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Comparison of Corn Seed Variety in Organic and Conventional Farming using Association and Classification Algorithms

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Abstract: This study investigates the performance of various corn seed varieties in organic and conventional farming systems. It compares key parameters such as yield, plant height, cob size, and other relevant traits across both systems. Advanced data mining techniques, including association rule mining and classification algorithms like Decision Trees and Support Vector Machines, will be utilized to identify critical factors affecting corn performance. The study aims to develop predictive models based on these factors to enhance understanding and decision-making in agriculture. The findings will offer valuable insights into the comparative benefits of organic versus conventional farming for corn production. Additionally, the research will guide farmers and stakeholders in selecting suitable seed varieties for specific farming methods. By identifying the strengths and weaknesses of each system, the study contributes to the broader goal of promoting sustainable and efficient agricultural practices. The results will be especially useful in addressing the growing demand for sustainable food production while maintaining high yields. Overall, this research aims to bridge gaps in knowledge and support the development of farming strategies that balance productivity with environmental stewardship.

Keywords: Corn, seed variety, organic farming, conventional farming, yield, classification algorithms, sustainable agriculture.

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Introduction

➢ Background:

Corn (*Zea mays*) is a globally important staple crop, providing essential nutrition and serving as a key ingredient in food products and animal feed. It also plays a significant role in biofuel and industrial production. As the world faces increasing population growth and environmental challenges, sustainable agricultural practices like organic farming are gaining prominence. Organic farming focuses on minimizing synthetic chemical use and enhancing soil health, contributing to environmental protection and human health.

This research, titled "Comparison of Corn Seed Variety in Organic and Conventional Farming using Association and Classification Algorithms," aims to evaluate the performance of different corn seed varieties in organic and conventional farming systems. By applying data mining techniques, such as association rule mining and classification algorithms, the study will identify factors that influence corn yield and quality under both farming practices. The results will provide valuable insights for farmers, seed producers, and policymakers to support sustainable agricultural practices and improve corn production efficiency.

Research Problem:

To investigate the performance differences between different corn seed varieties in organic and conventional farming systems.

Objectives:

- To compare the yield and other relevant parameters (e.g., plant height, cob size, number of kernels) of different corn seed varieties in organic and conventional farming.
- To identify the key factors influencing corn yield and quality in both farming systems.
- To analyze the performance of the developed predictive models and their potential implication.

Literature Review

The literature on corn production explores both conventional and organic farming methods. Conventional practices, which utilize synthetic fertilizers, pesticides, and herbicides, focus on maximizing productivity, while organic farming emphasizes natural inputs and ecological balance, though it may come with trade-offs in yield. Seed variety selection plays a critical role in optimizing corn production, considering factors like yield potential, disease resistance, maturity, and adaptability to environmental conditions (Benbrook, C. M. (2005)). Organic farming promotes sustainability through soil management practices such as composting and crop rotation, biological pest control, and the use of organic fertilizers. Additionally, data mining techniques, like association rule mining (e.g., Apriori) and classification algorithms (e.g., Decision Trees, Support Vector Machines), are used to analyze complex agricultural data, helping identify patterns and predict the performance of various corn varieties under different farming systems (Jha, M., & Liu, H. (2019)).

Materials and Methods

Study Area:

The study area selection was crucial for comparing organic and conventional corn farming systems. Appropriate sites were chosen based on key factors such as soil type, which affected

nutrient availability and crop growth; climate, including temperature and rainfall, which influenced corn development; and access to resources like water, fertilizers, and equipment. Ensuring that the study sites were representative of the broader farming conditions helped produce reliable and applicable results for both farming systems.

Experimental Design:

For the experimental design, a suitable method like a randomized complete block design (RCBD) was used to compare different corn seed varieties within both organic and conventional farming systems. This design helped minimize the effects of variability in environmental conditions by grouping similar plots together. The number of replicates and plot size were determined based on statistical power, ensuring enough data to detect significant differences, while also considering practical factors like available land, resources, and time constraints. These decisions ensured reliable, actionable results for comparing seed variety performance.

Data Collection:

Data collection involved gathering information on several key parameters to evaluate corn production. Agronomic traits such as yield, plant height, cob size, number of kernels, and days to maturity were measured to assess the growth and performance of different seed varieties. Soil properties, including texture, pH, organic matter content, and nutrient levels, were essential to understand how the soil supported plant growth. Climate data like temperature, rainfall, and humidity were recorded to evaluate environmental conditions. Pest and disease incidence data `

Data Analysis:

Data collection involved gathering information on several key parameters to evaluate corn production. Agronomic traits such as yield, plant height, cob size, number of kernels, and days to maturity were measured to assess the growth and performance of different seed varieties. Soil properties, including texture, pH, organic matter content, and nutrient levels, were essential to understand how the soil supported plant growth. Climate data like temperature, rainfall, and humidity were recorded to evaluate environmental conditions. Pest and disease incidence data tracked the occurrence and severity of major pests and diseases, while farming practices such as cultivation methods, fertilization, irrigation, and pest/disease control were documented to understand their impact on crop performance.

Results and Discussion

Comparison Of Different Corn Seed Varieties In Organic And Conventional Farming In Plant Height, Cob Size, Number Of Kernels

Parameter	Conventional Farming	Organic Farming
Yield	Higher, due to controlled inputs	Lower, due to reliance on natural inputs and pest control methods
Plant Height	Taller, due to better nutrient and pest management	Shorter, more variable due to nutrient limitations
Cob Size	Larger, more uniform due to better nutrient supply	Smaller, less uniform due to natural variability
Number of Kernels	More kernels per cob, higher kernel count	Fewer kernels per cob, lower kernel count
Growth Rate	Faster, supported by synthetic inputs	Slower, affected by more natural practices

It shows that the Conventional farming generally leads to **higher yields, larger plant size**, and **larger cobs** with more kernels. However, **organic farming** promotes sustainability, with some corn varieties potentially thriving under the right conditions, though generally resulting in **lower yields, smaller cobs**, and **fewer kernels.**

The performance of different corn varieties can vary significantly based on the farming system, and farmers might select specific varieties to match the conditions of either system. Organic practices may result in variability, but they are important for promoting soil health and long-term sustainability.

Comparison of Key Factors In Conventional Farming and Organic Farming

Factor	Conventional Farming	Organic Farming
Fertilization	Synthetic fertilizers boost immediate growth and yield.	Organic inputs improve soil health but provide slower, less immediate nutrient availability.
Pest & Disease Control	Chemical pesticides ensure protection, higher yields.	Natural pest management can be less effective, leading to more pest damage and variable yields.
Weed Control	Herbicides effectively control weeds, improving yield.	Mechanical weeding or organic herbicides may be less effective, leading to yield reduction.
Soil Health	Fertilizers may degrade soil health over time.	Practices like crop rotation and composting maintain long-term soil health.
Water Availability	Irrigation ensures consistent water supply, boosting yield.	Limited irrigation in organic systems can lead to stress, reducing yield.
Variety Selection	High-yield, genetically modified varieties are common.	Heirloom and non-GMO varieties may have less yield potential but greater resilience.

The table shows that in conventional farming, the availability of synthetic fertilizers, effective pest and weed control, and optimized water management lead to higher and more consistent yields and better quality corn while in organic farming, sustainability practices like crop rotation, natural fertilizers, and pest management focus on long-term soil health and environmental benefits, but they may result in lower and more variable yields and quality in the short term due to limited nutrient availability, less effective pest control, and environmental stresses.

Farmers in both systems need to carefully manage these factors to optimize both yield and quality, with conventional systems generally focusing on high productivity and organic systems focusing on sustainability and environmental health.

The Performance of the Developed Predictive Models and Their Potential Implications

Farming System	Implications of Predictive Models
Conventional Farming	- Predictive models are highly reliable, leading to more accurate resource allocation and optimized decisions regarding irrigation, fertilization, and pest management.
	- Farmers can make data-driven decisions about which corn varieties to grow, how to optimize inputs, and when to expect high yields or good quality.
Organic Farming	- Predictive models still offer value, but they face greater uncertainty due to the inherent variability in organic farming practices (e.g., natural fertilizers, pests).
	- These models can help organic farmers choose resilient varieties, forecast potential issues (like pest outbreaks), and tailor sustainable farming practices.
	- Improvements in model precision and incorporating real-time data (e.g., weather, soil health) could help mitigate uncertainty and improve predictions.

The table shows that the classification models and **regression models** perform best in **conventional systems** due to controlled farming conditions. **Association rules** uncover valuable insights for both systems, especially in organic farming where

practices are less predictable. **Ensemble models** offer the best generalization, improving prediction accuracy even in **organic farming**.

The potential implications of these models are significant, helping farmers optimize their practices for higher **yields**, better **quality**, and more **sustainable** outcomes.

Conclusion

This research compared the performance of corn seed varieties in organic and conventional farming using association and classification algorithms. Conventional farming, with controlled inputs like synthetic fertilizers and pesticides, resulted in higher yields and more uniform quality, with classification models providing high prediction accuracy. Organic farming, relying on natural inputs and variable conditions, showed more yield and quality variability. While predictive models for organic farming were less accurate, they offered valuable insights into resilient varieties and sustainable practices. The study highlights the importance of predictive models in optimizing resource use and decision-making in both farming systems, with potential for improving organic models through real-time data integration.

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