

Figure S1: The Python code developed in this study to extract stem anatomical parameters.

1.1 Load Python library functions

```
import numpy as np
import pandas as pd
import cv2
import math, os, json
import matplotlib.pyplot as plt
from PIL import Image
from glob import glob
```

1.2 Make custom functions

```
def get_scaler(img_arr, img_height, img_width):
    """
    Get the number of pixels of the scale in the image, corresponding to a physical
    length of 500 microns
    img_arr: image in matrix format
    img_height: image height, that is, the number of pixels in the vertical direction
    img_width: image width, that is, the number of pixels in the horizontal direction
    """
    rd = img_arr[img_height//2:, img_width//2:, :] # take the lower right piece of the
    image
    mask = (rd[..., 0] >= 240) * (rd[..., 1] <= 20) * (rd[..., 2] <= 20) # True for red
    pixels, False for non-red ones
    scaler = np.max(np.sum(mask, axis = 1)) # get the number of pixels of the scale
    return scaler
```

```
def get_center(cnt):
    """
    get the shape's center point and radius
    cnt: contour points
    """
    (x,y),radius = cv2.minEnclosingCircle(cnt)
    center = (int(x),int(y))
    radius = int(radius)
    return center,radius
```

```
def vb_initial_process(points):
    """
    get initial data on vascular bundle traits, including individual vascular bundle
    areas and
    individual vascular bundle centers
    points: contour points of individual vascular bundle
    """
    if shape_type == "polygon":
```

```

        vb_center = get_center(points)[0] # get center point
        area_pixel = cv2.contourArea(points) # get area
    elif shape_type == "circle":
        vb_center, vb_round = points[0], points[1] # get center point
        r = math.dist(vb_center,vb_round) # get radius
        area_pixel = round(math.pi * r ** 2,1) # get area

    return area_pixel,vb_center

```

```

def vb_more_process(area_pixel_union,vb_center_union,stem_center):
    """
    get more data on vascular bundle traits
    area_pixel_union:Vascular bundle pixel area set
    vb_center_union:Vascular bundle center point set
    stem_center:stem center point
    """
    num = len(area_pixel_union) # get vascular bundle number
    area_sum_pixel = np.sum(area_pixel_union) # get vascular bundle area
    area_mean_pixel = np.mean(area_pixel_union) # get average vascular bundle area
    # get the set of pixel distances from vascular bundles to stem center point
    center_dist_pixel_union = [math.dist(x,stem_center) for x in vb_center_union]
    # get the average pixel distances of vascular bundles to stem center point
    center_dist_mean_pixel = np.mean(center_dist_pixel_union)
    # get the max pixel distances of vascular bundles to stem center point
    center_dist_max_pixel = np.max(center_dist_pixel_union)
    # get the min pixel distances of vascular bundles to stem center point
    center_dist_min_pixel = np.min(center_dist_pixel_union)

    return (num,area_sum_pixel,area_mean_pixel,center_dist_pixel_union,
            center_dist_mean_pixel,center_dist_max_pixel,center_dist_min_pixel)

```