Supplementary Information: On the growth and form of shoots

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I. INFLUENCE OF RELATIVE MATURATION RATE

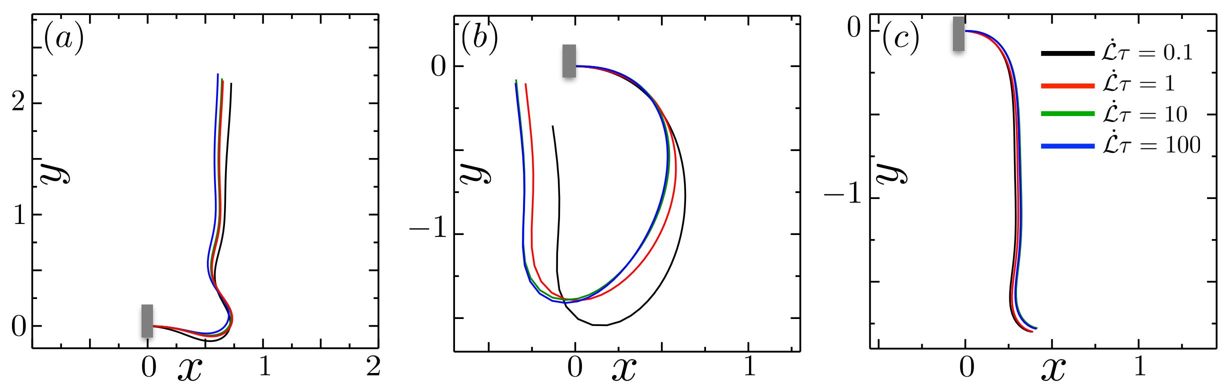

FIG. SI-1: Comparing the shapes of a growing filament for various values of relative maturation rate, $\dot{\mathcal{L}}\tau$ for sensitivity parameter $\mathcal{S} = 5$ and for three values elasticity parameter, (a) $\mathcal{E} = 1.14$,(b) $\mathcal{E} = 1.26$ and (c) $\mathcal{E} = 1.52$.

Here we examine the influence of the maturation rates on the growth morphologies in plant shoots. The relative maturation rate is controlled by the parameter $\dot{\mathcal{L}}_0\tau$ which we allow to vary in the range $[0.1 - 100]$. In Fig.SI-1 we show the observed shapes for various values of $\dot{\mathcal{L}}_0\tau$ and the elasticity parameter $\mathcal{E}$ for the sensitivity $\mathcal{S} = 5$, obtained by solving (2.4)-(2.7) of the main text. As $\mathcal{S}$ is relatively large, the actual shape of the shoots will influence the time dependent growth and the differences due to variations in $\dot{\mathcal{L}}_0\tau$ are expected to get amplified at long time.

However, there are no significant variations in the qualitative morphologies seen, even though there are quantitative differences.

II. INFLUENCE OF RELATIVE GROWTH ZONE LENGTH

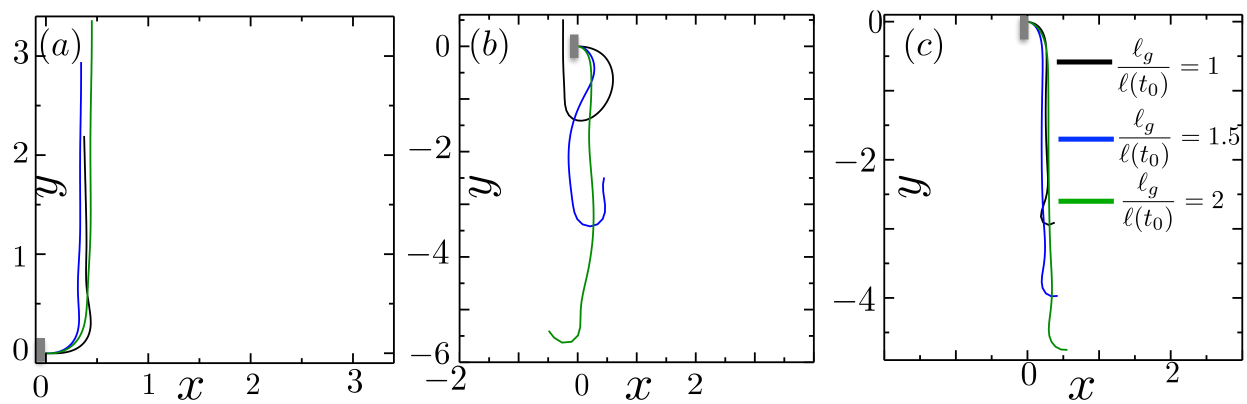

FIG. SI-2: The shapes of a growing filament for different relative length of growth zone $\ell_g/\ell(t_0)$. (a) Negative gravitropism for sensitivity parameter $\mathcal{S} = 5$ and elasticity parameter $\mathcal{E} = 0.7$. (b) Model shoot showing gravitropic sign reversal. The parameter regime where this behavior is observed varies depending on $\ell_g/\ell(t_0)$. (top to bottom) $\mathcal{S} = 5$, $\mathcal{S} = 6$, $\mathcal{S} = 7$ and for $\mathcal{E} = 1.3$. (c) Positive gravitropism observed for $\mathcal{E} = 1.52$ and $\mathcal{S} = 5$.

To test the dependence of the shapes of growing shoots on the value of the length of growing zone, ℓ_g relative to the initial length of the shoot, we chose various values of $\ell_g/\ell(t_0)$. Since the initial condition is always assumed to be a young shoot, we only consider cases with $\ell_g \geq \ell(t_0)$. Fig. SI-2 shows the results obtained for values of $\ell_g/\ell(t_0) = 1, 1.5$ and 2. The simulations show that the shoot basically displays same morphologies for all three values of ℓ_g. When the gravitropic sensitivity $\mathcal{S}$ dominates, the shoots always display negative gravitropism (Fig. SI-2(a)), whereas when elasticity parameter $\mathcal{E}$ dominates, they display positive gravitropism (Fig. SI-2(c)). When both these parameters are equally significant, the shoots display gravitropic reversal (Fig SI-2(b)). However, the parameter values where this reversal is observed shift to larger values with an increase in ℓ_g. Therefore, we again conclude that the qualitative features of the morphospace are independent of the value of ℓ_g, although the parameter values for which the shape transition occurs vary for large $\mathcal{E}$ and $\mathcal{S}$.

III. SIMULATION MOVIES

MOVIE1: Negative gravitropism observed in the massless limit for $\mathcal{S} = 2.5$, and $\mathcal{E}$=0

MOVIE2: Reversal of growth direction for $\mathcal{S} = 2.5$, and $\mathcal{E}$=1

MOVIE3: Reversal of growth direction for $\mathcal{S} = 3$, and $\mathcal{E}$=1.2

MOVIE4: Effectively positive gravitropism observed for $\mathcal{S} = 3$, and $\mathcal{E} = 1.5$.

The movies show the growing shoot for different values of the sensitivity parameter $\mathcal{S}$, and the elasticity parameter $\mathcal{E}$. The green color corresponds to the young, soft shoot while the brown color corresponds to the older stiffer shoot.