

# LAKAPATI - Corn Disease Classifier with Mitigation System using Neural Network

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## Abstract

As the Philippines is an agricultural country surrounded by bodies of water, the country is diversified in different crops, especially rice and corn fields. The country is truly blessed in the field of agriculture as the backbone of the country's growth. But given the lack of equipment, tools, and knowledge in dealing with the crops, farmers struggle in dealing with the farmlands. Moreover, with the rapid changes in the environment brought by climate change and the worsening situation in maintaining the growth of the crops in the fields, the farmers have a harder time catching up in order to maintain their crops. Given the situation of the country's agriculture and the weak performance output to produce crops in the field, the country imports a lot of crops in order to maintain food security. This application, with the help of Matlab, aims to help farmers and researchers to mitigate the loss of crops with the use of Computer Vision and Deep Learning algorithms. Convolutional neural network (CNN) will be used in the application to classify the condition of the crops. Along with class activation mapping, this enables localizing and generating the heatmap of the affected areas. The layers of the networks will be trained along with the PlantVillage dataset (Hughes, et al., 2015) as a basis for identifying the disease of the corn crops. Along with the Disease wiki function, the farmers will be able to know and come up with a solution to minimize the spread of the disease or reduce the risk of losing their crops. The application contains four functionalities that will be useful to the users. The functionality of the application contains an image uploader, disease wiki, heatmap and processing of image, and disease classifier. This application would benefit the farmers, researchers, and students who are interested in working in agriculture.

## Introduction

Philippine agriculture is heavily grounded in the nation's prosperity. It is one of the primary factors in driving the domestic economy and success. Agriculture, Forestry, and Fishing alone has contributed to 9.6% of the Growth Domestic Product (GDP) in 2021 (Philippine Statistics Authority, 2022). This is due to its geographical location and environment, ideal for the cultivation of horticulture and husbandry. It is a haven for natural resources, with diversity among the plethora of crops and harvest. As an archipelago with equatorial climate, it is notable that corn is a staple produce along with rice in the country. According to the Philippine Statistic Authority (PSA), the value of corn crop production at current prices was around 118 million and

had a total production of 8.30 million metric tons in 2021 (“Palay and Corn Quarterly Bulletin”, 2022). Throughout the years, agriculture has continuously grown to become the backbone of Philippine development.

Although agriculture is known to be the pride of local expansion, it is also proven that it contains weak links in its foundations. These hindrances include poor government management, limited funds, and slow adaptation to mechanization and innovation. Despite its current estimated 2.44 million metric tons from January to March of 2022 (PSA, 2022), people have led to imports for food security for the past few years. The central factor of funding has significantly reduced from its 3.6% annual budget from 2017 to 2019, to 1.7% in 2020, and 1.6% in 2021. It is also apparent that due to the insufficient technology, farmers are still stuck in the ways of manual labor. The traditional methods of production have become a rising concern especially with the aging population and demographic among farmers. The nation’s own progress has gone subpar and even decreased to an average growth rate of 2.1% in 2017-2019 alone. It was at “its slowest pace after 70 years of growing at 3.5% annually on the average” (IBON Foundation, 2022).

Because of the shortage and regression in promising rates of growth, the proponents pursued to create an application that offers identification of corn diseases and proposed methods to address such matters. The program will be similar to that of a Corn Disease Classifier with a Mitigation System, with an additional encyclopedia on the matters of corn diseases. Using Computer Vision and Deep Learning algorithms, the Corn Disease Classifier with Mitigation System will be able to determine the proper diagnosis through image recognition and its solutions across a database via convolutional neural network (CNN). Additionally, users will be able to use class activation mapping to help identify a general location of the disease within their crop.

Entitled LAKAPATI, an AI-based Corn Crop Mitigation App System, the following project aims to steer agriculture into better progress and development. Classification and instant identification of crop condition will provide accurate and convenient foundations towards better cultivation of harvest using the frameworks and algorithms previously mentioned. The application further aims to avoid the spreading and possible elimination of the risk efficiently. It is also with the system that the main users, farmers and researchers, will have better knowledge and understanding on corn diseases and mitigation methods. People in agriculture will likewise have a supplementary resource to rely on. It will also guide them through the many aspects of corn farming in a way that is easy to grasp yet insightful. The program will be able to advance the shift into modern and sustainable agriculture. With LAKAPATI, the proponents wish to promote agriculture and its potential as well as encourage those that are interested to pique their curiosity to learn about the wonders of agronomy.

# Functionalities

TABLE I.

Functionality	Persona	Description	Benefit
Picture uploader button for image inferencing	Farmers, researchers, and students	This function will enable the user to upload the picture into the AI Engine responsible for the classification of the corn diseases.	The user would be able to assess the damage done by the crop's disease.
Disease Wiki	Farmers, researchers, and students	Shows essential information regarding different crop conditions and corresponding methods of mitigation.	The user would be able to see the information regarding the status of their crops.
Heatmap for the affected area of the crop	Farmers, researchers, and students	This function will enable the user to visually distinguish the areas of damage that has been done to the crops and gives a percentage of such affected area through machine learning	Modern farmers don't have the tool for crop assessment, with this it would enable them to assess what will be an approach to mitigate the risk of spreading the disease in the other crops.
Disease classifier	Farmers, researchers, and students	Using a Convolutional Neural Network (CNN), this app enables the farmers to classify what kind of disease their corn crops have.	This enables the farmers to assess the situation if they the disease is contagious to the other crops and mitigates the spread of the disease by using the Disease Wiki function of the app.
Displaying processed image	Farmers, researchers, and students	Projects the result of the processed image on the table based on the image uploaded.	This enables the researchers and students to know the relationship and benefits of machine learning to agriculture.
About App	Farmer, researchers, and students	A supplementary page in the application. Briefly explains the concept and process behind the purpose of the	This enables the user to explicitly understand the

		program. Once the functionality is running, overall descriptions including that of the application and creators should be seen.	purpose of the program as it provides additional thoughts of
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## Walkthrough

Note: Before using the application, please have the following framework or tools installed:

1. Deep Learning Toolbox
2. Computer Vision Toolbox
3. Parallel Computing Toolbox
4. Deep Learning Toolbox for Googlenet Network

As a supplement, attached is a [video](#) version of this walkthrough. Alternate link:

<https://drive.google.com/file/d/1HPyLru3wR9foWsesM8nW98ornhYUCfnk/view?usp=sharing>

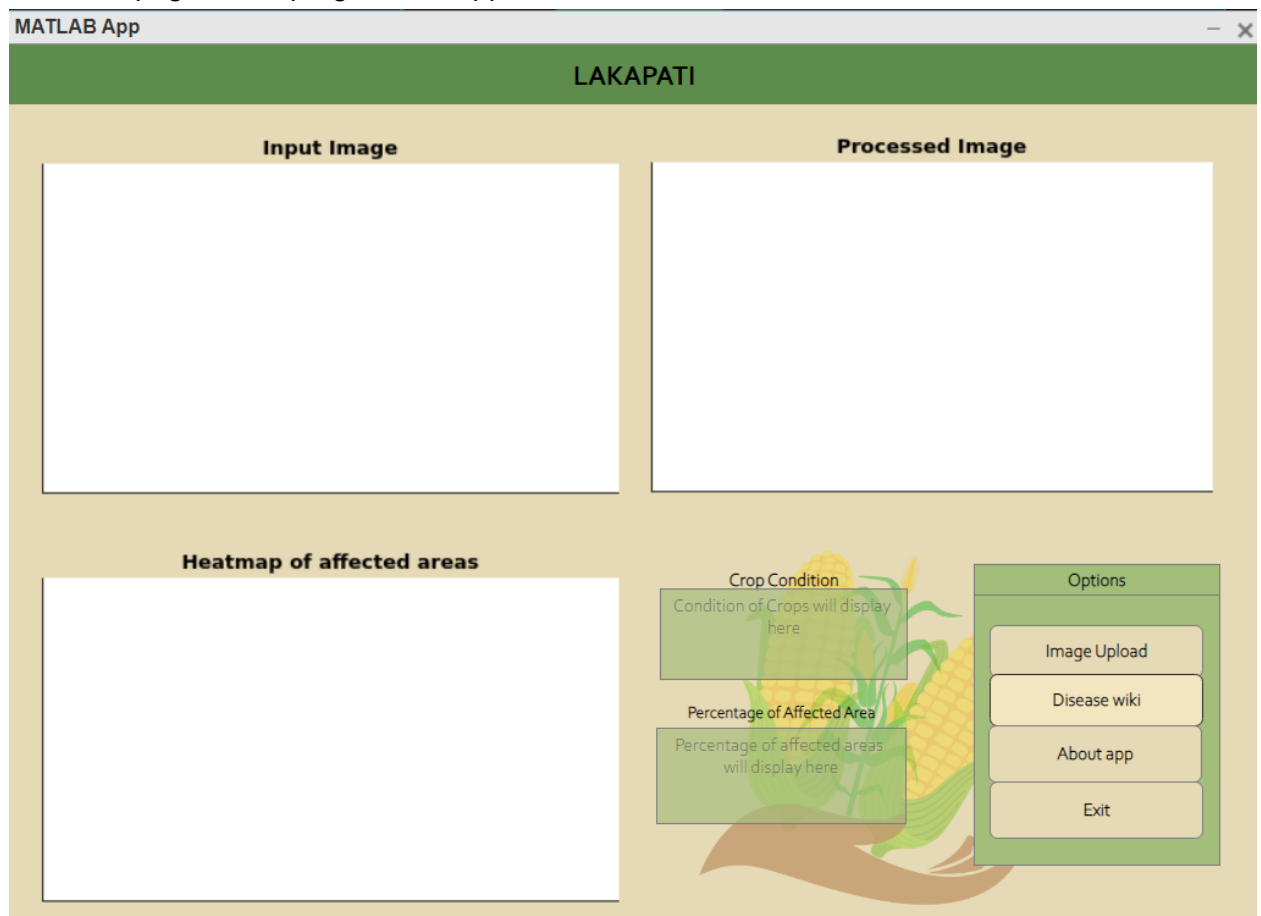
1. The following starting/opening page is presented to show the program name and a picture for visual supplement.



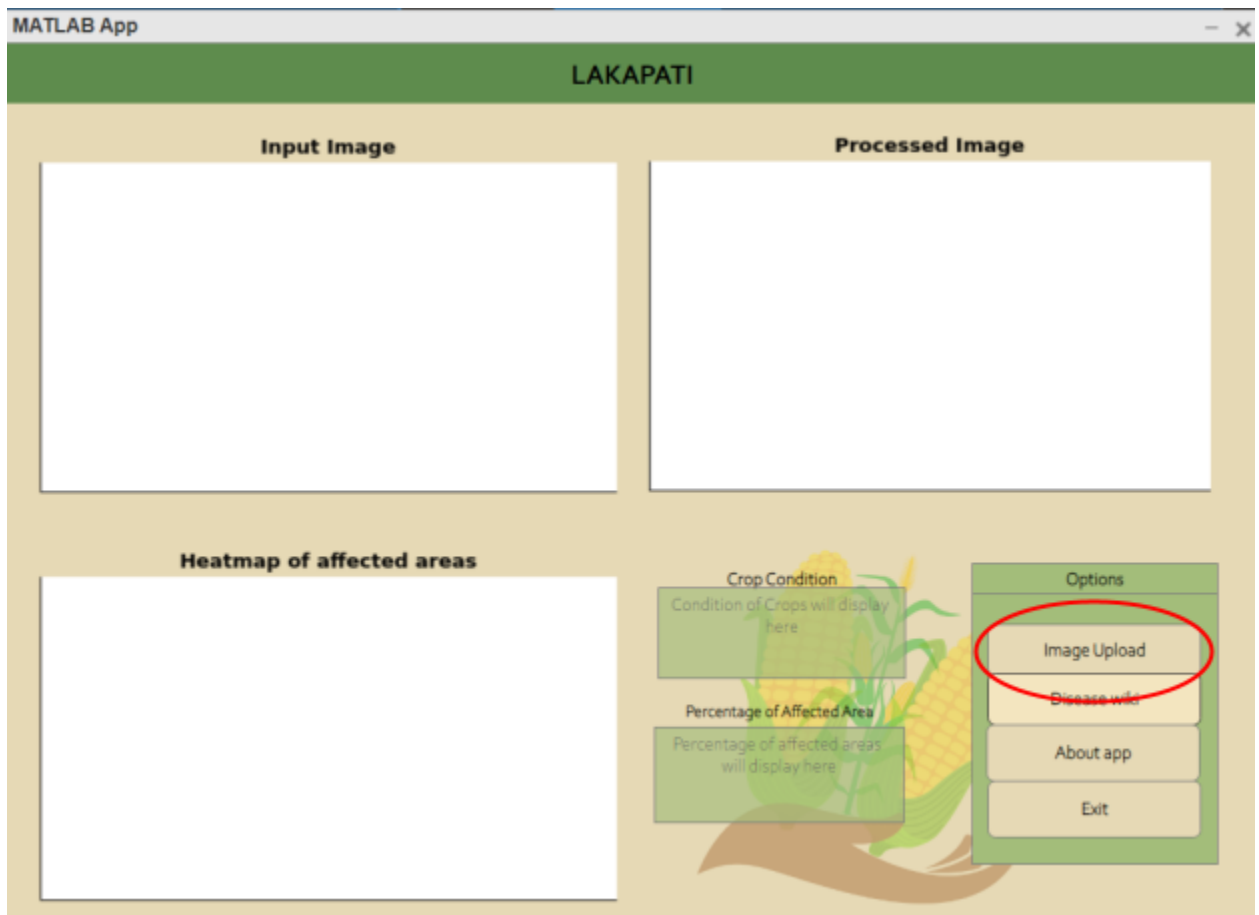
2. Press the “Get Started” button to continue and open the main program.



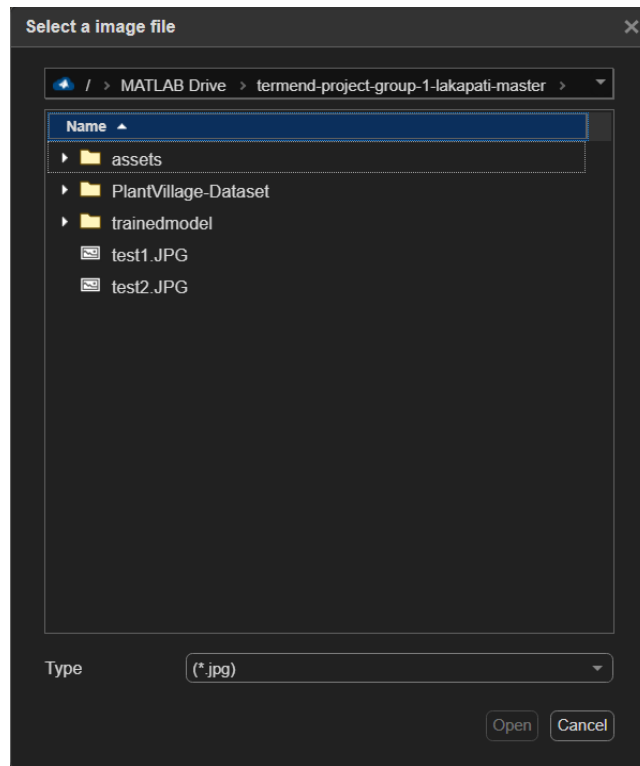
3. The main page of the program will appear as shown below.



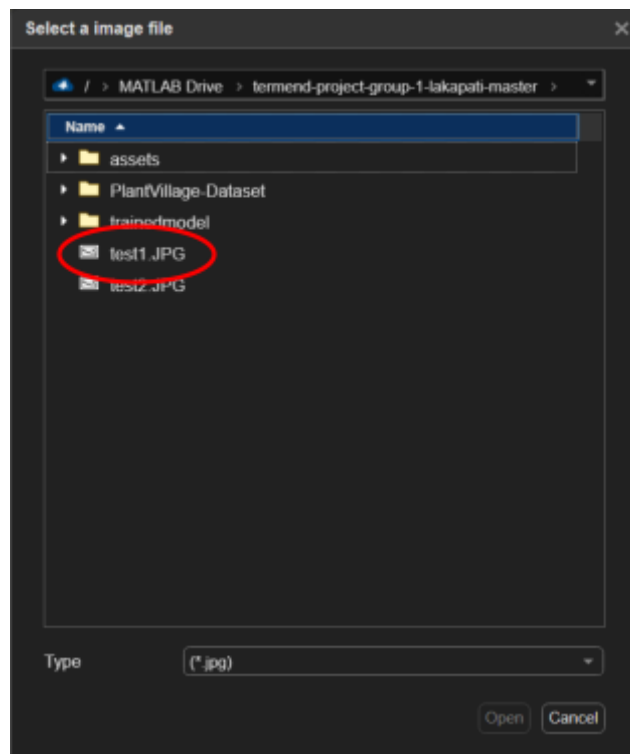
4. First, we will use the first function, Image Upload. Click the “Image Upload” button or the topmost button located at the options area in the lower right portion of the screen.



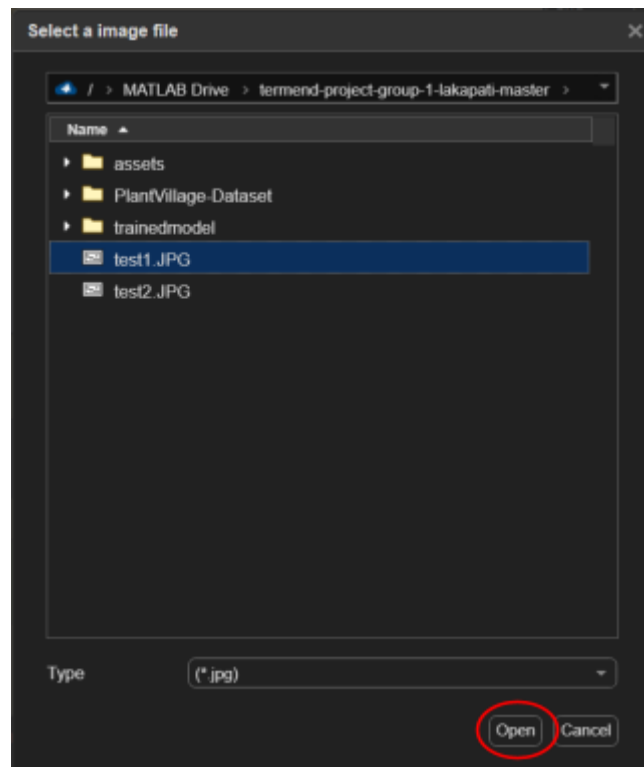
5. From there, you will be asked to upload an image or in this case, “select a image file”.



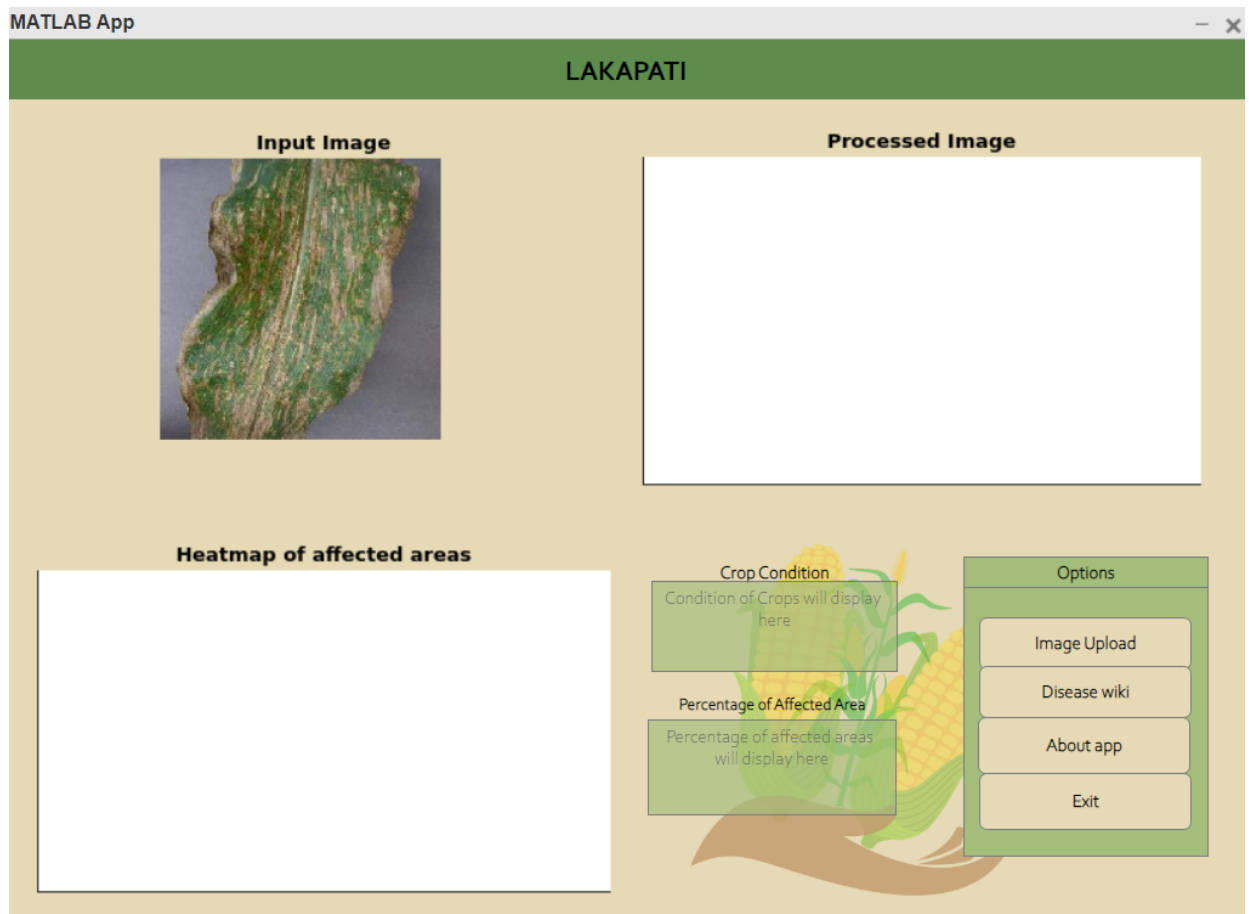
6. Choose the photo to be uploaded and processed. For this walkthrough, the image with the filename “test1.JPG” will be used. Click the file then press the “Open” button.



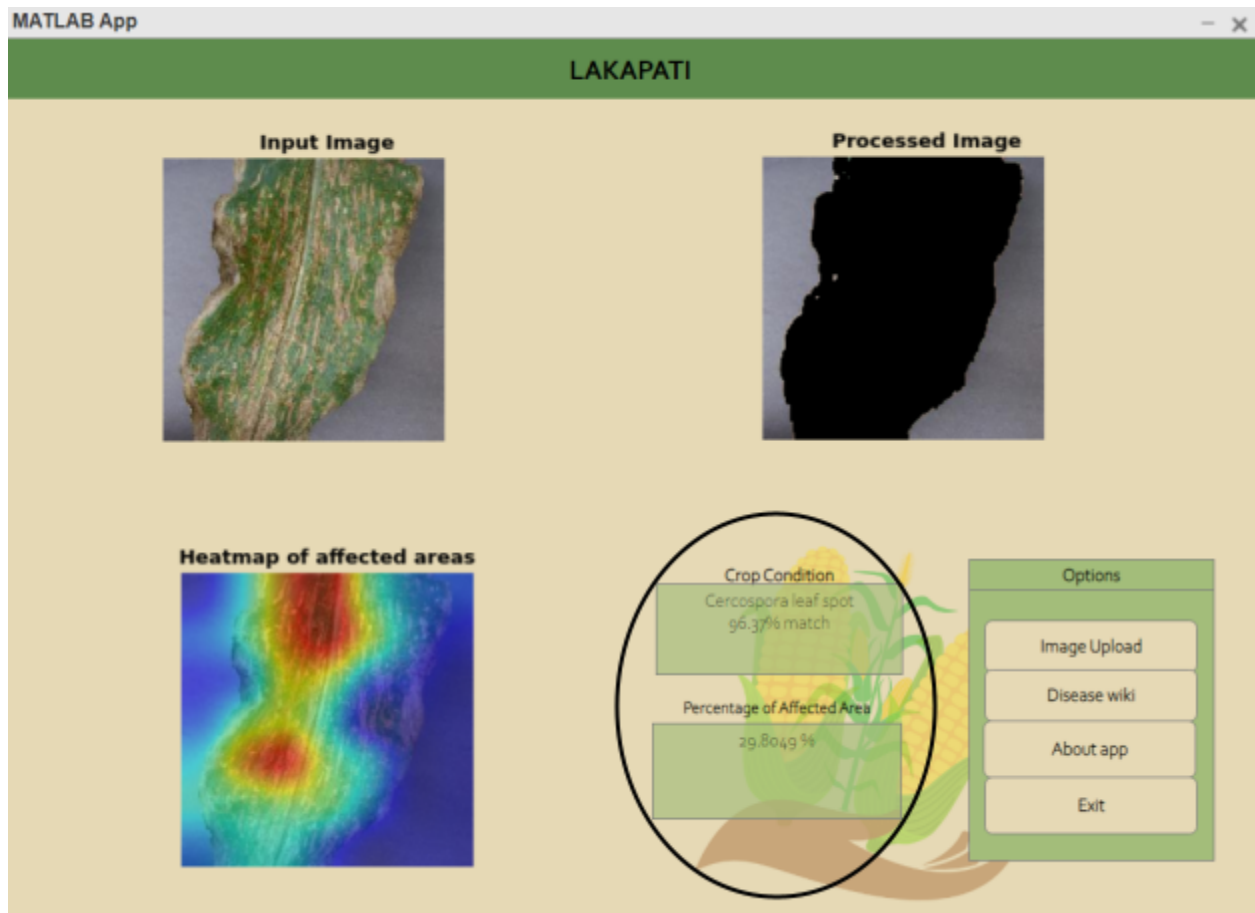




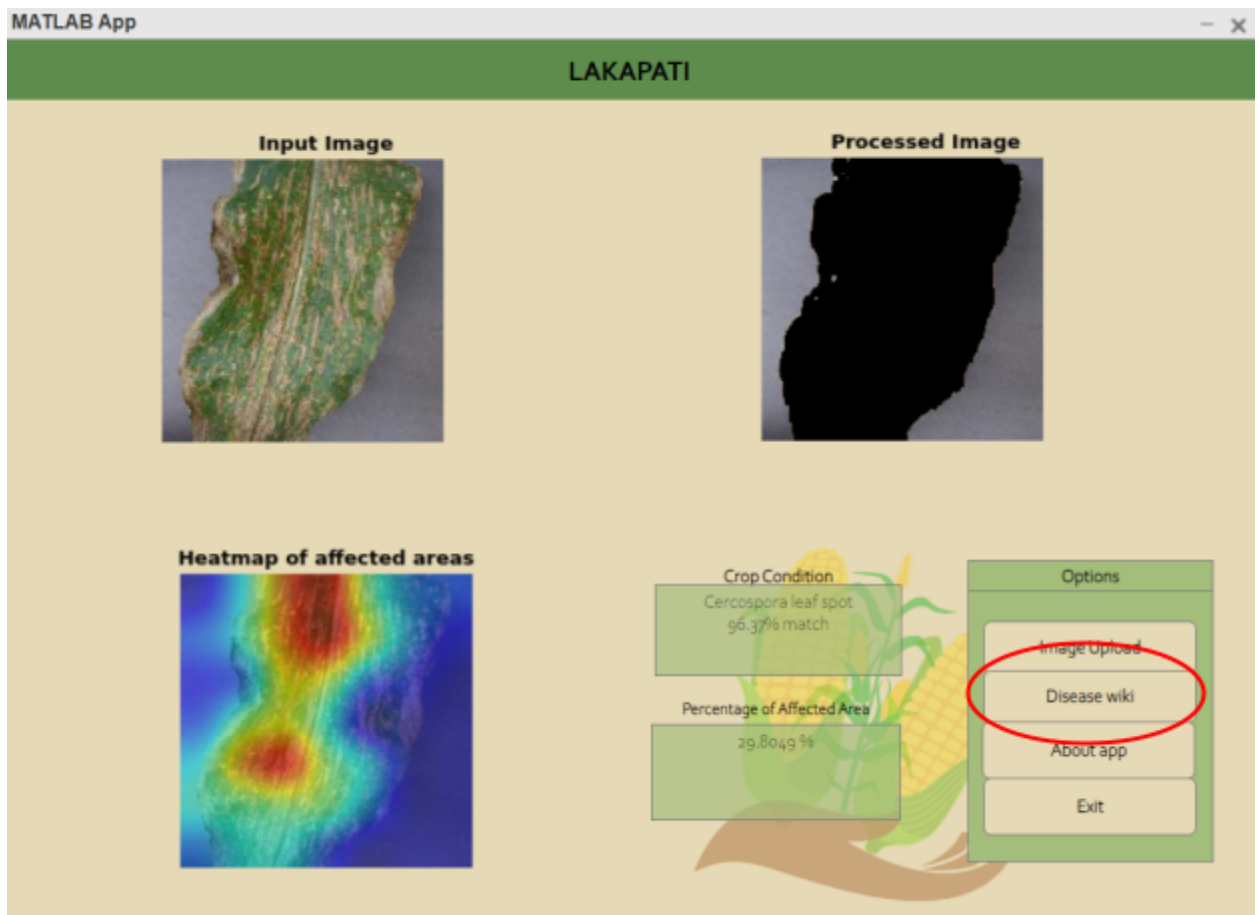
7. The main page will now again display with the image and process it according to the tracker. This may take a few seconds to complete.



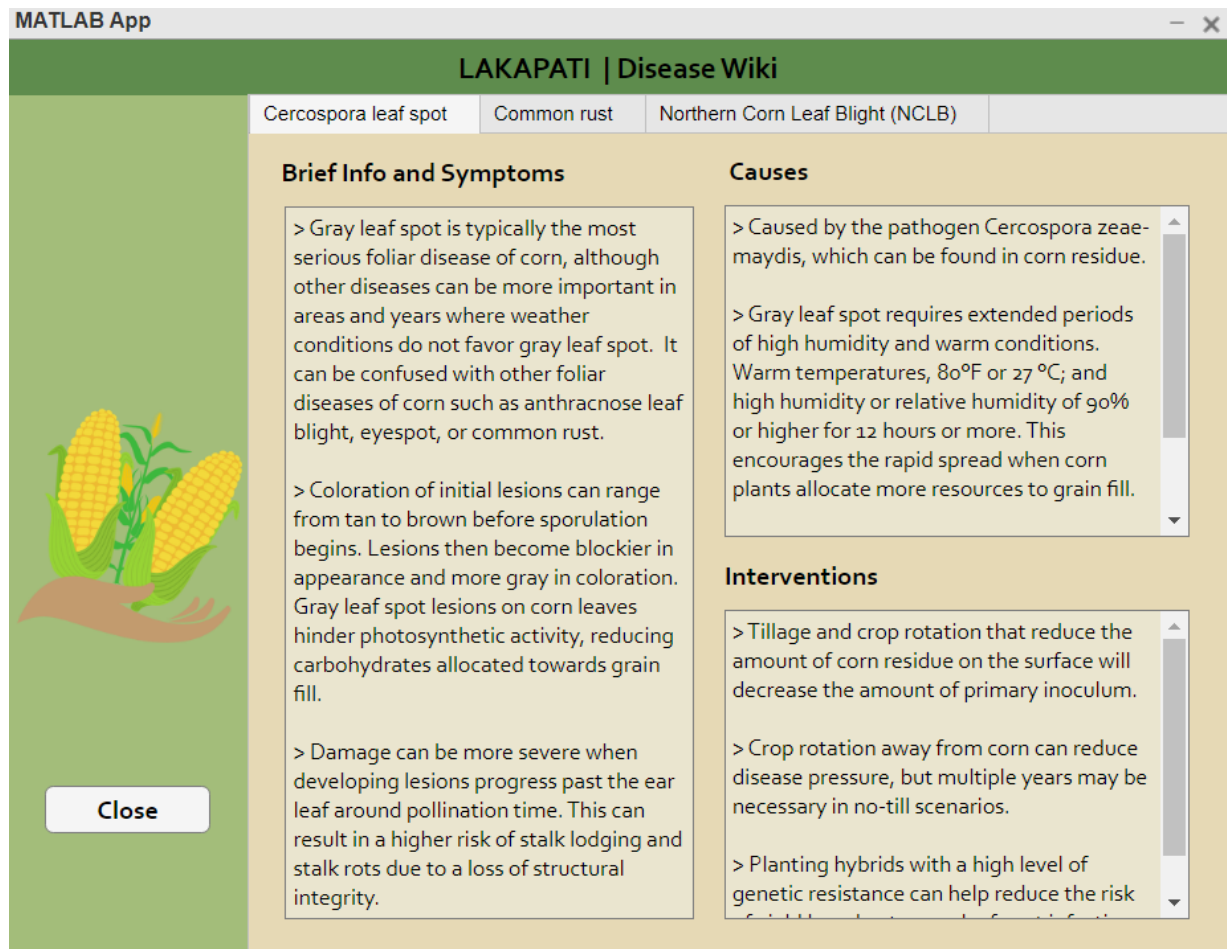
8. Once the system has finished, the result of the processed image and heatmap of affected areas will be displayed. The crop's condition and percentage of affected areas will also be identified as seen in the boxes to the left of the options area.



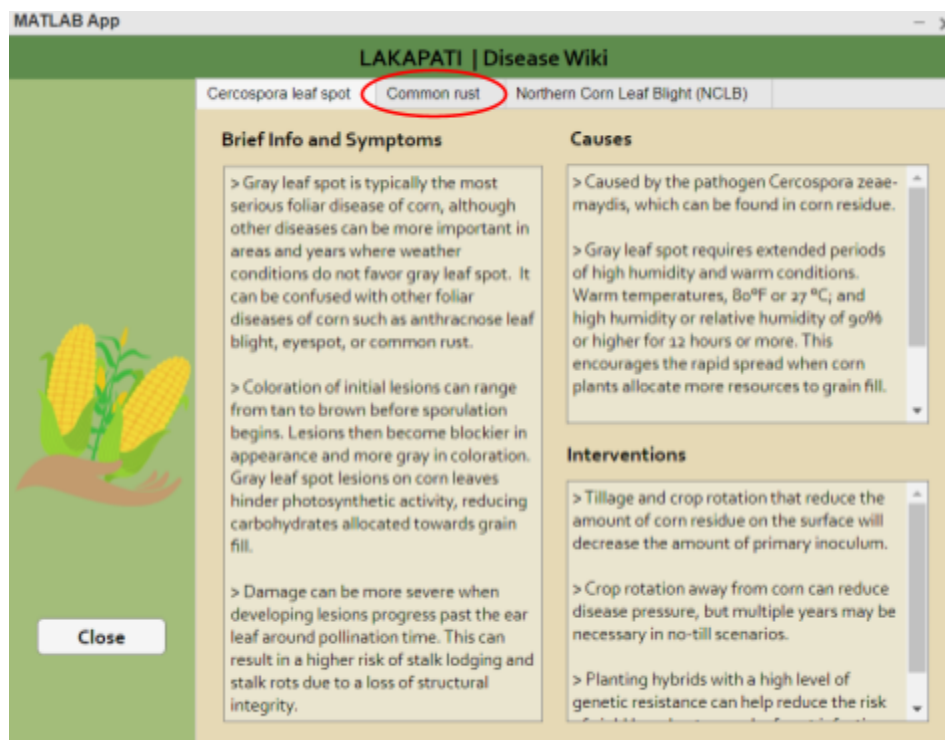
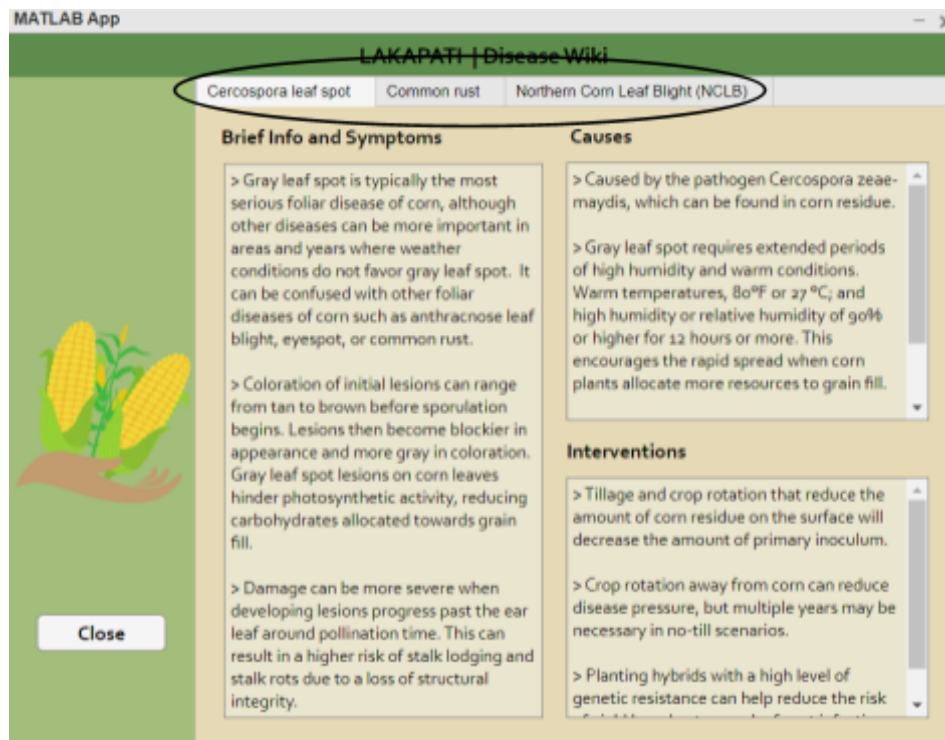
9. Now, the 2nd feature, Disease Wiki, will be explored. Click the “Disease Wiki” button or the 2nd topmost button from the options area.



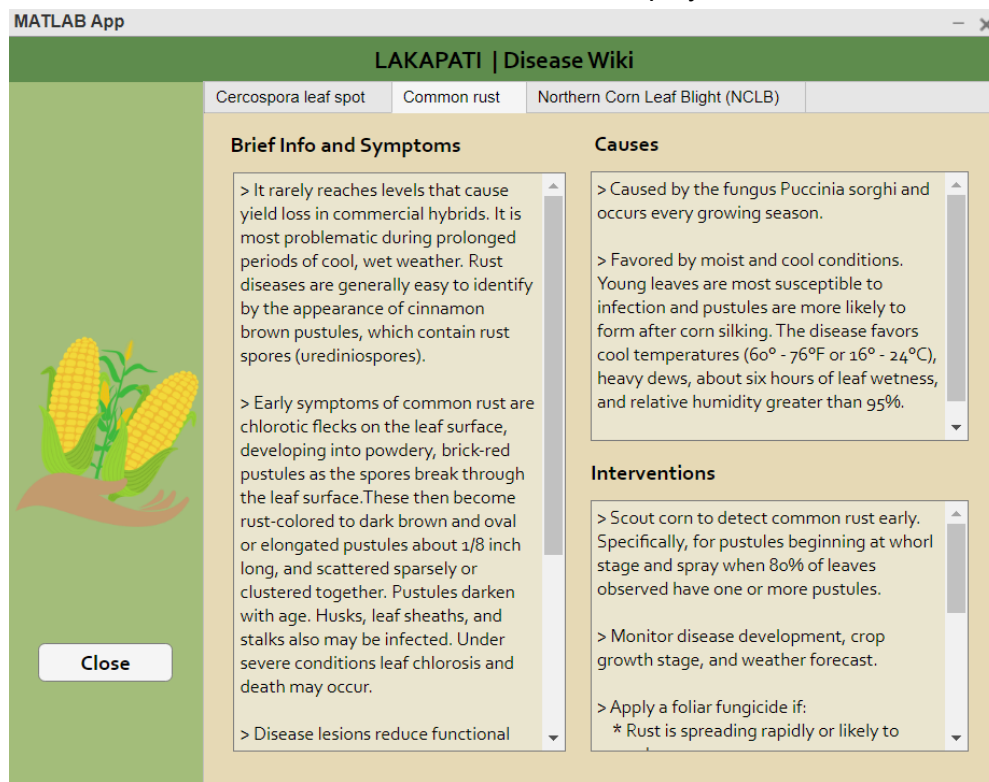
10. The app will then direct you to the Disease Wiki pop-up window. Here, brief information and symptoms, causes, and interventions of the corn diseases can be found.



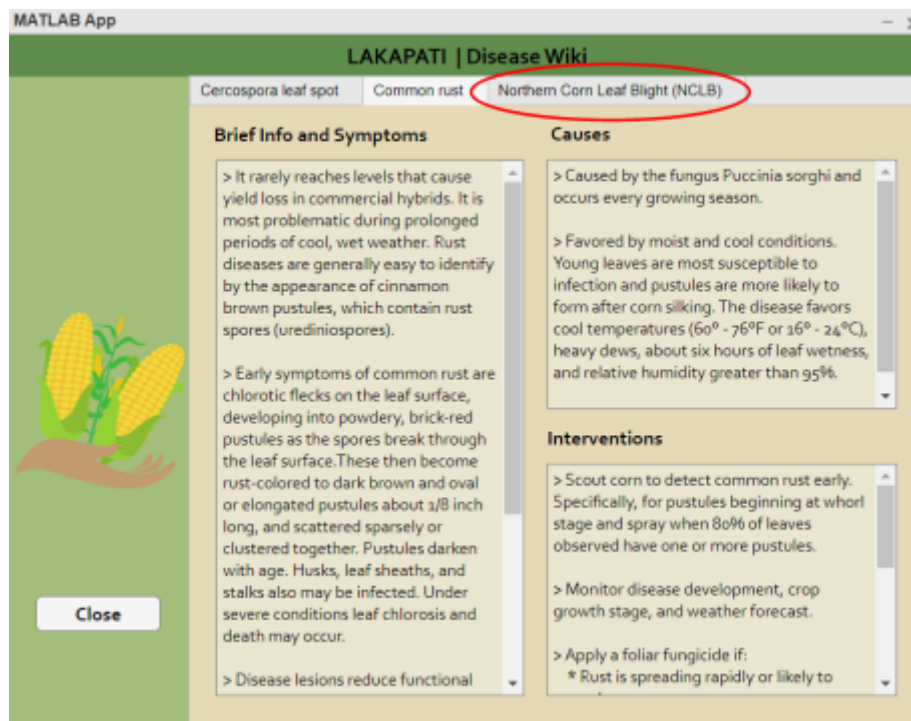
11. You can also click any of the other diseases to learn more about the condition in the bar above. In this case, common rust will be chosen. Click the “Common rust” option or the text beside “Cercospora leaf spot”.



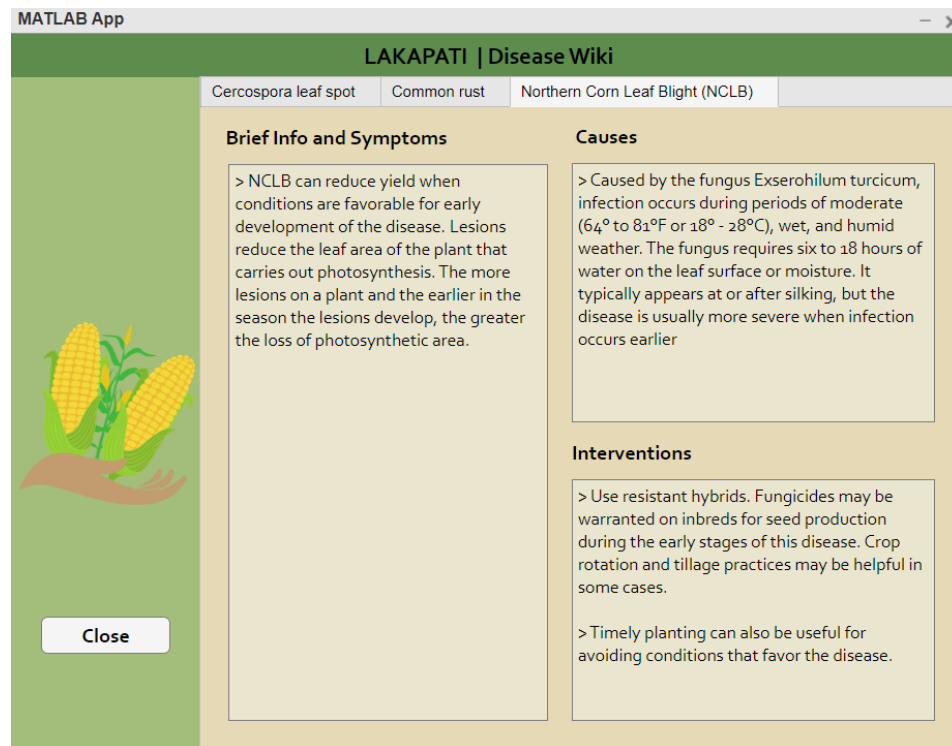
12. The Disease Wiki on common rust will now be displayed.



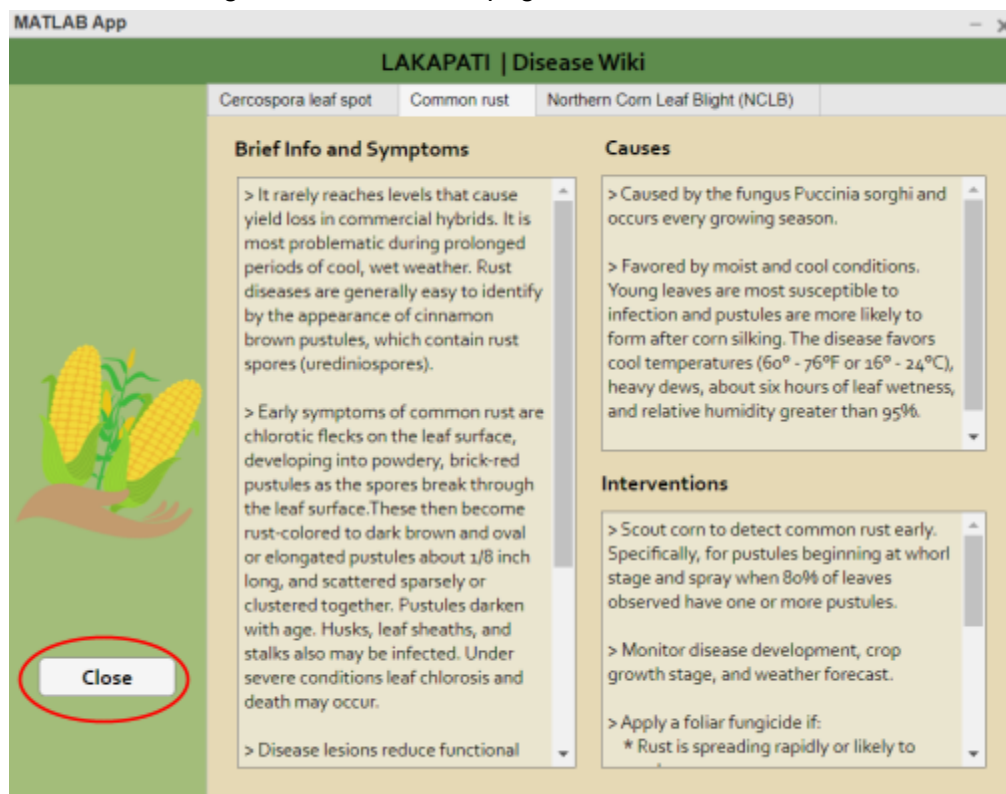
13. You can also check the 3rd disease. Click the “Northern Corn Leaf Blight (NCLB)” button.



14. The information under Northern Corn Leaf Blight (NCLB) is now presented.

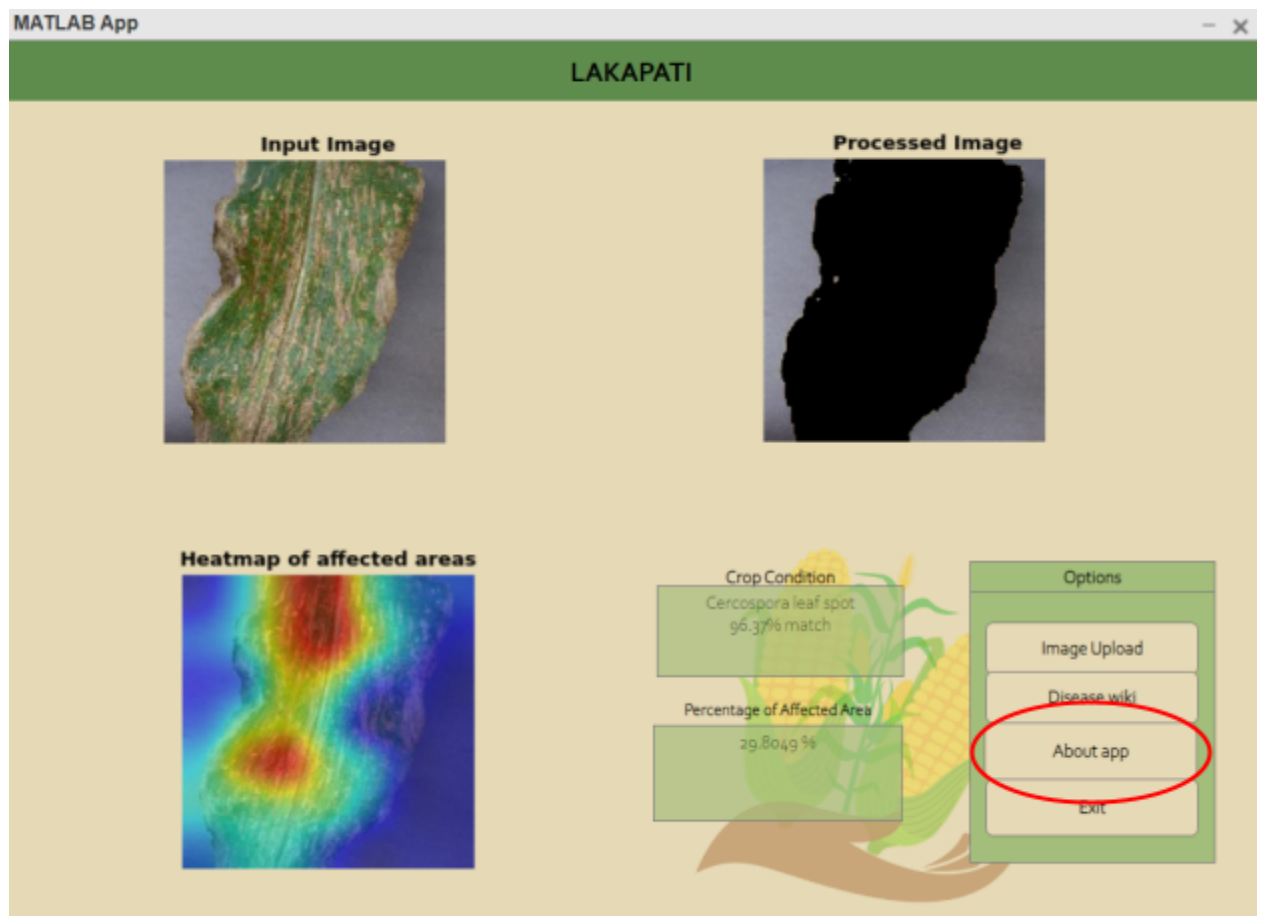


15. Press "Close" to go back to the main page.

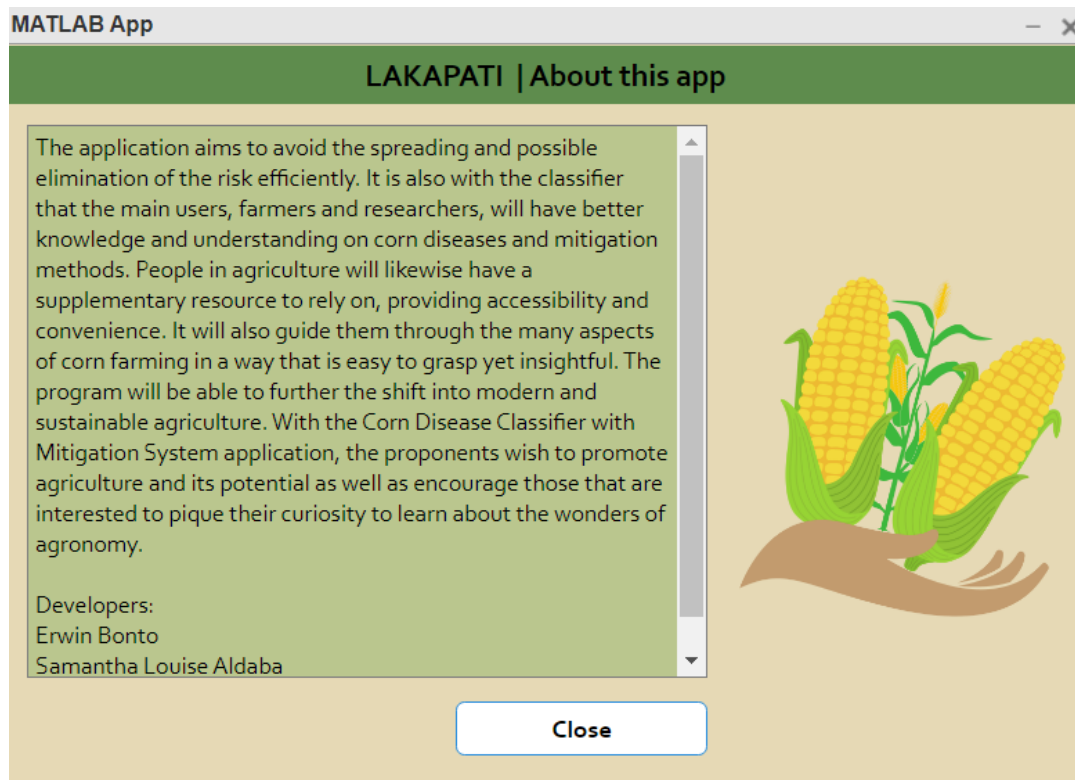




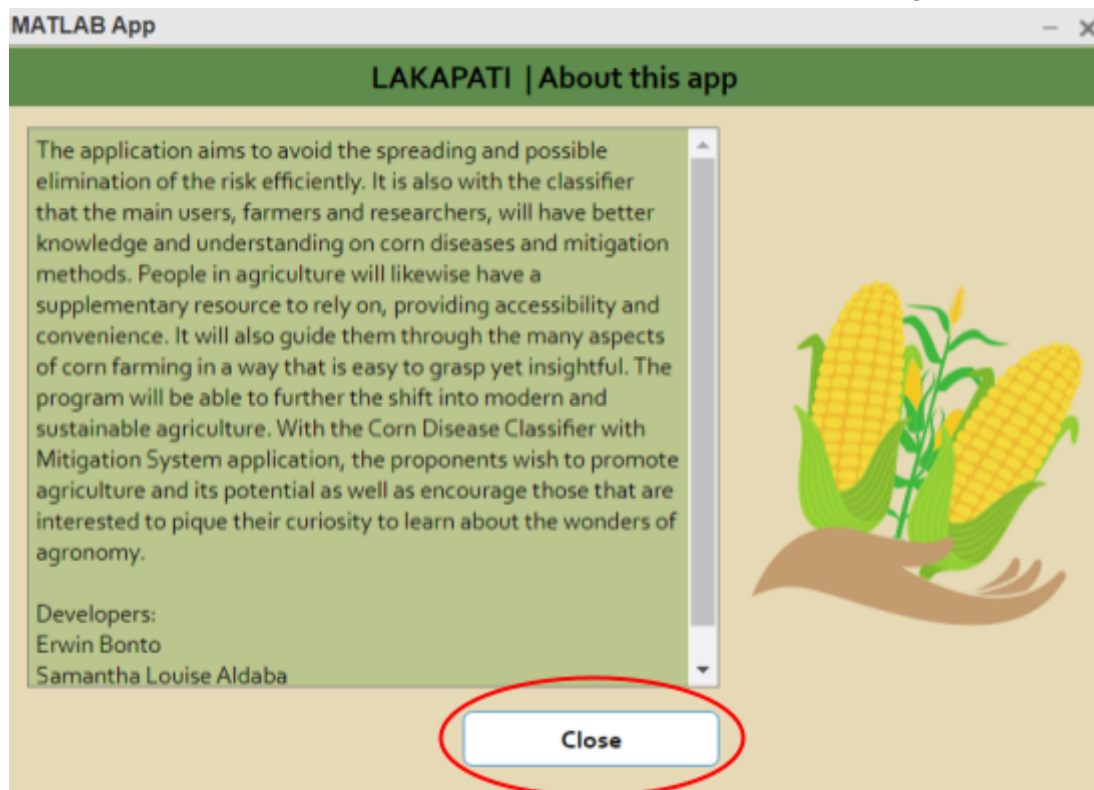
16. Back on the main page, we will now proceed to the 3rd feature, About App. Again by the options area, click on the “About App” button.



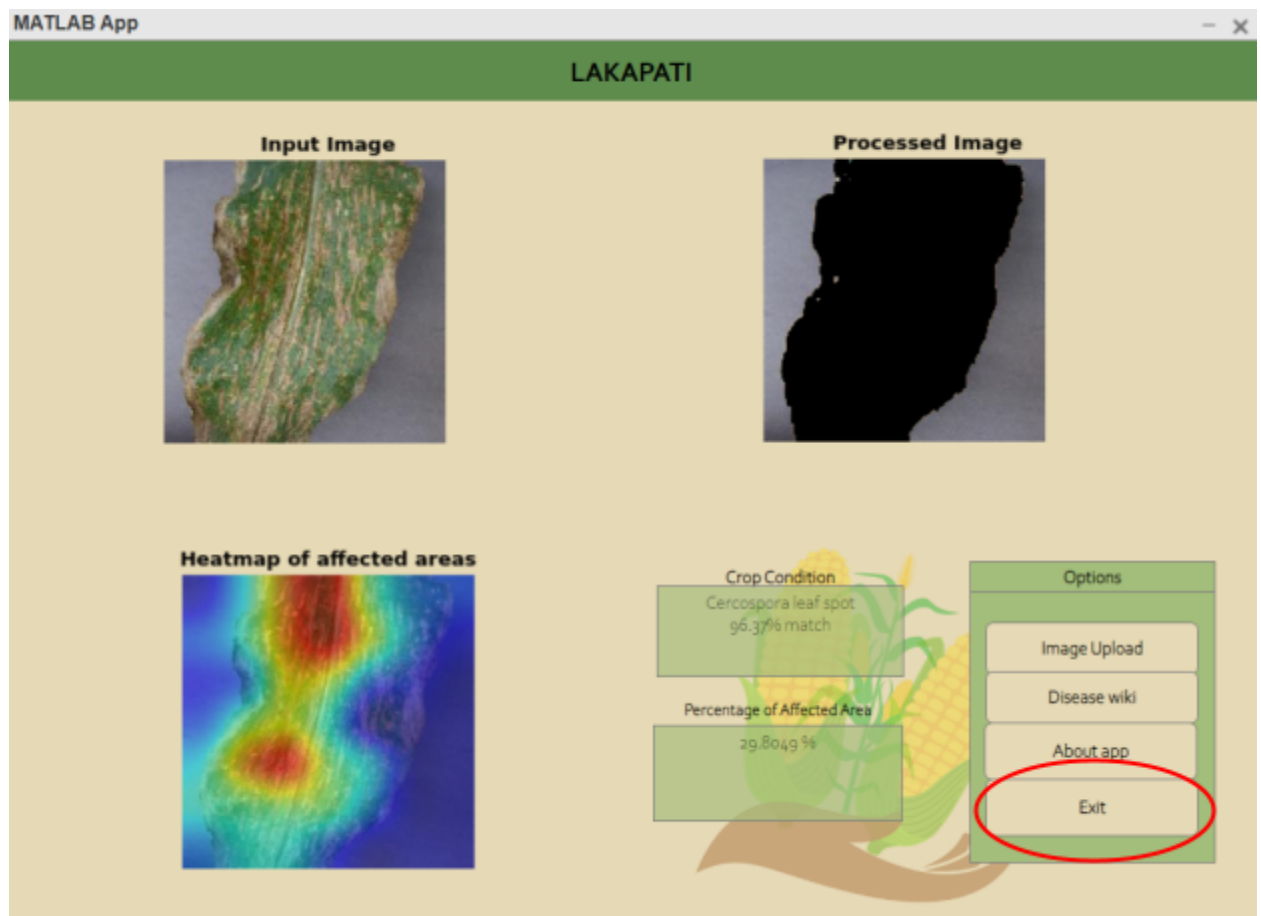
17. The program will direct you to another pop-up window. This is the About app page.



18. Click "Close" to leave the About App section and return to the main page.



19. To close and end the application, click the “Exit” button or the bottommost option at the lower right of the screen, also located in the options area.



## References:

- Palay and Corn Quarterly Bulletin. (2022). In Philippine Statistics Authority. Philippine Statistics Authority. <https://psa.gov.ph/sites/default/files/Palay%20and%20Corn%20Quarterly%20Bulletin%2C%20January-March%202022.pdf>
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