OnionAider: A Model Driven Decision Support System for Weather and Pest-Occurrence Prediction in Onion Cultivation

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ABSTRACT

The cultivation of onions is crucial for meeting global demand, as they are widely consumed and used as a seasoning in various dishes worldwide. However, the production of onions is significantly affected by climatic factors and pest infestations. To address these challenges, this study presents OnionAider, a Model Driven Decision Support System that utilizes weather and pest-occurrence prediction models for onion cultivation. The system integrates descriptive, exploratory, historical, and AGILE methodologies to develop a comprehensive mobile application. The effectiveness of OnionAider was evaluated through data retrieval, questionnaires, and interviews with farmers, experts, and relevant stakeholders. The results indicate a strong relationship between climatic data and pest infestation in onions, with temperature and humidity being the primary predictors. The developed mobile application incorporates an algorithm derived from the Proponent-Rete method and offers valuable features for onion farmers. The system complies with ISO 25010 software compliance criteria. This article discusses the methodology, results, and implications of OnionAider in enhancing onion cultivation practices.

Key words: Climatic factors, Decision Support System, OnionAider, Onion cultivation, Pest-occurrence prediction, Weather prediction

1. INTRODUCTION

Onions (Allium cepa L.) are in high demand worldwide due to their universal use in culinary practices. This article presents OnionAider, a Model Driven Decision Support System designed to predict weather patterns and pest occurrences in onion cultivation. The effective management of onion crops is essential, as climatic factors and pests significantly impact their growth and production.

The Philippines is a tropical country and recognized as an onion-growing country from the Luzon to Mindanao. Onion is a versatile high-value crop that can be cultivated throughout the archipelago. Farmers tried and proven that they can earn more from cultivating "sibuyas" as they called it in Filipino particularly the red bulb variety [2]. As a matter of fact, many farmers shifted from rice to onion to take advantage of growing demand for onions [5].

2. METHODOLOGY

The study involved 20 onion farmers in Aritao, Nueva Vizcaya, and collected data from two local government unit (LGU) members, one informant from PAGASA (Philippine Atmospheric, Geophysical, and Astronomical Services Administration), an Entomologist, and ten IT experts serving as systems evaluators. Data retrieval, questionnaires, and interviews were employed to gather information.

2.1 Weather Forecasting and Pest Occurrence Prediction Models

The study utilized the Autoregressive Integrated Moving Average (ARIMA) model for weather forecasting. Regression analysis was employed to represent variables and evaluate the relationship between dependent and independent variables. The Rete Algorithm, a matching algorithm, was implemented in the decision support system to establish relationships between climatic and pest data[4].

3. RESULTS AND DISCUSSION

The results demonstrate a significant relationship between climatic data and pest infestations in onions. Temperature and humidity were identified as the most common predictors. Using mathematical notations, $T \times H \times P \, \alpha \, (O_{Aw}$ or $O_{Th})$ Armyworm Occurrence and Thrips Occurrence, $T \times H \, \alpha \, (O_{Lm})$ Leaf Miner Occurrence, $T \, \alpha \, (O_{OF})$ Onion Fly Occurrence, and $T \times H \, \alpha \, (O_{An})$ Anthracnose Occurrence, led to the algorithm

PestMin≥Pest≥PestMax as illustrated in Figure 1. Figure 2 shows the developed android app interface as well as the predicted pest occurrence which the equation was incorporated into the OnionAider mobile application, which operates on an browser based interface and an Android-based mobile device [1][3].
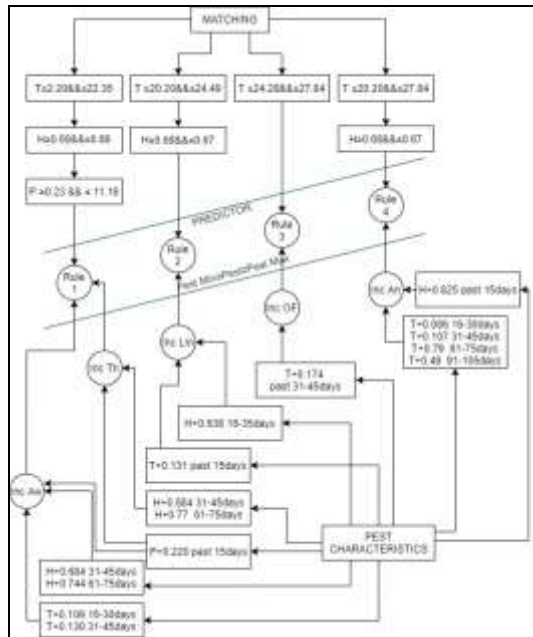

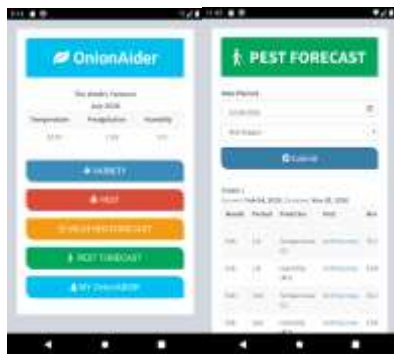**Figure 1**. The Figure Illustrates the Prediction Mode in Relation to Pest Characteristics

Figure 2. Developed Onionaider Main Interface and Forecast

3.1 Features and Evaluation

OnionAider offers a range of useful features for onion farmers, which were evaluated based on the software compliance criteria of ISO 25010. Table 1 shows the evaluation results that the features met the required standards, enhancing onion cultivation practices and facilitating weather and pest-occurrence prediction.

Table 1. The Summary of Extent of Compliance in Accordance with ISO 25010 Standards

Compliance	Mean	Qualitative Description
Functionality	4.96	Very Great Extent
Efficiency	4.92	Very Great Extent
Compatibility	4.86	Very Great Extent
Usability	4.86	Very Great Extent
Reliability	4.83	Very Great Extent
Security	4.86	Very Great Extent
Maintainability	4.79	Very Great Extent
Portability	4.47	Very Great Extent
OVERALL MEAN	4.82	Very Great Extent

4. CONCLUSION

OnionAider, a Model Driven Decision Support System, has proven effective in predicting weather patterns and pest occurrences in onion cultivation. The integration of weather and pest prediction models provides valuable insights for onion farmers, enabling them to make informed decisions. The developed mobile application, OnionAider, complies with software compliance criteria, ensuring its reliability and usability.

REFERENCES

1. Allen, E. **Precision pest control: smartphone app is the farmer's newest weapon in crop protection**, Retrieved from *https://phys.org/news/2019-01-precision-pest-smartphone-app-farmer.html*, 2019

2. Bautista N.M., Aquino Jr E.M. **Community-based wide-scale strategic prevention and control of armyworm in the province of Nueva Ecija**. DA-RCPCIII, Technical report. 2017

3. B.Manoj, K.V.K.Sasikanth, M.V.Subbarao, V Jyothi Prakash. **Analysis of Data Science with the use of Big Data**, International Journal of Advanced Trends in Computer Science and Engineering, Volume 7, No.6, 2019.

4. Dalila B.M.M. Fontes, Paulo A. Pereira, Fernando A.C.C. Fontes. **A Decision Support System for TV self-promotion Scheduling**, International Journal of Advanced Trends in Computer Science and Engineering, Volume 8, No.2, 2019.

5. Perante II, L. **East-West Seed PHL projects sustainable onion industry nationwide,** Retrieved from https://businessmirror.com.ph/2018/05/05/east-west-seed-phl-projects-sustainable-onion-industry-nationwide/, 2018.