesting or separate planting areas.

2.10. Economic Analysis

To assess the economic feasibility of intercropping novoecijanotake alongside lettuce by recording all expenses incurred during the experiment and calculating the total revenue generated from the harvested crops based on market prices.

2.11. Statistical Analysis

The data gathered from this research were analyzed and interpreted using Analysis of Variance (ANOVA) tests that can revealed significant differences in growth rates and yields among different treatment groups, highlighting the influence of cultivation methods and environmental factors on crop performance.

3. Results and Discussions

3.1. Effects of Novoecijanotake Cultivation Alongside Lettuce on the Ph, Levels Of N, P, K, and Moisture Content in the Soil

Soil fertility is a critical factor in crop production, as it determines the availability of essential nutrients such as nitrogen (N), phosphorus (P), and potassium (K), along with moisture content, which influences plant growth and productivity. Nitrogen is vital for leafy growth and chlorophyll production, phosphorus supports root development and energy transfer, while potassium enhances plant resilience against diseases and environmental stress (Brady & Weil, 2016). Soil pH also plays a crucial role in nutrient availability, as it affects microbial activity and nutrient solubility. Additionally, moisture content is essential for nutrient dissolution and absorption by plant roots (Schmidt et al., 2017). This study evaluates the changes in soil pH, nitrogen, phosphorus, potassium, and moisture content before and after planting under different treatments: T1 (intercropping of lettuce and Novoecijanotake mushroom), T2 (lettuce only), and T3 (Novoecijanotake mushroom only).

Table 1. Soil Test Data of pH, N, P, K and Moisture Content Before and After Planting.

Treatment	pH		%N (OM)		P (ppm)		K (ppm)		Moisture Content	
	Before	After	Before	After	Before	After	Before	After	Before	After
T1 (intercrop of lettuce and novoecijanotake)	5.24	5.55	5.24%	5.35%	127.14 ppm	136.33 ppm	1127.09 ppm	1153.53 ppm	13.23%	14.03%
T2 (lettuce)	5.43	6.12	5.06%	5.54%	93.91 ppm	96.76 ppm	860.75 ppm	956.02 ppm	12.91%	135.82
T3 (novoecijanotake)	6.36	6.39	5.10%	5.69%	113.55 ppm	84.33 ppm	1010.48 ppm	969.76 ppm	13.09%	12.48%

Note: *Denotes significant difference at $p < 0.05$.

The results of the soil test before and after planting show variations in soil pH, nitrogen, phosphorus, potassium, and moisture content across the three treatments. The intercropping of lettuce and novoecijanotake (T1) resulted in an increase in soil pH from 5.24 to 5.55, nitrogen content from 5.24% to 5.35%, phosphorus from 127.14 ppm to 136.33 ppm, potassium from 1127.09 ppm to 1153.53 ppm, and moisture content from 13.23% to 14.03%. Similarly, lettuce monocropping (T2) exhibited an increase in pH (5.43 to 6.12), nitrogen (5.06% to 5.54%), phosphorus (93.91 ppm to 96.76 ppm), potassium (860.75 ppm to 956.02 ppm), and moisture content (12.91% to 135.82%). However, mushroom monocropping (T3) resulted in minimal pH change (6.36 to 6.39), a nitrogen increase from 5.10% to 5.69%, a decline in phosphorus from 113.55 ppm to 84.33 ppm, potassium from 1010.48 ppm to 969.76 ppm, and a reduction in moisture content from 13.09% to 12.48%.

The increase in nitrogen content across all treatments suggests microbial activity and organic matter decomposition contributed to nitrogen availability. The intercropped system (T1) exhibited a notable increase in phosphorus and potassium, which may be attributed to the synergistic effect of lettuce and mushrooms in nutrient cycling. The reduction in phosphorus and potassium in the mushroom monocrop (T3) could be due to nutrient absorption by the fungal mycelium without sufficient replenishment. Moisture content increased in T1, indicating that the intercropping system may have enhanced soil water retention, while the decline in T3 suggests that mushrooms alone may not contribute significantly to soil moisture conservation.

Intercropping practices have been widely studied for their potential benefits in resource utilization and soil fertility management. According to Sharma and Jha (2020), intercropping leafy vegetables with fungi can enhance soil microbial activity but may lead to soil nutrient depletion if not properly managed. Similarly, Zhang et al. (2018) reported that mushroom cultivation significantly alters soil pH and moisture levels, which can negatively impact the growth of other crops like lettuce. Furthermore, a study by Lee et al. (2021) highlighted that excessive moisture in mushroom cultivation may lead to root rot and poor lettuce establishment in intercropping systems.

3.2. Effect of intercropping on Soil Salinity

Soil salinity is a major concern in agricultural production as excessive salt levels can negatively impact plant growth, nutrient uptake, and soil health. Electrical conductivity (EC) is a key indicator of soil salinity, with higher values indicating greater salinity levels. Various agricultural practices, including intercropping, can influence soil salinity by affecting water and nutrient cycles. In this study, the effect of intercropping lettuce (*Lactuca sativa*) with Novoecijanotake on soil salinity was assessed, comparing it with monoculture systems of lettuce and mushroom cultivation.

Table 2. Salinity Before and After Planting.

Treatment	E.C (dS/m)		Degree of Salinity	
	Before	After	Before	After
T1 (intercrop of lettuce and novoecijanotake)	2.85 dS/m	0.61 dS/m	Low Salinity Soil	Non-Saline Soil
T2 (lettuce)	1.25 dS/m	0.20 dS/m	Non-Saline Soil	Non-Saline Soil
T3 (novoecijanotake)	1.31 dS/m	0.50 dS/m	Non-Saline Soil	Non-Saline Soil

Note: Legend: 0-2 non-saline; 2.0-4.0- low salinity; 4.0-8.0 moderate saline; 8.0-16.0 high saline; 16.0-32.0 severe.
*Denotes significant difference at $p < 0.05$.

The data presented in Table 2 highlight the changes in soil salinity before and after planting under different treatments: T1 (intercropping of lettuce and Novoecijanotake mushroom), T2 (lettuce only), and T3 (Novoecijanotake mushroom only). Before planting, T1 exhibited the highest electrical conductivity (E.C) at 2.85 dS/m, indicating low salinity soil, whereas T2 and T3 recorded lower initial E.C values of 1.25 dS/m and 1.31 dS/m, respectively, both classified as non-saline. After planting, all treatments showed a reduction in salinity levels. T1 had the most significant decrease, reducing its E.C to 0.61 dS/m, shifting from low salinity to non-saline soil. Similarly, T2 and T3 also demonstrated reductions to 0.20 dS/m and 0.50 dS/m, respectively, both remaining within the non-saline classification. The significant reduction in soil salinity in T1 suggests that intercropping lettuce with mushrooms can contribute to improving soil conditions more effectively than monoculture systems.

The reduction in soil salinity observed in this study is consistent with findings from previous research. Intercropping has been reported to improve soil properties by enhancing microbial activity and increasing organic matter content (Wang et al., 2020). Additionally, lettuce is known to uptake salts from the soil, reducing overall salinity levels (Almutairi et al., 2019). Mushrooms, on the other hand, contribute to soil conditioning by decomposing organic substrates and releasing beneficial compounds that enhance soil fertility (Akinbile et al., 2022). While both crops contribute to soil improvement, their distinct growth requirements make their simultaneous cultivation impractical.

3.3. Height of Lettuce (In Cm)

Lettuce is one of the most popular leafy vegetables due to its high nutritional value and economic potential. Its growth is influenced by environmental factors, cultivation practices, and intercropping systems. The data presented shows the height of lettuce over five weeks under three treatments: T1 (intercropping of mushroom and lettuce), T2 (lettuce only), and T3 (mushroom only). The weight of lettuce can be directly related to its height, as taller plants typically indicate better growth and development.

Table 3. Height of lettuce (in cm).

Treatment	Week 1	Week 2	Week 3	Week 4	Week 5
T1 (intercrop of lettuce and novoecijanotake)	4.43	10.52	15.58	18.57	20.50
T2 (lettuce)	7.63	14.70	21.37	25.60	27.50
T3 (novoecijanotake)	0	0	0	0	0
CV%	19.38	2.19	2.46	1.32	1.80

The results reveal that T2, where lettuce is grown alone, exhibited the highest growth rate, reaching a height of 27.50 cm by Week 5. T1 the intercropping system with mushrooms, showed a slower growth rate, reaching 20.50 cm by the same period. In contrast, T3, which focused solely on mushrooms, showed no growth in lettuce, as lettuce was not planted. The coefficient of variation (CV%) remained relatively low, indicating consistent growth trends among replicates. The reduced growth in T1 may be attributed to competition for light, nutrients, and space between lettuce and mushrooms in the intercropping system.

According to Thompson et al. (2020), intercropping systems can impact plant growth due to competition and resource allocation. However, intercropping also offers benefits such as improved land use efficiency and diversification of income sources. The lower height of lettuce in T1 may reflect the initial trade-off in growth, but this system could be advantageous for farmers aiming to cultivate mushrooms and lettuce together. Further studies could optimize the arrangement and spacing to minimize competition and maximize the benefits of intercropping.

3.4. Leaf Area of Lettuce

Leaf area is a critical physiological parameter in lettuce growth as it directly influences photosynthetic capacity, plant development, and yield potential. Understanding how different treatments affect leaf area can provide insights into optimizing growth conditions and intercropping practices.

Table 4. Leaf Area of Lettuce (in cm^2).

Treatment	Week 1	Week 2	Week 3	Week 4	Week 5
T1 (intercrop of lettuce and novoecijanotake)	3.53	7.10	14.53	27.67	52.65
T2 (lettuce)	3.51	7.77	14.16	28.85	52.91
T3 (novoecijanotake)	0	0	0	0	0
CV%	22.75	18.27	19.97	28.30	17.09

The data reveals a clear trend of increasing leaf area for both T1 (intercropping of mushroom and lettuce) and T2 (lettuce) across five weeks, with T2 showing slightly higher leaf area measurements than T1. By week 5, the leaf area for T1 reached 52.65 cm^2, while T2 slightly surpassed it at 52.91 cm^2. Treatment T3 (mushroom) shows no leaf area growth, as expected. The coefficient of variation (CV%) indicates moderate variability across weeks, with the highest variation observed in week 4 (28.30%). This variability could be influenced by environmental factors or interspecies competition.

The slightly reduced leaf area in T1 compared to T2 suggests that intercropping lettuce with mushrooms might induce some degree of competition for resources like light, water, or nutrients. However, intercropping systems can offer other benefits, such as improved land-use efficiency and enhanced microclimatic conditions.

According to Dagnachew et al. (2021), intercropping systems can increase overall productivity by optimizing resource use and reducing pest pressure, even if minor trade-offs in individual crop growth occur. This aligns with the current findings, as T1 demonstrates comparable leaf area growth to T2 while also supporting mushroom cultivation.

3.5. Number of Leaves in Lettuce

The number of leaves in lettuce is a key indicator of vegetative growth and overall plant vigor, as it reflects the plant's ability to perform photosynthesis and accumulate biomass. Studying how intercropping systems affect leaf production provides valuable insights into the compatibility and resource-sharing dynamics between different crops.

Table 5. Number of leaves.

Treatment	Week 1	Week 2	Week 3	Week 4	Week 5
T1(intercrop of lettuce and novoecijanotake)	2.33	3.67	5.33	6.67	8.64
T2 (lettuce)	2.67	4.67	7.00	8.67	10.40
T3 (novoecijanotake)	0	0	0	0	0
CV%	32.66	44.90	36.86	31.95	29.38

The data shows an increasing trend in the number of leaves for both T1 (intercropping of mushroom and lettuce) and T2 (lettuce-only) across the five weeks. By week 5, T1 recorded an average of 8.64 leaves per plant, slightly lower than T2, which had 10.40 leaves. Treatment T3 (mushroom-only) showed no leaf development, as expected. The coefficient of variation (CV%) indicates high variability, particularly in the early weeks (32.66% in week 1 and 44.90% in week 2), which gradually stabilized over time. This variability may be attributed to initial competition for resources in T1 or varying environmental conditions.

The lower leaf number in T1 compared to T2 suggests that intercropping with mushrooms might slightly hinder leaf development due to competition for light, nutrients, or space. However, intercropping offers additional benefits, such as improved microclimate and efficient use of land resources. For instance, studies by Pannacci and Bartolini (2016) highlight that intercropping systems can enhance biodiversity and resource-use efficiency, even if minor reductions in individual crop performance are observed. These findings align with the current results, demonstrating that lettuce growth in an intercropping system remains competitive while providing the added advantage of mushroom production.

3.6. Cap Diameter of Novoecijanotake

The growth of lettuce is influenced by various factors such as nutrients, water, and environmental conditions. In an intercropping system, competition for these resources may affect the growth and yield of the crops involved. Intercropping mushrooms with lettuce is an innovative approach that aims to maximize space and resources. However, the compatibility of these two crops needs to be assessed to determine if they can thrive together. This study evaluates the cap diameter of Novoecijanotake mushrooms in different treatments, with T1 representing intercropping of mushrooms and lettuce, T2 as lettuce only, and T3 as mushrooms only.

Based on the data, the cap diameter of Novoecijanotake mushrooms remained at 0 cm from Week 2 to Week 10 in all treatments, indicating no growth during this period. Growth was first observed at Week 12 in T1 (0.25 cm) and T3 (0.17 cm), while no growth was recorded in T2, as expected since it only contained lettuce. At Week 14 and Week 16, the cap diameter continued to increase in T1 and T3, with T1 reaching 0.40 cm and T3 reaching 0.36 cm by the final week. The coefficient of variation (CV%) ranged from 23 to 29.59 during the weeks when growth was recorded, indicating variability in the mushroom's response to the treatments.

Table 6. Cap Diameter of Novoecijanotake (in cm).

Treatment	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12	Week 14	Week 16
T1(intercrop of lettuce and novoecijanotake)	0	0	0	0	0	0.25	0.32	0.40
T2 (lettuce)	0	0	0	0	0	0	0	0
T3 (novoecijanotake)	0	0	0	0	0	0.17	0.26	0.36
CV%	0	0	0	0	0	29.59	23	29.49

The results suggest that the intercropping of mushrooms and lettuce (T1) did not significantly hinder mushroom growth, but it also did not show significant improvement compared to the sole mushroom cultivation (T3). On the other hand, the complete absence of mushroom growth in T2 confirms that lettuce alone does not support fungal development. This indicates that the simultaneous cultivation of lettuce and mushrooms may not be ideal, as lettuce requires sunlight and regular watering, while mushrooms thrive in dark, humid conditions with minimal disturbance.

According to Chang and Miles (2004), mushrooms require a controlled environment with high humidity and minimal competition from other plants to ensure proper fruiting body development. The findings indicate that intercropping lettuce with mushrooms not only allows both crops to grow but may also create a favorable microclimate for mushroom development. This supports the findings of Suárez-Quezada et al. (2020), who highlighted that intercropping systems could benefit mushroom growth by improving environmental conditions and resource utilization. Thus, intercropping mushrooms and lettuce offers a sustainable approach to maximizing land productivity and fostering complementary growth dynamics. The presence of lettuce in an intercropping system may alter these factors, making it difficult for mushrooms to develop properly. Therefore, based on the findings and supported literature, the cultivation of lettuce and mushrooms together in an intercropping system is not feasible due to their differing growth requirements and environmental needs.

3.7. Stem Length of Novoecijanotake

The intercropping of Novoecijanotake mushrooms and lettuce shows promising results, with both crops potentially benefiting from the system. This sustainable farming practice maximizes land use while supporting the growth and development of mushrooms, particularly in environments conducive to both crops. Further research is encouraged to explore the yield and quality of lettuce in this intercropping system, as well as its economic viability for small-scale farmers.

Table 7. Stem Length of Novoecijanotake (in cm).

Treatment	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12	Week 14	Week 16
T1(intercrop of lettuce and novoecijanotake)	0	0	0	0	0	0.28	0.36	0.44
T2 (lettuce)	0	0	0	0	0	0	0	0
T3 (novoecijanotake)	0	0	0	0	0	0.19	0.30	0.39
CV%	0	0	0	0	0	28.41	21.51	25.55

Based on the data presented in Table 7, the stem length of Novoecijanotake showed variations across different treatments over the 16-week period. In Treatment 1 (intercropping of mushroom and lettuce), no growth was recorded until Week 12, where a slight increase in stem length was observed at 0.28 cm, which further increased to 0.36 cm at Week 14 and 0.44 cm at Week 16. In Treatment 2 (lettuce only), no mushroom growth was observed throughout the experiment. Similarly, in Treatment 3 (mushroom only), no stem length was recorded until Week 12 (0.19 cm), which later increased to 0.30 cm at Week 14 and 0.39 cm at Week 16. The coefficient of variation (CV%) ranged from 21.51% to 28.41% in the last weeks, indicating variability in mushroom growth.

These findings suggest that the intercropping of mushroom and lettuce is not feasible. The absence of mushroom stem growth in the earlier weeks and the minimal growth recorded in later weeks indicate that the presence of lettuce may have negatively affected the mushroom's development. Novoecijanotake thrives in organic-rich substrates, whereas lettuce grows best in nutrient-rich soil with readily available nitrogen, phosphorus, and potassium. The mushroom also needs nitrogen in moderate amounts and essential minerals such as phosphorus, potassium, calcium, and magnesium support its growth and fruiting. Proper moisture levels around 60–70%, water content is also crucial for mycelial colonization and fruiting body development. Unlike plants like lettuce, which absorb nutrients directly from soil, Novoecijanotake relies on breaking down organic matter to access the nutrients needed for growth. Additionally, Novoecijanotake requires a shaded or low-light environment to develop properly, while lettuce needs sufficient light for photosynthesis. Space is another factor—lettuce roots spread out in soil or nutrient solutions, while mushrooms grow compactly but need airflow to prevent contamination. The stark contrast in their growth conditions likely contributed to the unsuccessful intercropping system.

3.8. Weight of Lettuce Yield

Lettuce yield is an essential parameter in evaluating the productivity and efficiency of agricultural systems, particularly in innovative setups like intercropping. In this study, the weight of lettuce yield varied significantly across treatments.

Lettuce under different treatments exhibited significant variation in yield, as shown in the data. Treatment 1, which involved the intercropping of lettuce with mushrooms, resulted in a yield of 8.96 grams, while Treatment 2, where lettuce was cultivated alone, produced a higher yield of 16.80 grams. On the other hand, Treatment 3 (T3), where only mushrooms were grown, showed no lettuce yield. The CV at 16.56% indicates a moderate level of variability among the treatments.

Table 8. Weight of Lettuce Yield (in grams).

Treatment	Yield
T1(intercrop of lettuce and novoecijanotake)	8.96
T2 (lettuce)	16.80
T3 (novoecijanotake)	0
CV (%)	16.56

Note: *Means with the same letter are not significantly different.

The data intercropping mushrooms with lettuce (T1) reduced the lettuce yield compared to lettuce alone (T2). This could be attributed to competition for essential resources such as light, nutrients, and space, as both crops have distinct growth requirements. However, intercropping are often implemented to maximize land productivity and provide multiple outputs, even if individual crop yields are reduced.

According to Kumar et al. (2021) found that intercropping leafy vegetables with mushrooms can lead to resource competition but offers benefits like improved land use efficiency and economic returns. Similarly, intercropping (e.g., Ramírez et al., 2019) highlight that while competition can impact the growth of one crop, the combined economic return and efficient use of land often justify the approach. Further research and management practices, such as adjusting plant densities or substrate composition, could enhance the compatibility and yields of intercropping.

3.9. Return on Investment of Intercropping Novoecijanotake Alongside Lettuce

Lettuce (Lactuca sativa) is a high-value leafy vegetable popular for its crisp texture and nutritious content. Its growth can be influenced by various factors, including soil salinity, which affects plant weight and overall yield. Intercropping, or growing two crops together, is a common agricultural practice aimed at optimizing land use and increasing profitability. In this study, three treatments were compared: Treatment 1 (intercropping of mushroom and lettuce), Treatment 2 (lettuce only), and Treatment 3 (mushroom only), in terms of cost, yield, and profitability.

Table 9. Return on Investment of Intercropping Novoecijanotake alongside Lettuce.

Cost of Materials	Treatment 1 (intercrop of mushroom and lettuce)	Treatment 2 (lettuce)	Treatment 3 (mushroom)
Cost to Produce:			
Lettuce seed	100	100	0
Spawn	150	0	150
Sawdust	0	0	0
Labor Cost			
Soil	0	0	0
Total Expenses	250	100	150
Total Harvest (pc)	15	21	0
Income (P25/pc)	375	525	0
Profit	125	425	-150
ROI%	50%	425%	0

Based on the data, Treatment 1 incurred a total expense of ₱250, producing a harvest of 15 lettuce heads. With an income of ₱375 (₱25 per piece), this treatment resulted in a profit of ₱125 and a return on investment (ROI) of 50%. Treatment 2, which involved growing lettuce only, showed the highest profitability. With a cost of ₱100 and a yield of 21 lettuce heads, this treatment generated an income of ₱525, yielding a profit of ₱425 and an ROI of 425%. On the other hand, Treatment 3, which focused solely on mushroom production, incurred ₱150 in expenses but did not yield any income, resulting in a loss of ₱150 and an ROI of 0%.

These findings highlight the economic advantages of monocropping lettuce under saline soil conditions compared to intercropping with mushrooms. The lower ROI in Treatment 1 may be attributed to competition for resources like water, nutrients, and light between lettuce and mushrooms. Meanwhile, the absence of yield in Treatment 3 could be due to unfavorable conditions for mushroom growth in saline soils, as high salinity levels can inhibit mycelial growth and fruiting body development. According to Singh et al. (2019), intercropping can maximize land use efficiency, but its success heavily depends on the compatibility of the crops involved. Similarly, studies by Chakraborty et al. (2020) emphasize that salinity-sensitive crops, such as mushrooms, require specific growing conditions to thrive.

4. Conclusions and Recommendations

4.1. Conclusion

This study tested whether Novoecijanotake and lettuce could grow well together, but the results showed that they weren't the best match. While the lettuce grew fine, the mushroom struggled due to competition for nutrients and space. Intercropping did improve soil moisture and nitrogen levels, but it didn't boost overall productivity. From a financial perspective, growing lettuce alone was the most profitable, while the mushrooms didn't generate Future research could explore different mushroom varieties or better farming techniques to make intercropping more effective and sustainable, enough yield to be economically viable. This shows that while intercropping has potential, it's important to find the right crop combination. Future research could explore different mushroom varieties or better farming techniques to make intercropping more effective and sustainable.

4.2. Recommendation

It is recommended to grow lettuce alone for higher yield. Further studies can be explored using other mushroom varieties that might be more suitable for intercropping with lettuce, as not all mushrooms may thrive in this system. Adjustments in spacing, nutrients, and environmental conditions may also help improve the performance of both crops in an intercropping system.

References

Alam, M., et al. (2022). Benefits of intercropping mushrooms and leafy vegetables. Journal of Sustainable Agriculture, 14(3), 45–53. https://www.researchgate.net/publication/330237996

Akinbile, C. O., et al. (2022). Soil conditioning properties of mushroom cultivation: A sustainable agricultural practice. Agriculture and Environment Journal, 35(2), 87–102. https://www.mdpi.com/2071-1050/12/9/3853

Almutairi, K. A., et al. (2019). Salt uptake efficiency of lettuce (Lactuca sativa) under different salinity levels. Journal of Soil Science and Plant Nutrition, 19(3), 450–463. (Publisher not available – access may be restricted)

Andermeer, J. (1989). The ecology of intercropping. Cambridge, UK: Cambridge University Press. https://www.cambridge.org/core/books/ecology-of-intercropping

Dagnachew, L., Alemayehu, G., & Tesfaye, B. (2021). Intercropping systems and their role in sustainable agriculture: A review. Journal of Agricultural Science and Technology. https://sciencejournals.stmjournals.in/index.php/RRJoAST/index

Fernando, M., et al. (2021). Synergistic effects of intercropping systems on crop productivity. International Journal of Agricultural Research, 18(2), 87–102. https://scispace.com/journals/international-journal-of-agricultural-research-128pludu

Hasanuzzaman, M., et al. (2021). Salinity stress in plants: Mechanisms of adaptation and alleviation strategies. Physiologia Plantarum, 173(1), 1–19. https://onlinelibrary.wiley.com/toc/13993054/2021/173/1

Lee, M., Park, S., & Kim, J. (2021). Soil moisture and pH alterations in intercropping systems involving fungi and leafy vegetables. International Journal of Agricultural Sciences, 47(3), 341–356. https://www.researchgate.net/publication/375099030

Li, F., & Li, S. (2019). Microenvironmental changes in intercropping systems and their impact on mushroom growth. Agronomy and Horticulture Journal. https://www.intechopen.com/series-topic/104

Pannacci, E., & Bartolini, S. (2016). Intercropping systems to improve crop productivity and resource use efficiency: A review. European Journal of Agronomy. https://www.journals.elsevier.com/european-journal-of-agronomy

Ramírez, C., Morales, G., & Ríos, S. (2019). Intercropping systems: Productivity and sustainability of mixed crops. Agricultural Systems Journal. https://www.nature.com/articles/s41598-023-45454-z

Royse, D. J., et al. (2017). Mushroom cultivation: Trends and challenges. Horticultural Reviews, 44, 53–112. https://www.pubhort.org/hr.htm

Li, L., Sun, J., Zhang, F., & Guo, T. (2007). Intercropping helps to improve resource use efficiency and crop productivity. Field Crops Research. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/intercropping

Sharma, R., & Jha, P. (2020). Effects of intercropping on soil fertility and crop yield. Agricultural Research Journal, 35(2), 102–115. https://arccjournals.com/journal/agricultural-reviews/R-2709

Stützel, H. (1995). A model for predicting the leaf area development of lettuce (Lactuca sativa L.). European Journal of Agronomy. https://pmc.ncbi.nlm.nih.gov/articles/PMC4242352/

Suárez-Quezada, J., Ortega, R., & Martínez, E. (2020). Enhancing mushroom cultivation through intercropping systems: A review. Journal of Sustainable Agriculture. https://www.researchgate.net/publication/372935196

Thompson, J., Smith, A., & Lewis, B. (2020). Intercropping systems and their effects on vegetable growth and yield. Journal of Sustainable Agriculture, 12(3), 45–52. https://www.researchgate.net/publication/358695878

Wang, X., et al. (2020). Intercropping systems and their effect on soil microbial communities. Agronomy Journal, 112(5), 2873–2891. https://pmc.ncbi.nlm.nih.gov/articles/PMC9846038/

Zhang, Y., Li, W., & Chen, X. (2018). Influence of mushroom cultivation on soil properties: A case study. Journal of Mycology and Soil Science, 12(4), 220–233. https://www.researchgate.net/publication/373688954