

# BioIMA User Manual

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# 1. Software Introduction

Observing, describing, and statistically analyzing the external morphological characteristics of organisms can help interpret the similarities and differences between different species. Quantifying the differences in biological traits provides a basis for various studies. However, due to differences among species, most methods are designed for specific tasks and are not easily adaptable or extensible to new problems, contexts, and datasets. Especially in the field of forestry science, most work still relies on manual measurements. Existing measurement tools lack standardization and reproducibility, resulting in significant errors in statistical analyses.

Semi-automated image processing methods, such as using Image-J and similar software, require users to manually adjust image parameters and mark regions of interest to extract phenotypic parameters. Although this method provides some flexibility, it requires users to have image analysis and coding skills, and the adjustment process is cumbersome and time-consuming. In addition, due to the reliance on manual parameter adjustment and annotation, it is often difficult to accurately outline the edges of objects, leading to less accurate phenotypic parameter calculations and thus affecting research efficiency and the reliability of results.

As a biological image intelligent recognition and automatic measurement system, BioIMA significantly improves the efficiency of image measurements through simple interactive segmentation, real-time modification, and automatic phenotypic data extraction, addressing the lack of standardization and reproducibility in existing measurement systems.

The software primarily consists of the following modules: Control Page, Basic Mode, and Automatic Mode.

Control page: Manages and accesses user workspaces and file data.

Basic Mode: Includes angle measurement, area measurement, scale setting, color extraction, length measurement, and labeling functions. This mode is suitable for users who need to manually select regions of interest (ROIs) for measurement.

Automatic Mode: Includes auto-segmentation, auto-labeling, and automatic phenotypic measurement. Automatic mode enables efficient image analysis by allowing users to measure desired parameters with minimal clicks. This mode implements a complete workflow, including SAM model loading, image encoding, and prompt-based decoding, while supporting one-click automated measurements.

After loading the model, users only need to select the target region and provide minimal input prompts to complete segmentation. This feature not only reduces manual annotation efforts but also ensures high recognition accuracy even in complex backgrounds.

## **2. Installation**

BioIMA is currently supported on Windows operating systems (Windows 7 or later versions). The installation process is simple and straightforward, with the following detailed steps:

- (1) Download the installation package: Obtain the BioIMAsSetup.exe installer from the designated download link.
- (2) Run the installer: Double-click BioIMAsSetup.exe. If the system displays a User Account Control (UAC) prompt, click "Yes" to allow installation.
- (3) Follow the installation wizard
- (4) Optional: Create a desktop shortcut (recommended for quick access).
- (5) Automatic .NET Runtime installation (if required): If .NET 6.0 Runtime is not detected on your computer, the installer will automatically download and install it silently (Internet connection required).
- (6) Complete the installation: Click "Finish" to exit the wizard. BioIMA is now ready for use.
- (7) Launch the software: Use the desktop shortcut or BioIMA icon in the Start menu to start the application.

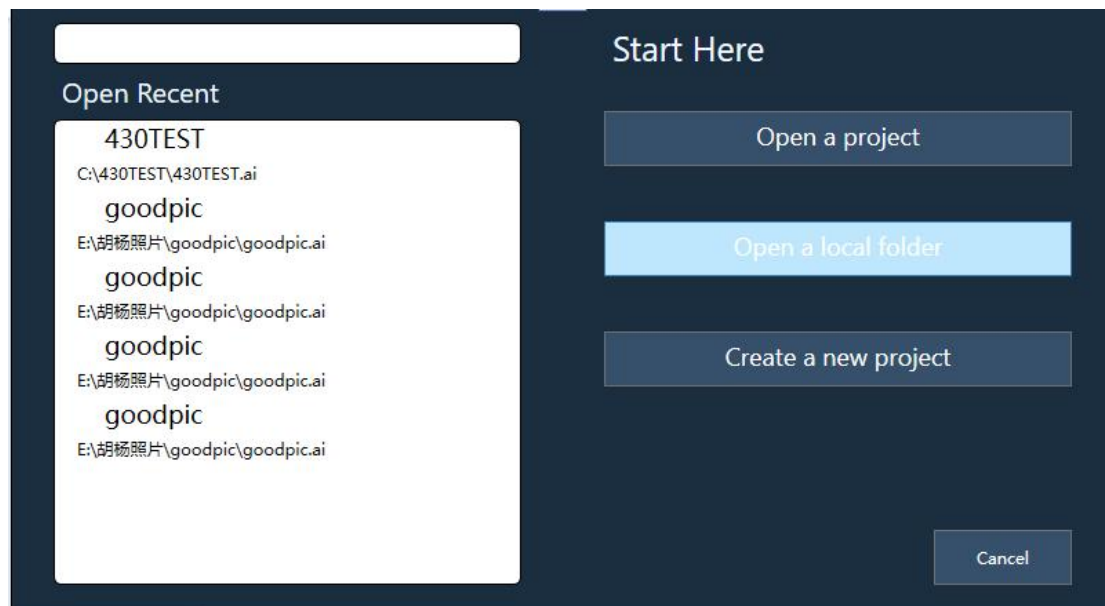
## 3. Software Functions

### 3.1 Executing the Program

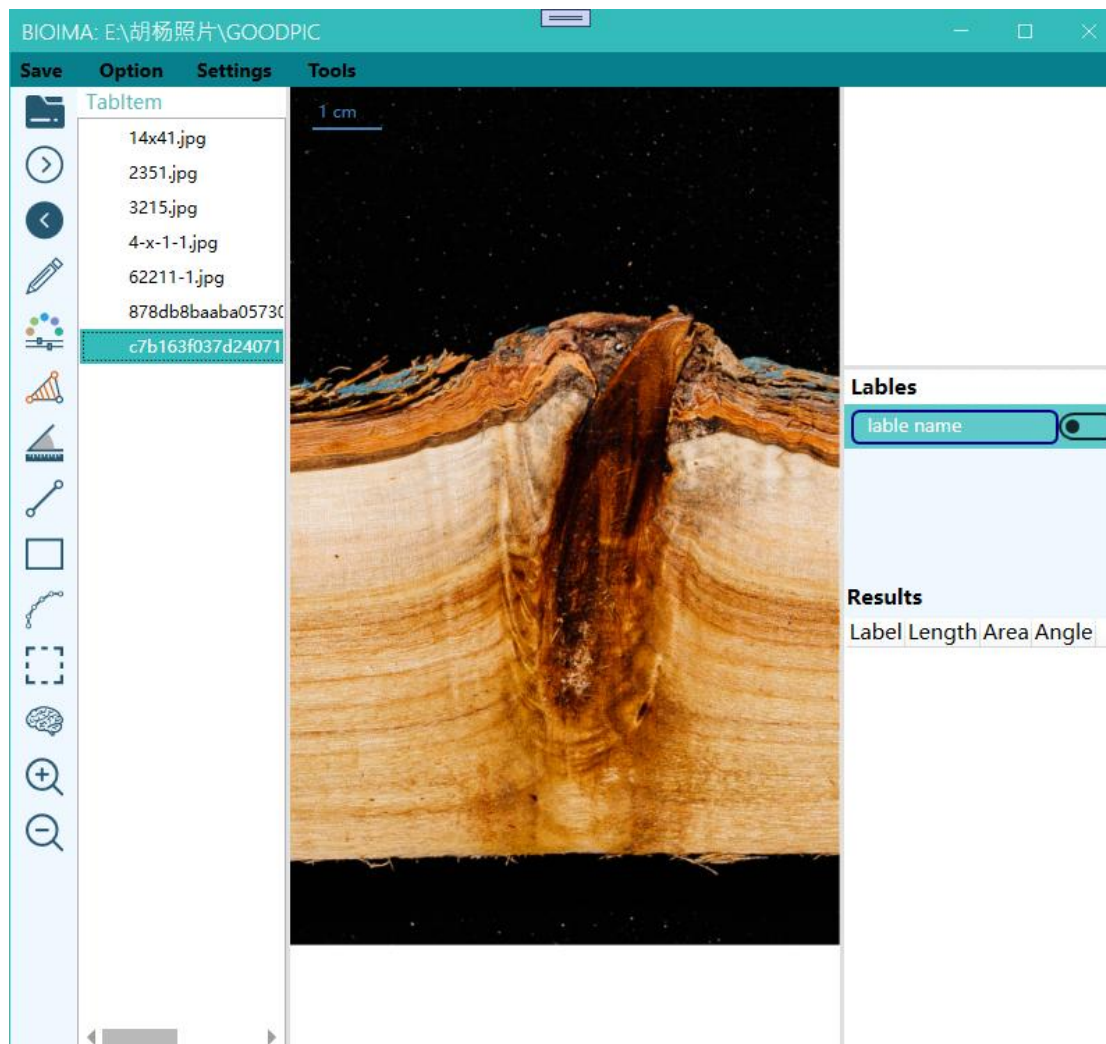
On Windows systems, after downloading and installing the software, double-click BioIMA to run the program.

### 3.2 Software Interface

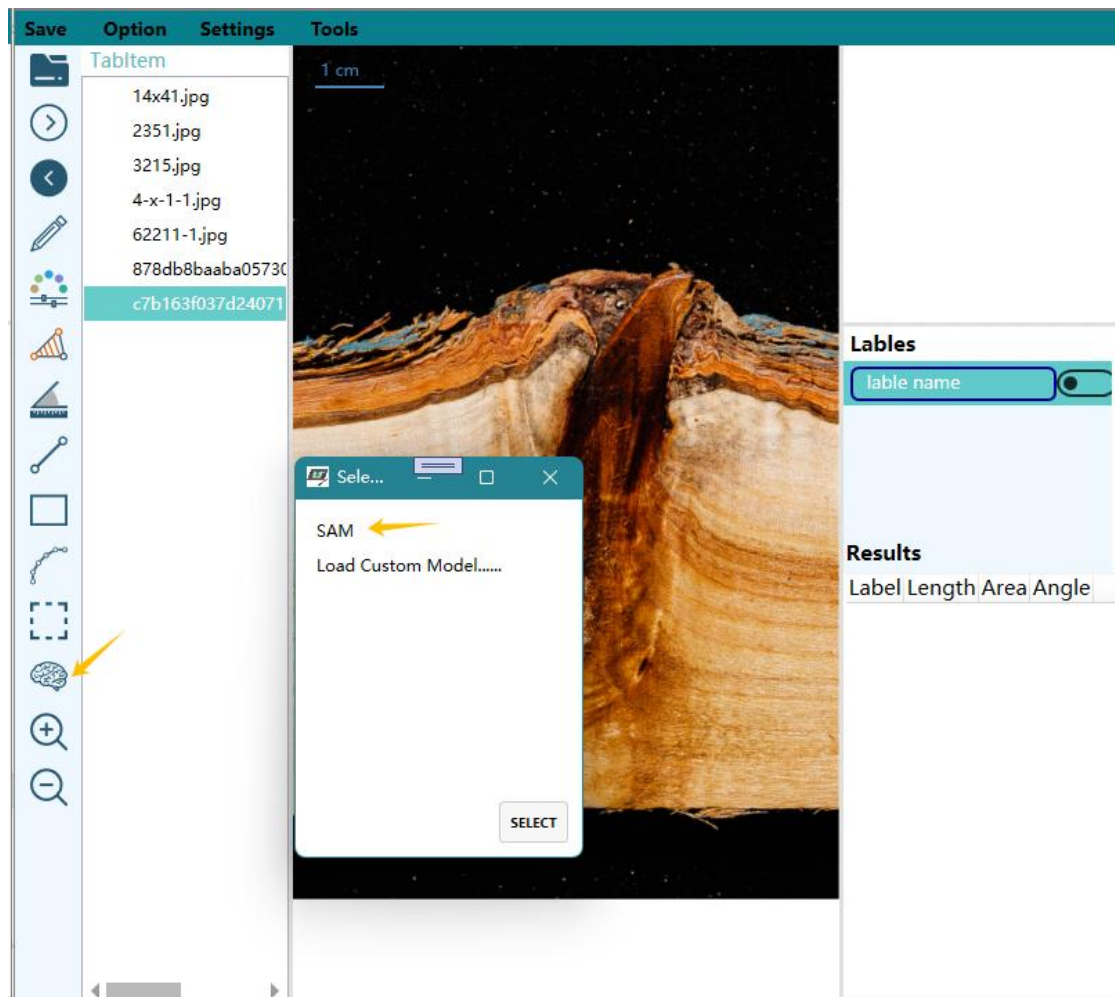
The software interface appears as follows after launching:



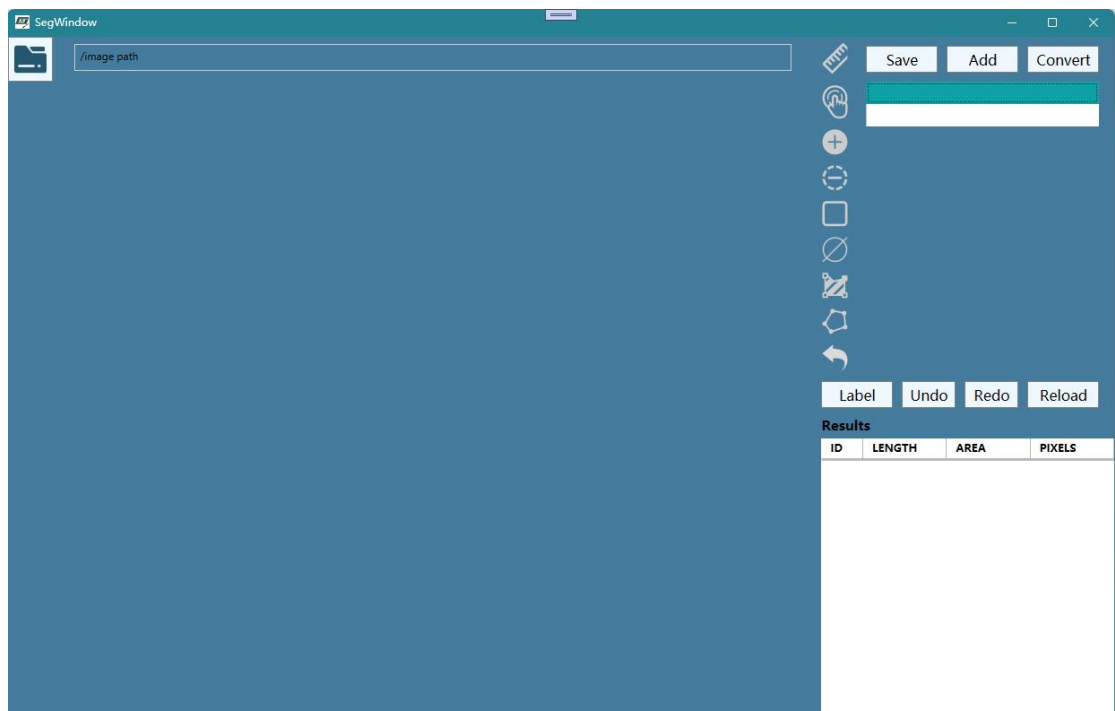
The interface after entering a project is as follows:



In the standard mode interface, click the brain icon to enter the mode selection screen:



Click **SAM** to enter the automatic mode interface:


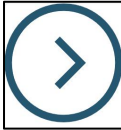
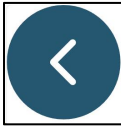



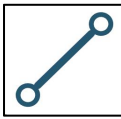
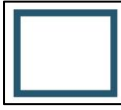


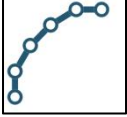
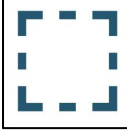



## 3.3 Main Functional Modules

### 3.3.1 Start Interface

- **Open Recent:** Recently opened folders
- **Open a Project:** Open an existing project
- **Open a Local Folder:** Open a local folder
- **Create a New Project:** Create a new project

### 3.3.2 Main Interface



-  Open File
-  Next image
-  Previous image
-  Extract Colors
-  Calculate Polygon Area
-  Measure Angle
-  Measure Length
-  Rectangular Selection

-  Polygonal Selection
-  Select & Manage Annotations
-  Select Automatic Mode
-  Zoom In
-  Zoom Out

### 3.3.3 Mode Selection Interface

**SAM:** SegmentAnythingModel, select to enter automatic mode. This feature is based on the ONNX format of the SAM (Segment Anything Model) model, designed to provide lightweight and convenient intelligent image processing and analysis capabilities locally. Users only need to input an image and use points or boxes to provide prompts. The system will automatically segment the target area and calculate various metrics for the region of interest (ROI), such as area, perimeter, and circularity.

### 3.3.4 Automatic Mode Features

-  **File:** Select the target file from the folder
-  **Scale:** Set the image size ratio





- **Select Target Area:** Choose the target area



- **Add Target Area:** Add Prompt Points for Target Region



- **Select Non-target Area:** Choose a non-target area



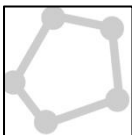
- **Box Selection:** Select the target range using a box



- **Calculate Longest Side and Circumscribed Circle Diameter:**  
Measure the longest side and the diameter of the circumscribed circle



- **Calculate Target Area:** Measure the area of the target region



- **Calculate Target Perimeter:** Measure the perimeter of the target region




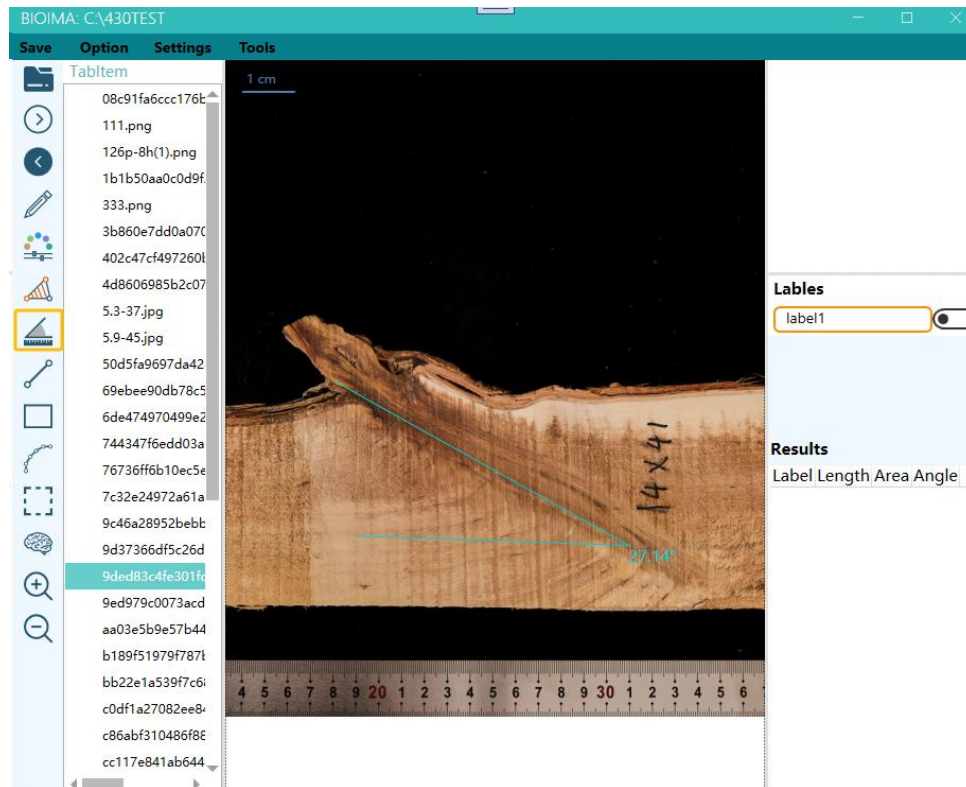
- **Delete Image Annotations:** Remove annotations from the image
- **Undo:** Undo the previous action
- **Redo:** Redo the previous action
- **Reload:** Tap on the icon to load a new image

## 4. Analysis Example

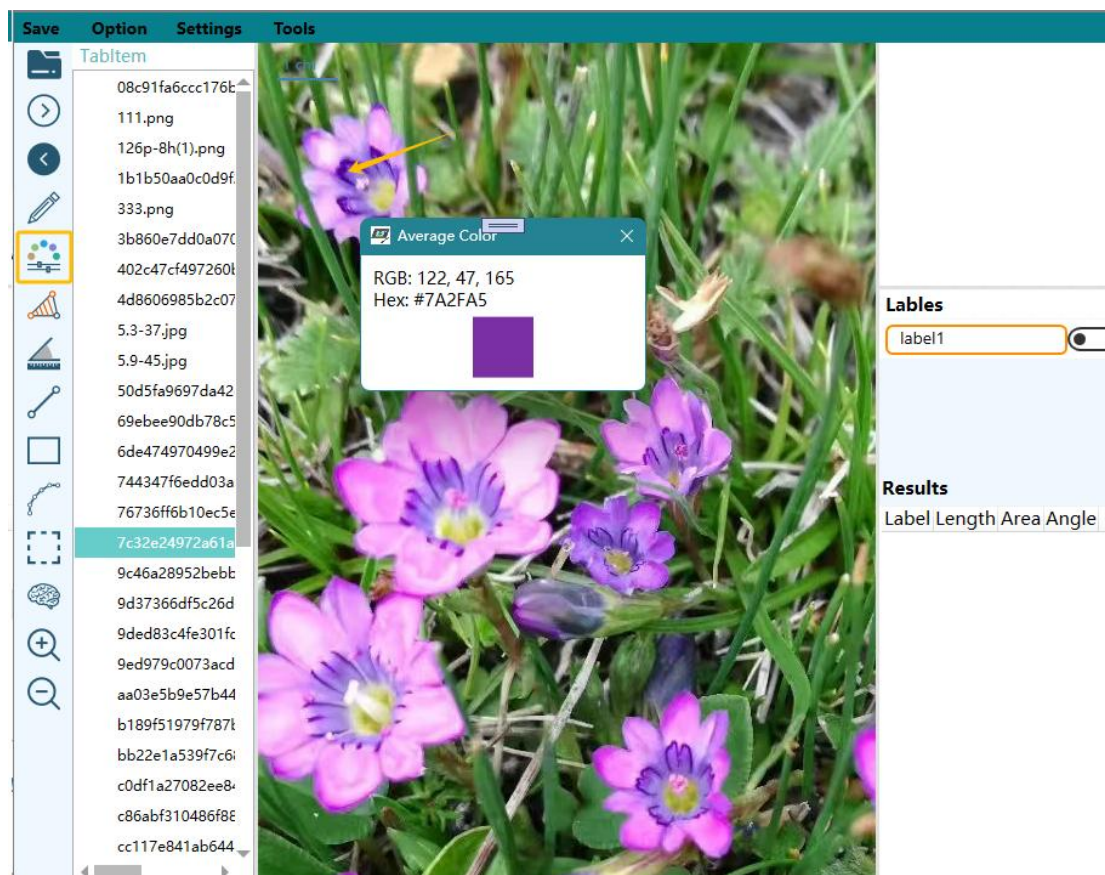
### 4.1 Standard Measurement Mode

#### 4.1.1 Angle Measurement


Click the  **Angle Measurement** button to measure angles. The first left-click will determine the starting point of the first line segment. The second click will define its endpoint and also serve as the starting point for the second line segment. The system will generate a gray auxiliary line to help locate the second line segment. Once the second line segment is completed, the angle will be automatically calculated and displayed at its starting point.

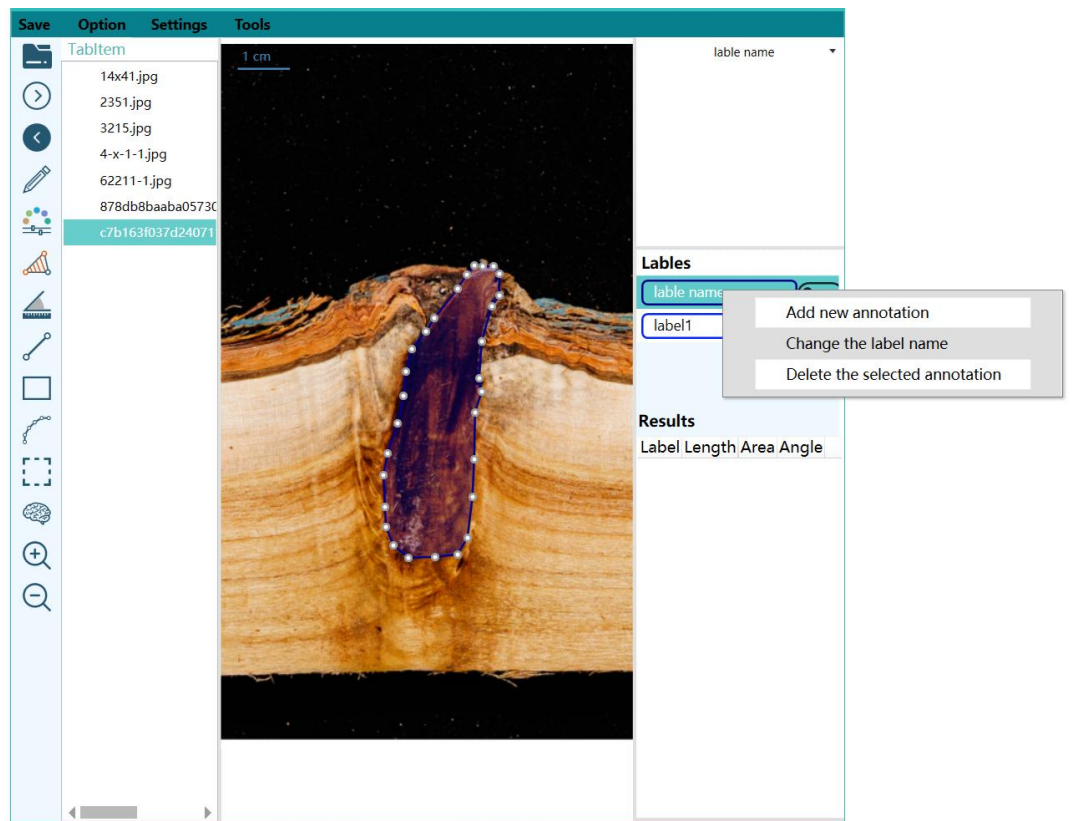


#### 4.1.2 Color Extraction

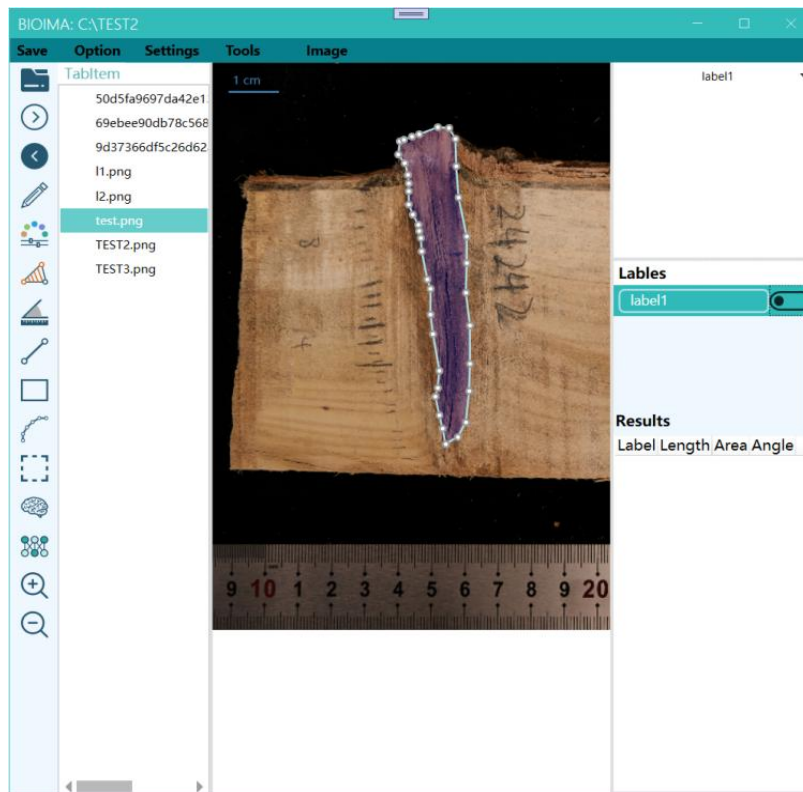


### 4.1.3 Polygon Area Measurement


Click the  **Polygon Area Measurement** button to measure the area of a polygon. On the canvas, sequentially click each vertex of the polygon to define its shape. During this process, you can right-click to confirm/finalize the polygon annotation."Click on the label box on the right to edit the label name, modify its color, or delete it.

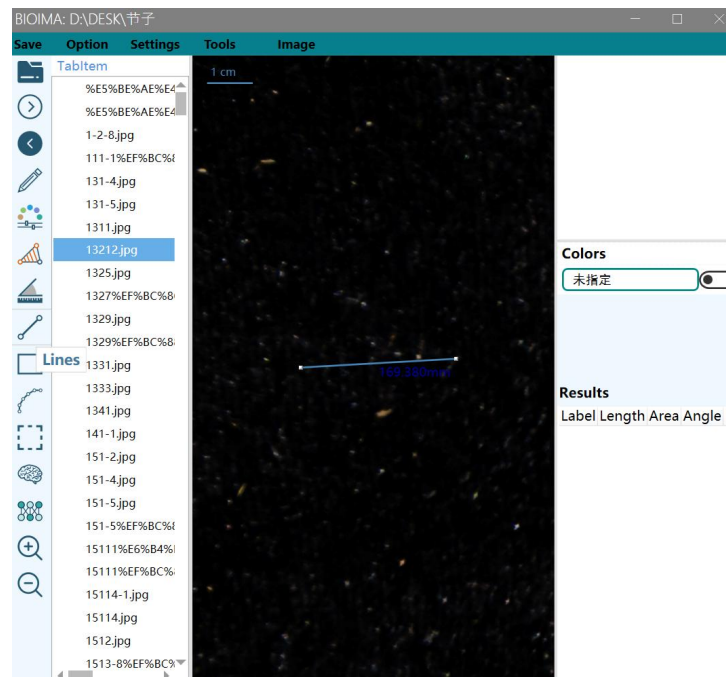


After completing vertex selection, a left-click will trigger the system to calculate and display the polygon's area.



### 4.1.3 Length Measurement

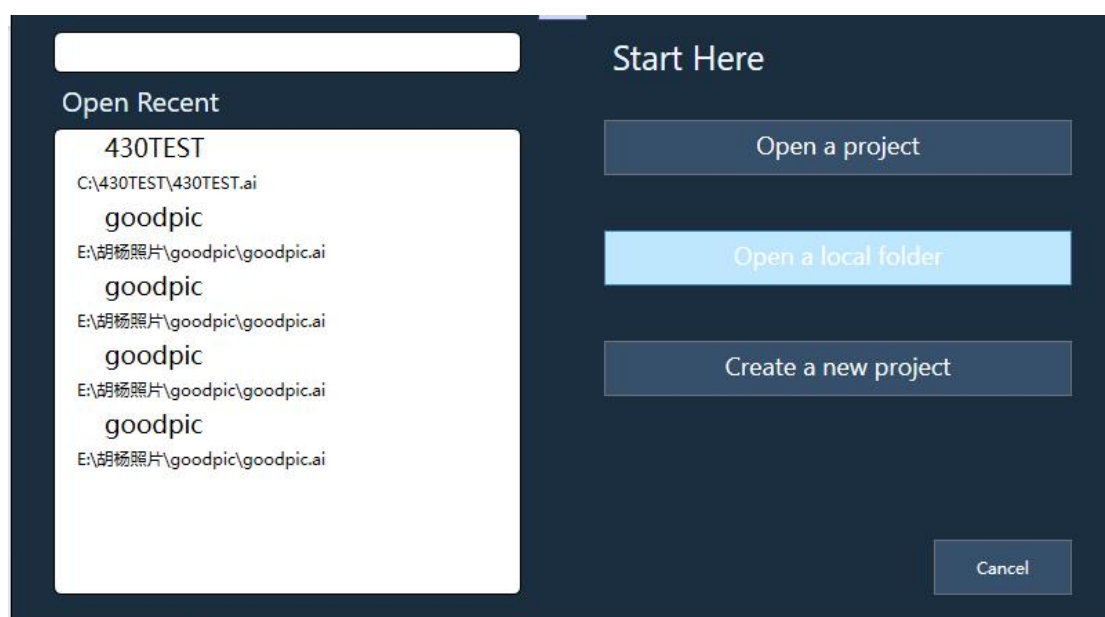
Click the  **Length Measurement** button, then click on the starting point on the canvas and drag the mouse to the endpoint to measure the distance. During the operation, a line connecting the start and end points will be displayed in real time, and the system will automatically calculate and show the distance between the two points for accurate measurement and recording.

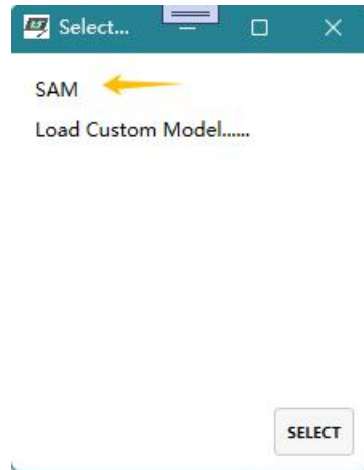


## 4.2 Automatic Measurement of Image Target Area

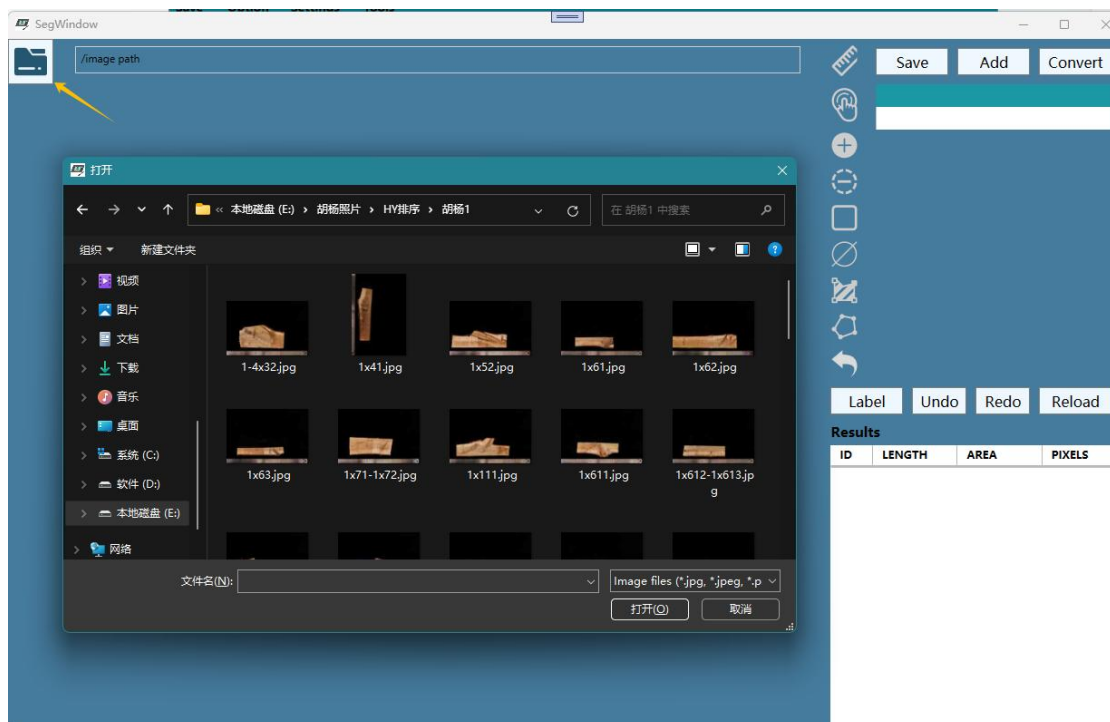
### 4.2.1 Open an Image

After opening BioIMA, select the "open a local folder" option to open the desired local folder and enter the main page. In the main page, click the "brain" icon, then select the "SAM" option to switch to the automatic analysis window and begin the relevant operations.





In the automatic analysis window, click the "File" button at the top left and select the "Open Image File" option. The system supports various common image formats such as JPG, PNG, etc., making it easy for users to import and start analyzing the desired images.

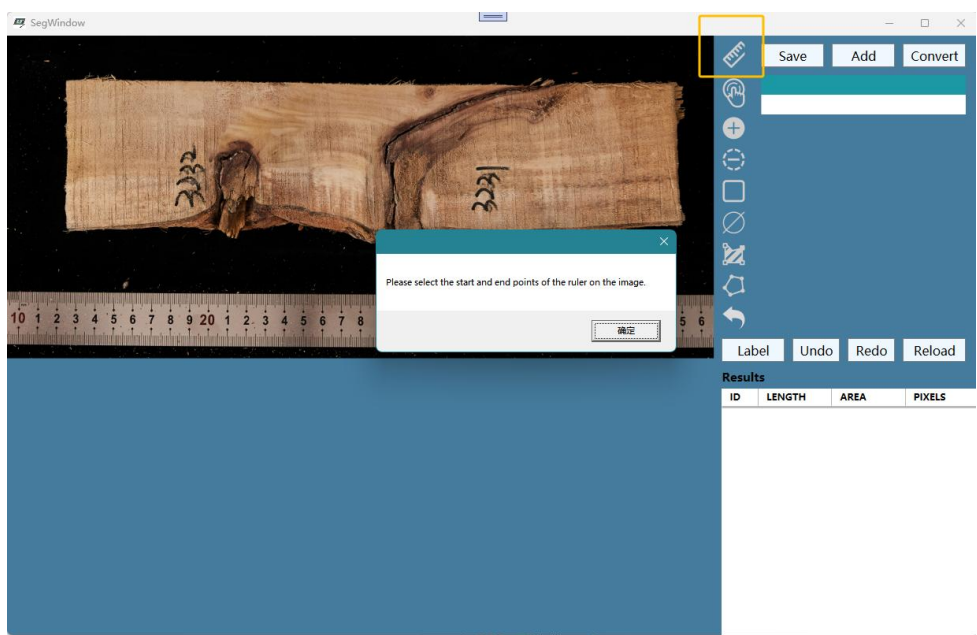
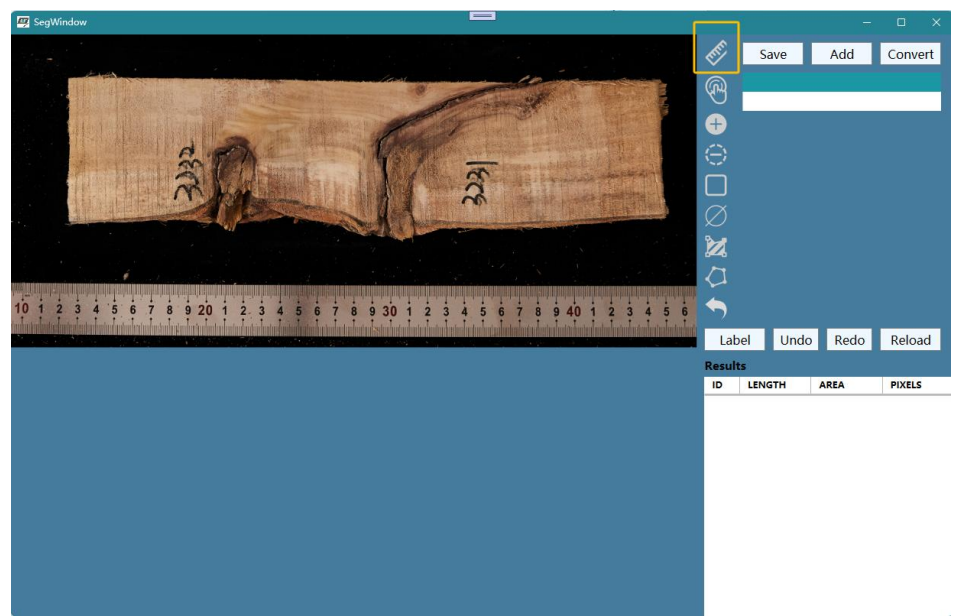


#### 4.2.2 Setting the Scale

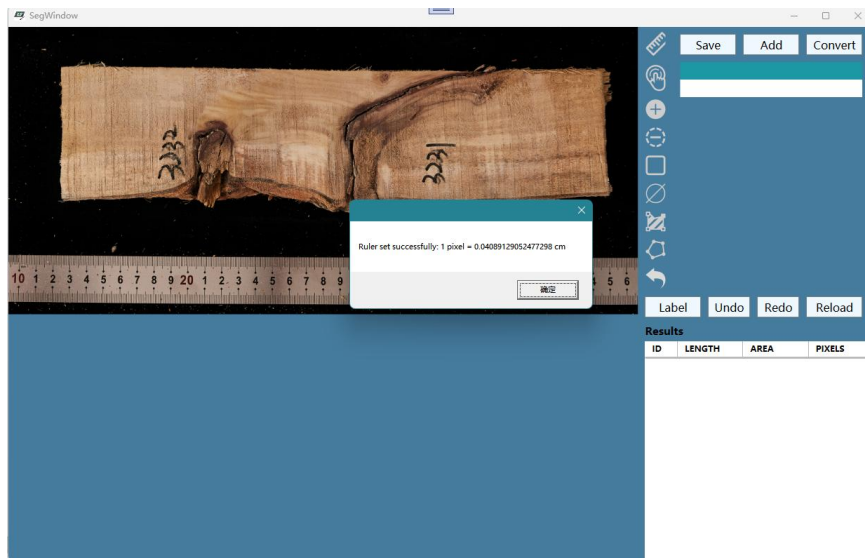
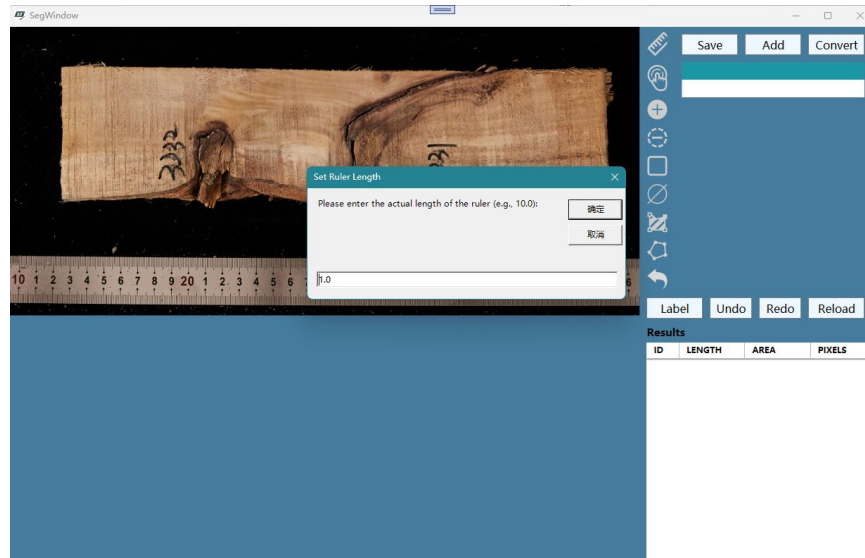
After opening the image, click the scale option in the top-right corner of the interface. Then, click on the selected scale line in the image. A prompt will appear, asking the user to input the actual length and unit of the scale line. Once the input is complete, click "Confirm" to set the scale. This scale will be used for subsequent



precise measurements, ensuring that the distance and area calculations in the image are consistent with the actual dimensions.




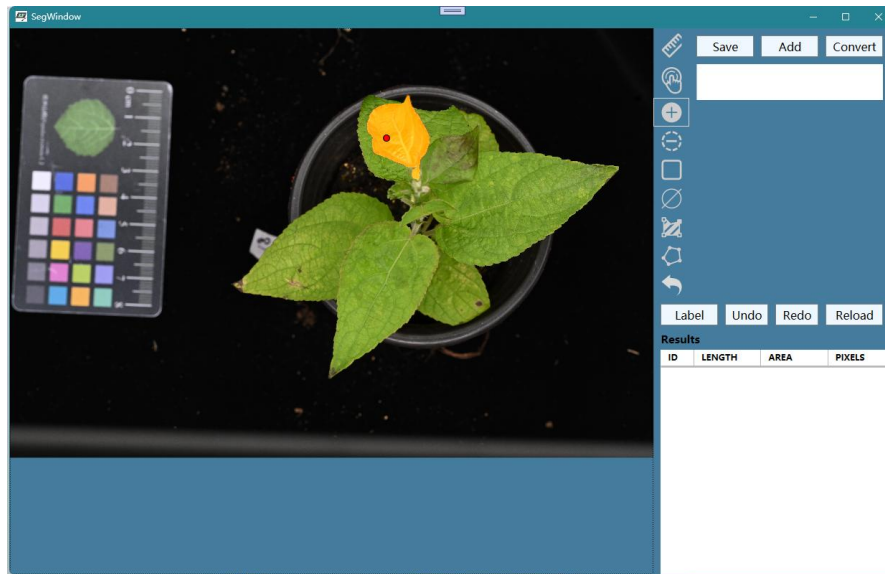




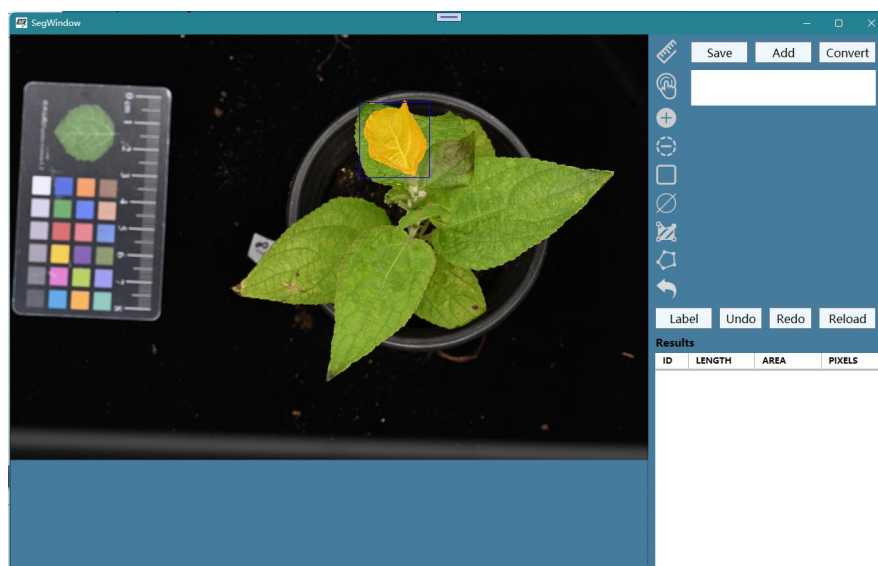
### 4.2.3 Selecting the Target Area

Click the second hand icon in the top-right corner to activate the selection function. Then, the user can click on the target area in the image. The system will automatically recognize and select that area. The model will adjust based on the selected position and highlight the chosen region, making it easier for subsequent analysis operations.


**Note:** When segmentation prompts fail (via either box selection or point clicks), ensure you've pressed the prompt button  before initiating segmentation.



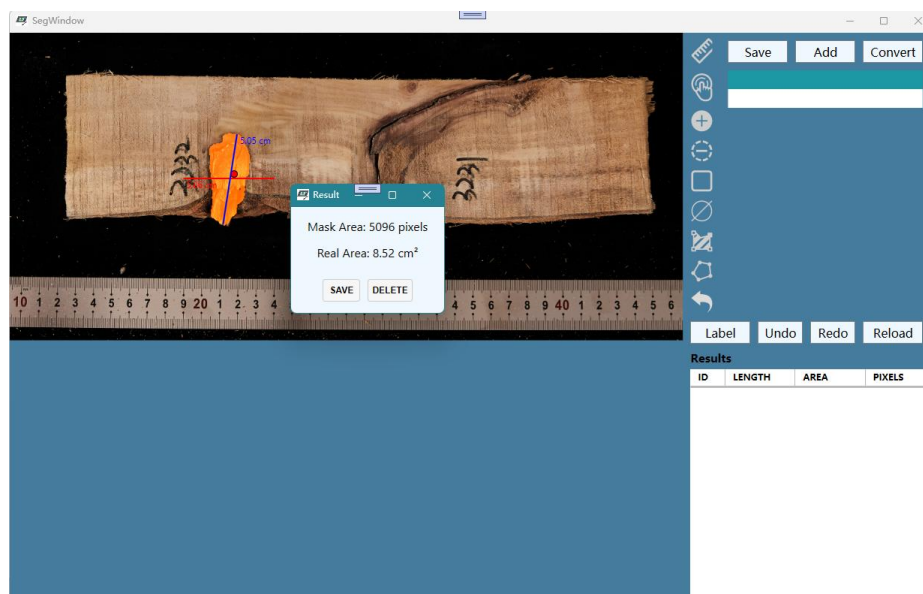
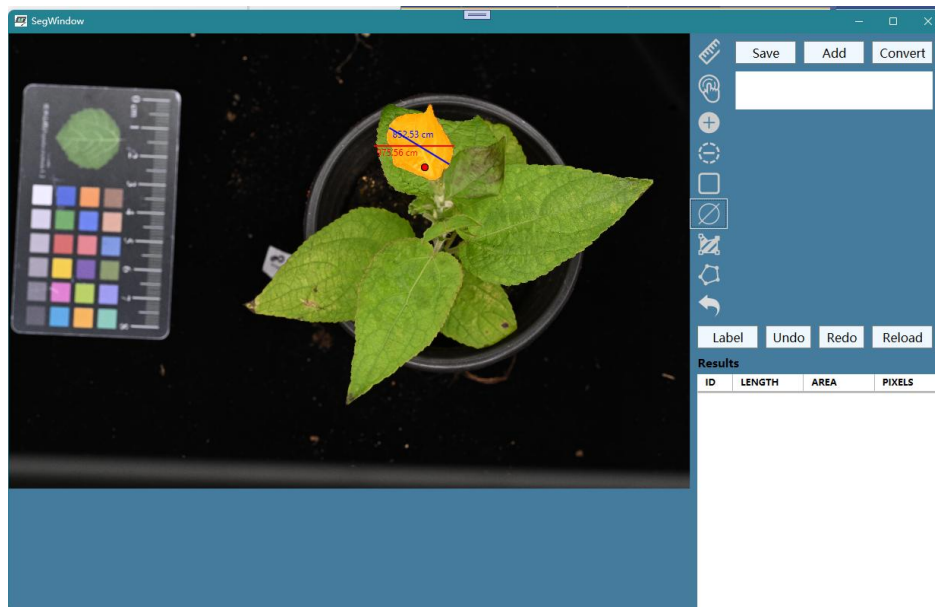
When the user needs to select a specific small area, they can use the fifth "Box Selection" button on the right. Once activated, the user simply needs to drag the mouse to draw a box in the image. The system will automatically recognize and select the target area within the box. This feature helps the user define the analysis range more precisely.




#### 4.2.4 Image Metric Measurement

Click the  button at the bottom right, and the system will automatically calculate the length of the longest edge and the diameter of the circumscribed circle

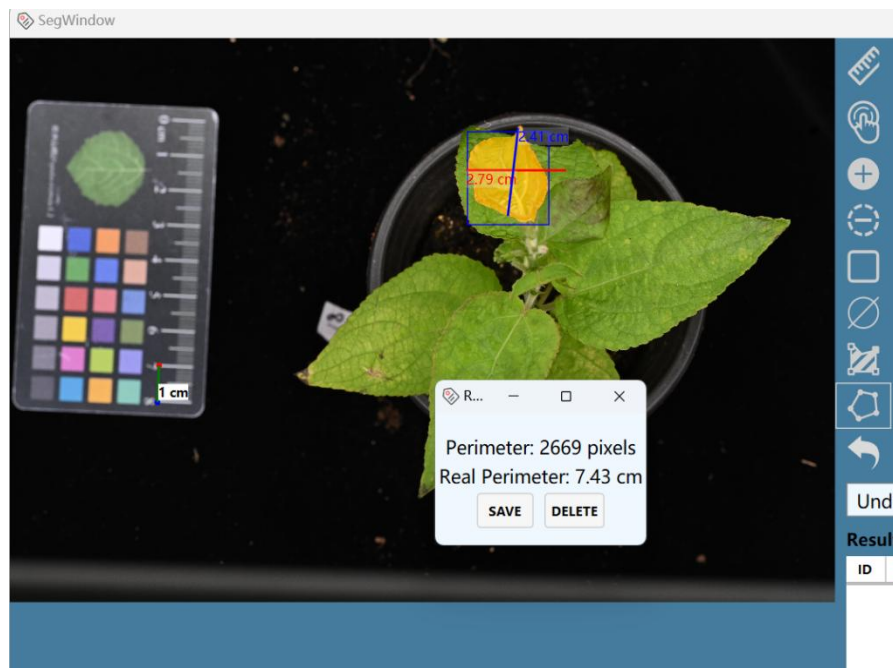
for the selected area. The calculation results will be displayed on the image, with the blue line representing the length of the longest edge and the orange line representing the diameter of the circumscribed circle, allowing users to visually view and analyze the geometric features of the selected area. The results will be displayed on the interface, and the data can be selected for copying or saving.

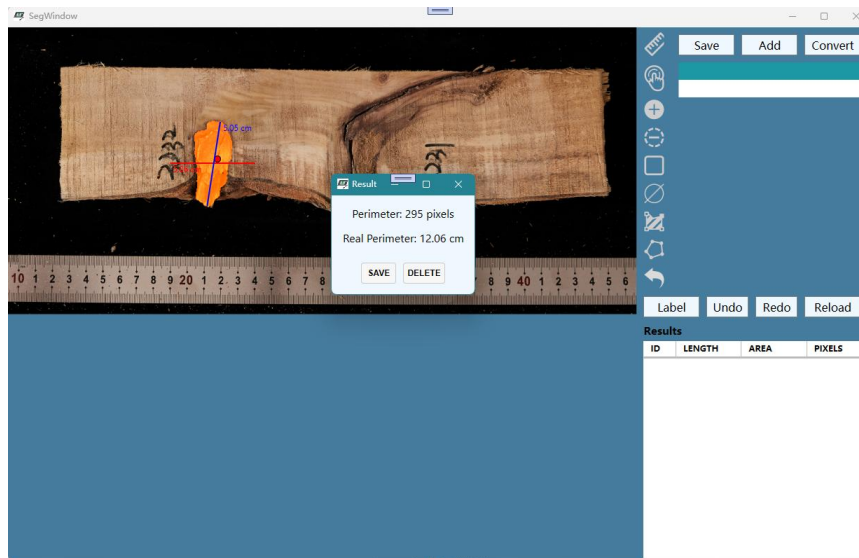


Click the  button, and the system will automatically calculate the area of the selected region. The calculation results will be displayed on the interface, and the data can be selected for copying or saving. For example, in the image shown, the area of the selected region is 3.93 cm².



Click the button, and the system will automatically calculate the perimeter of the selected region. The calculation results will be displayed on the interface, and the data can be selected for copying or saving. For example, in the image shown, the perimeter of the selected region is 7.43 cm and 12.6cm.





After completing the measurement of the current image, click the "Reload" button at the lower right corner of the interface to load a new image. This action will refresh the interface and prepare it for the next image analysis.