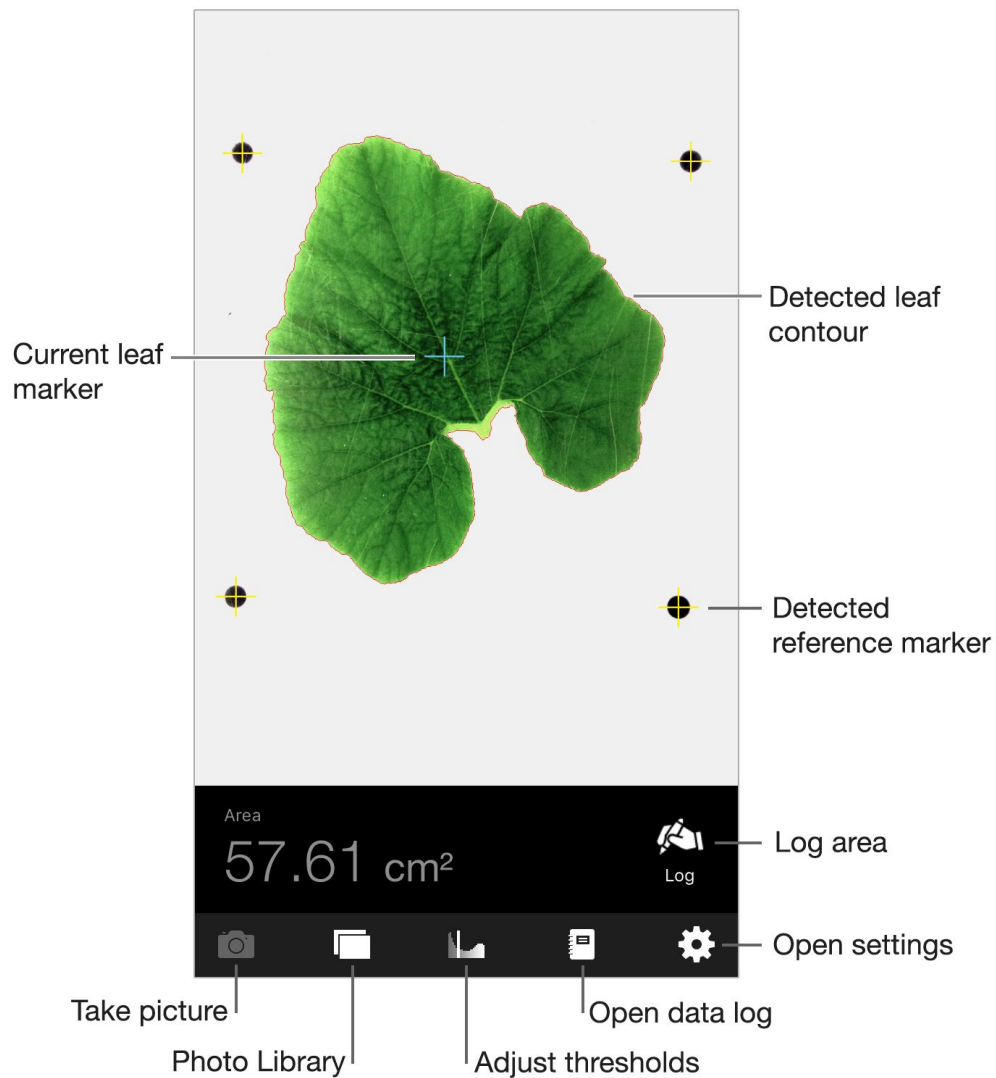# Leafscan
# User Guide

Release version 1.3.21

December 6, 2018

# Overview

Leafscan is an iOS app that measures the area of a leaf (or leaves) from a picture. It lets you take a picture with your mobile device or load one from your Photo Library. Leafscan helps you keep track of your measurements and export them as a CSV file via AirDrop, email, and more.
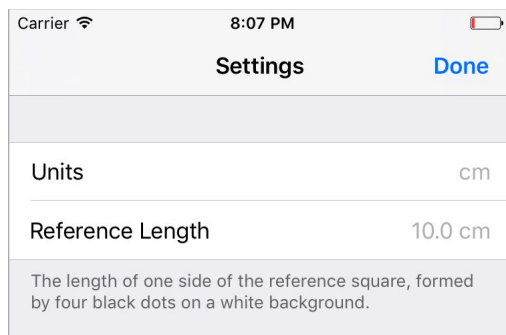
**Additional features:**

- Measure multiple leaves in one photo
- Keep track of the total area for groups of leaves
- Automatically correct for pictures taken at an angle
- Adjust the detection thresholds for better control
- Customize the measurement units (mm, cm, or in)

# Set up the leaf

**Obtain the reference markers.** In order to determine the scale of the photo and correct for the perspective, Leafscan uses four "reference markers" arranged in a square on a white background. The last page in this document contains reference markers you can use.

**Enter the reference length.** Measure the length of one side of the square formed by the reference markers. It's easier to measure the distance between the edges of the markers than between the centers. Enter this "reference length" and its units in the app's settings.

| Carrier 📶 | 8:07 PM | 🔋 |
|---|---|---|
| | **Settings** | **Done** |
| | | |
| Units | | cm |
| Reference Length | | 10.0 cm |

The length of one side of the reference square, formed by four black dots on a white background.

> **Note.** Even though the default reference length is 10 cm, you should always measure it yourself after printing the reference sheet. The actual reference length is often affected by different paper sizes and printer settings.

**Position the leaf.** Place the leaf (or leaves) you want to analyze on the white reference sheet, preferably within the reference marker space. For best results, flatten the leaf using a clear, non-glare acrylic sheet.

**Set up the leaf nondestructively.** If the leaf you want to measure is attached to the plant, it may be best to clamp a clear plastic cover over the leaf and background. Use a thick base, such as a clipboard.

# Take a picture and measure leaf area

**Take a picture.** Tap 📷 and position the phone to take a good picture. All four reference markers must be visible. Steady the camera, tap on the white circle, and accept the photo.

**Measure the area.** After taking a picture, yellow crosshairs appear on the reference markers. A thin, red contour appears around the leaf and a blue crosshair appears on its center. You can zoom in to see the contour better. Below the photo, the calculated area is displayed.

**Improve leaf detection.** The leaf should have a good contrast against the white background. Avoid angles where the leaf shines and try to exclude background objects. If the app can't detect all four reference markers, you'll need to take another picture. If the contour is wrong or the leaf is not detected at all, you can adjust the detection thresholds (see below).

**Measure multiple leaves.** If your picture has multiple leaves, tap on the leaf you want to analyze. Its area will be displayed.

**Load an existing photo.** Tap ■ and choose a photo.

**Save photos.** Photos you take from the app can be automatically saved in your Photo Library. You can enable/disable this feature in the app's settings.
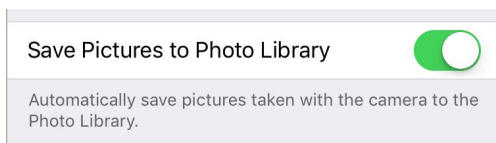


# Adjust detection thresholds

If the leaf contour doesn't wrap the leaf tightly, tap ▙ to adjust the detection thresholds.

**Adjust the saturation threshold.** Tap ⠿ to display the saturation threshold and histogram. Saturation is the intensity of color, so a typical leaf will have greater saturation than the white background. In the saturation histogram, this means that leaf pixels will cluster to the right (higher values), while background pixels will cluster to the left (lower values). Move the saturation threshold (red bar) to separate the leaf pixels from the background pixels. As you move the threshold, the leaf contour is updated.
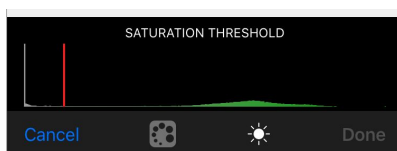


**Adjust the value threshold.** Tap ☀ to display the value threshold and histogram. Value is the intensity of light, so a typical leaf will have lower (darker) value than the white background. In the value histogram, this means that leaf pixels will cluster to the left (lower values), while

background pixels will cluster to the right (higher values). Move the value threshold (red bar) to separate the leaf pixels from the background pixels. As you move the threshold, the leaf contour is updated.
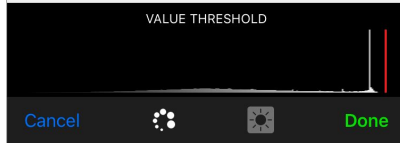


# Log area measurements

**Log the area.** Tap  to log the current leaf area to the data log. A checkmark appears next to the button label to indicate that the area was logged.

**Show the data log.** Tap  to show the data log containing a list of all the areas logged. Each log entry (or row) has a Leaf ID, which is automatically incremented after an area is logged. The Area column shows the area logged, and the Cumul. Area column shows the cumulative area of the previous log entries.

**Rename the Leaf ID.** Tap the log entry you'd like to rename. Tap ⊏⊐ and enter the new ID.

**Restart the cumulative area.** The cumulative area may be restarted on any log entry. This is useful when leaves belong to different groups (e.g., plants or treatments). To restart the cumulative area on a row, tap the row and then tap ⊕. To undo, tap the row again and then tap ⊕. A blue dot next to a row indicates that the cumulative area was restarted on that row.

**Export the log as a CSV file.** Tap ↥ and choose the destination for the CSV file.

**Delete log entries.** To delete a single log entry, swipe the row to the left and then tap the Delete button. To delete all rows, tap 🗑 and then tap the Delete All button. Deleting all rows cannot be undone.