

Table S1. Inputs for the gene regulatory network

Protein activity profiles		
$[Dpp]_\alpha = -0.5 * \tanh(cdpp1/cw * X_{c_\alpha} - cdpp1 * cdpp2) + 0.5$		
$[Wg]_\alpha = -0.5 * cwg4 * \tanh(cwg1/cwg3 * Y_{c_\alpha} - cwg1 * cwg2) + 0.5 * cwg4$		
$[N]_\alpha = 1 \text{ if } Y_{c_\alpha} < 1.5, \text{ else } [N]_\alpha = 0$		
Variables		
Xc: X position of the center of mass of a cell		
Yc: Y position of the center of mass of a cell		
cw: compartment width (maximum Xc for cells where Xc>0; - minimum Xc if Xc <0)		
Values of constants		
cdpp1=5	cwg1=2	cwg3=50
cdpp2=0.7	cwg2=0.5	cwg4=1.14
Mechanical compression		
$\text{comp}_\alpha = -Aw_\alpha + 0.5$		
$Aw_\alpha = (A_{0_\alpha} + 2*A_{1_\alpha} + 2*A_{2_\alpha})/5$		
Variables		
A0: area of the α^{th} cell		
A1: average area of the first neighbors of the α^{th} cell		
A2: average area of the second neighbors of the α^{th} cell		

Table S2. Calculation of protein activities within the network

$[Brk]_\alpha = 1 - [Dpp]_\alpha$				
$[Arm]_\alpha = carm1 * [Wg]_\alpha * (comp_\alpha + carm2); [Arm] \geq 0$				
$[VgBE]_\alpha = cvgbe * [N]_\alpha$				
$[Fj]_\alpha = [Vg]_\alpha$				
$[Ds]_\alpha = cds1 - cds2 * comp_\alpha - cds3 * Vg_\alpha; [Ds] \geq 0$				
$[D]_\alpha = Dassym_\alpha * (cd1 * [Ds]_\alpha - cd2 * [Fj]_\alpha); 0 \leq [D]_\alpha \leq cd3$ $Dassym_\alpha = (Xgradw_\alpha^2 + Ygradw_\alpha^2)^{0.5} - cd4; Dassym_\alpha \geq 0$ $Xgradw_\alpha = (Xgrad0_\alpha + 3 * Xgrad1_\alpha + 2.5 * Xgrad2_\alpha + 2 * Xgrad3_\alpha + 1 * Xgrad4_\alpha) / 9.5$ $Ygradw_\alpha = (Ygrad0_\alpha + 3 * Ygrad1_\alpha + 2.5 * Ygrad2_\alpha + 2 * Ygrad3_\alpha + 1 * Ygrad4_\alpha) / 9.5$ $Xgrad_\alpha = \sum_\beta (Xc_\beta - Xc_\alpha) / \Delta_\beta * (GradInput_\beta - GradInput_\alpha)$ $Ygrad_\alpha = \sum_\beta (Yc_\beta - Yc_\alpha) / \Delta_\beta * (GradInput_\beta - GradInput_\alpha)$ $\Delta_\beta = ((Xc_\beta - Xc_\alpha)^2 + (Yc_\beta - Yc_\alpha)^2)^{0.5}$ $GradInput_\alpha = cd5 * [Fj]_\alpha - cd6 * [Ds]_\alpha$				
$[Yki]_\alpha = cyki1 + cyki2 * [D]_\alpha - ckyi3 * comp_\alpha; [Yki] \geq 0$				
$\delta [VgQE]_\alpha / \delta t = VgQEind - cvgqe1 * VgQE \text{ (if } [N]_\alpha = 0\text{)}$ $VgQEind = cvgqe2 + (cvgqe3 + cvgqe4 * [Dpp]_\alpha - cvgqe5 * [Brk]_\alpha) * [Arm]_\alpha$ $* (1 + cvgqe6 * [Yki']_\alpha) \text{ (VgQEind} \geq 0\text{)}$ $VgQE_\alpha = 0 \text{ (if } [N]_\alpha = 1\text{)}$ $Yki'_\alpha = Yki_\alpha - cvgqe7; Yki'_\alpha \geq 0$				
$[Vg]_\alpha = [VgQE]_\alpha + [VgBE]_\alpha$				
Values of constants				
carm1=5	cds3=0.3	cd5=0.3	cvgqe1=0.28	cvgqe6=1.2
carm2=0.2	cd1=1	cd6=2	cvgqe2=-1.2	cvgqe7=1
cvgbe=1	cd2=0.1	cyki1=1	cvgqe3=0.6	
cds1=1.3	cd3=2	cyki2=0.7	cvgqe4=0.4	
cds2=4	cd4=0.17	cyki3=3	cvgqe5=0.4	

Table S3. Simulation of the different mutants

Uniform Dpp signaling	$[Dpp]_\alpha=1$
Brk^0	$[Brk]_\alpha=0$
Brk^0/Dpp^0	$[Dpp]_\alpha=0; [Brk]_\alpha=0$
Induction of uniform Dpp	$[Dpp]_\alpha=1$ if $t>60$ hrs
Induction of Tkv^{QD} clones	$[Dpp]_{\text{clone}}=3$ if $t>60$ hrs
Vg^0	$[Vg]_\alpha=0$
Vg overexpression	$[Vg]_\alpha=[VgBE]_\alpha+[VgQE]_\alpha+8$
Induction of Ds^\uparrow -clones	$[Ds]_{\text{clone}}=5$ if $t>60$ hrs
Induction of Fj^\uparrow -clones	$[Fj]_{\text{clone}}=4$ if $t>60$ hrs
Tkv^{QD} under Spalt enhancer	Dpp profile: $cdpp1=50$; $cdpp2=0.6$
Ap^0	$[N]_\alpha=0; [Wg]_\alpha=0.1$
$Ap^0 + Nrt-Wg$	$[N]_\alpha=0; [Wg]_\alpha=1$
$Ap^0 + Nrt-Wg + Vg^\uparrow$ -clone	$[N]_\alpha=0; [Wg]_\alpha=1;$ $[Vg]_{\text{clone}}=[VgBE]+[VgQE]+1$
Vg^0 / uniform Dpp signaling	$[Vg]_\alpha=0; [Dpp]_\alpha=1$
D^0	$[D]_\alpha=0;$

Table S4. Sensitivity analysis of final size and features related to growth dynamics

		Final size (fold change)	Growth rate decrease (\times factor 10)					
Original		1.0		+ +	+ +	+ +	+ +	+ +
2*cg1	0.02							
0.5*cg1	$\sim 12^1$		-	-	-	-	-	-
2*cg2	$\geq 20^1$		-	-	-	-	-	-
0.5*cg2	0.03		-	-	-	-	-	-
2*cg3	5.8		-	-	-	-	-	-
0.5*cg3	0.4		-	-	-	-	-	-
2*cg4	1.2		-	-	-	-	-	-
0.5*cg4	1.0		-	-	-	-	-	-
2*cg5	0.7		-	-	-	-	-	-
0.5*cg5	1.4		-	-	-	-	-	-
2*cdpp1	1.1		-	-	-	-	-	-
0.5*cdpp1	0.7		-	-	-	-	-	-
2*cdpp2	3.0		-	-	-	-	-	-
0.5*cdpp2	0.3		-	-	-	-	-	-
2*cwg1	2.1		-	-	-	-	-	-
0.5*cwg1	0.6		-	-	-	-	-	-
2*cwg2	3.1		-	-	-	-	-	-
0.5*cwg2	0.5		-	-	-	-	-	-
2*cwg3	1.4		-	-	-	-	-	-
0.5*cwg3	0.8		-	-	-	-	-	-
2*cwg4	$\sim 5^1$		-	-	-	-	-	-
0.5*cwg4	0.4		-	-	-	-	-	-
2*carm1	$\sim 5^1$		-	-	-	-	-	-
0.5*carm1	0.4		-	-	-	-	-	-
2*carm2	$\sim 4^1$		-	-	-	-	-	-
0.5*carm2	0.4		-	-	-	-	-	-
2*cvgbe	1.0		-	-	-	-	-	-
0.5*cvgbe	0.6		-	-	-	-	-	-

Table S5. Sensitivity analysis of experimental features related to the Dpp gradient model

2*cfj	+	-	+	+	+	+	+	+	+	+
0.5*cfj	+	-	+	+/-	+	+	+	+	+	+
2*cds1	+	+/-	+	-	+	-	-	+/-	+/-	+
0.5*cds1	+	-	+	-	+	+	+	+	+	+
2*cds2	+	+	+	+	+	-	+	-	+	+
0.5*cds2	+	-	+	-	+	+/-	+/-	+/-	+/-	+/-
2*cds3	+	-	+	+/-	+	+	+	+	+	+
0.5*cds3	+	+/-	+	+	+	+	+	+	+	+
2*cd1	+	+	+	+	+	+/-	+	+	+	+
0.5*cd1	+	-	+	+/-	+	+	+	+	+	+
2*cd2	+	-	+	+/-	+	+	+	+	+	+
0.5*cd2	+	+	+	+	+	+	+	+	+	+
2*cd3	+	+	+	+	+	+	+	+	+	+
0.5*cd3	+	-	+	+/-	+	+	+	+	+	+
2*cd4	+	-	+	+	+	+	+	+	+	+
0.5*cd4	+	+	+	+	+	+	+	+	+	+
2*cd5	+	+	+	+	+	+	+	+	+	+
0.5*cd5	+	-	+	-	+	+	+	+	+	+
2*cd6	+	+	+	+	+	+/-	+	+/-	+/-	+
0.5*cd6	+	-	+	+/-	-	+	+	+	+	+
2*cyki1	+	- ¹	+ ¹	*	+ ¹	- ¹	+ ¹	*	- ¹	
0.5*cyki1	+	+	+	-	-	+	+/-	+/-	+/-	-
2*cyki2	+	+	+	+	+	+/-	+	+	+	+
0.5*cyki2	+	-	+	+/-	+	+	+	+	+	+
2*cyki3	+	-	+	+	+	+/-	+	+	+	+/-
0.5*cyki3	+	+	+	-	+	+	+	+	+	+
2*cvgqe1	+	-	+	+/-	-	+	+	+	+	+
0.5*cvgqe1	+	+	+	-	+	+	+	+	+	+
2*cvgqe2	+	-	+	+	-	+	+/-	+	+	-
0.5*cvgqe2	+	+	+	-	+	-	+	-	+	+/-
2*cvgqe3	+	+	+	-	+	-	+	-	+	+/-
0.5*cvgqe3	+	-	+	+	+	+	+	+	+	-
2*cvgqe4	+	+	+ ¹	-	+	+	+	+/-	+/-	+
0.5*cvgqe4	+	-	+	+	+	+	+	+	+	+/-
2*cvgqe5	+	+/-	+	+	+	+	+	+	+	+
0.5*cvgqe5	+	+/-	+	+/-	+	+	+	+	+	+
2*cvgqe6	+	+/-	+	+/-	+	+	+	+	+	+
0.5*cvgqe6	+	+/-	+	+/-	+	+	+	+	+	+

Table S6. Sensitivity analysis of experimental features related to the Vg feed-forward mechanism

Original													
2*cgl 0.5*cgl													Absence of vg-QE activity in DV boundary of wild-type
2*cg2 0.5*cg2													Presence of vg-QE activity outside DV boundary in wild-type
2*cg3 0.5*cg3													Absence of vg-QE activity in an ap ⁰ mutant
2*cg4 0.5*cg4													Absence of vg-QE activity in an ap ⁰ /nrt-Wg mutant
2*cg5 0.5*cg5													Autonomous vg-QE induction by vg in an ap ⁰ /nrt-wg mutant
2*cdpp1 0.5*cdpp1													Absence of vg-QE activity in an ap ⁰ /nrt-Wg mutant
2*cdpp2 0.5*cdpp2													Non-autonomous vg-QE induction by vg in an ap ⁰ /nrt-wg mutant
2*cwg1 0.5*cwg1													Absence of vg-QE activity in an ap ⁰ /nrt-Wg mutant
2*cwg2 0.5*cwg2													Autonomous vg-QE induction by vg in an ap ⁰ /nrt-wg mutant
2*cwg3 0.5*cwg3													Non-autonomous vg-QE induction by vg in an ap ⁰ /nrt-wg mutant
2*cwg4 0.5*cwg4													Non-autonomous vg-QE induction by vg in an ap ⁰ /nrt-wg mutant
2*carm1 0.5*carm1													Absence of vg-QE activity in an ap ⁰ /nrt-Wg mutant
2*carm2 0.5*carm2													Autonomous vg-QE induction by vg in an ap ⁰ /nrt-wg mutant
2*cvgbe 0.5*cvgbe													Non-autonomous vg-QE induction by vg in an ap ⁰ /nrt-wg mutant

2*cfj	+	+	+	+	+	+
0.5*cfj	+	+	+	+	+	+
2*cds1	+	+	+	+	-	+
0.5*cds1	+	+	+	+	+	-
2*cds2	+	+	+	-	+	+
0.5*cds2	+	+	+	+	+	+
2*cds3	+	+	+	+	+	+
0.5*cds3	+	+	+	+	+	+
2*cd1	+	+	+	+	-	+
0.5*cd1	+	+	+	+	-	-
2*cd2	+	+	+	+	+	+
0.5*cd2	+	+	+	+	+	+
2*cd3	+	+	+	+	+	+
0.5*cd3	+	+	+	+	+	+
2*cd4	+	+	+	+	+	+
0.5*cd4	+	+	+	+	+	+
2*cd5	+	+	+	+	+	+
0.5*cd5	+	+	+	+	+	+
2*cd6	+	+	+	-	+	+
0.5*cd6	+	+	+	+	+	-
2*cyki1	+	+	+	-	¹ +	¹ +
0.5*cyki1	+	+	+	+	-	-
2*cyki2	+	+	+	+	+	+
0.5*cyki2	+	+	+	+	+	-
2*cyki3	+	+	+	+	+	-
0.5*cyki3	+	+	+	+	+	+
2*cvgqe1	+	+	+	+	+	+
0.5*cvgqe1	+	+	+	+	+	+
2*cvgqe2	+	-	+	+	-	-
0.5*cvgqe2	+	+	+	-	+	+
2*cvgqe3	+	+	+	-	+	+
0.5*cvgqe3	+	+	+	+	-	-
2*cvgqe4	+	+	+	-	+	+
0.5*cvgqe4	+	+	+	+	+	+
2*cvgqe5	+	+	+	+	+	+
0.5*cvgqe5	+	+	+	+	+	+
2*cvgqe6	+	+	+	-	+	+
0.5*cvgqe6	+	+	+	+	+	-

Table S7. Sensitivity analysis of experimental features related to the mechanical force models

	Original	Build-up of a proximo-distal compression gradient in wild-type	Wedge-shaped compression gradient in the presence of uniform Dpp	Polygon distribution of entire cell population	Polygon distribution of mitotic cells only
2*cg1	-	-	-	-	-
0.5*cg1	+/- ¹	+ ¹	+/- ¹	+ ¹	+ ¹
2*cg2	+ ¹	+/- ¹	+/- ¹	+ ¹	+ ¹
0.5*cg2	+	+/-	+/-	+	-
2*cg3	+	+	+	+	-
0.5*cg3	+	+	+	+	+
2*cg4	+	+	+	+	+
0.5*cg4	+	+	+	+	+
2*cg5	+	+	+	+	+
0.5*cg5	+	+	+	+	+
2*cdpp1	+	+	+	+	+
0.5*cdpp1	+	+	+	+	+
2*cdpp2	-	+	+	-	-
0.5*cdpp2	+	+	-	-	-
2*cwg1	+	+/-	+	+	+
0.5*cwg1	+	+	+	+	+
2*cwg2	-	+/-	+	+	+
0.5*cwg2	+	+	+	+	+
2*cwg3	+	+	+	+	+
0.5*cwg3	+	+	+	+	+
2*cwg4	+/-	+/- ¹	+ ¹	+ ¹	-
0.5*cwg4	+	+	+	-	-
2*carm1	+/-	+/- ¹	+ ¹	+ ¹	-
0.5*carm1	+	+	+	-	-
2*carm2	+/-	+/- ¹	+ ¹	+ ¹	-
0.5*carm2	+	+	+	-	-
2*cvgbe	+	+	+	+	+
0.5*cvgbe	+	+	+	-	-

2*cfj	+	+	+	+
0.5*cfj	+	+	+	+
2*cds1	+/-	+/- ¹	+ ¹	- ¹
0.5*cds1	+	+	+	+
2*cds2	-	+/-	+	+
0.5*cds2	+	+/-	+	+
2*cds3	+	+	+	+
0.5*cds3	+/-	+	+	-
2*cd1	+	+	+	+
0.5*cd1	+	+	+	-
2*cd2	+	+	+	+
0.5*cd2	+	+	+	+
2*cd3	+	+	+	+
0.5*cd3	+	+	+	-
2*cd4	+	+	+	-
0.5*cd4	+	+	+	+
2*cd5	+	+	+	+
0.5*cd5	+	+	+	-
2*cd6	-	+	+	+
0.5*cd6	+	+	+	+
2*cyki1	+	+ ¹	+ ¹	- ¹
0.5*cyki1	+	+/-	-	-
2*cyki2	+	+	+	+
0.5*cyki2	+	+	+	+
2*cyki3	+/-	+	+	+
0.5*cyki3	+	+	+	-
2*cvgqe1	+	+	+	+
0.5*cvgqe1	+	+	+	+
2*cvgqe2	+	+	+	+
0.5*cvgqe2	-	+/- ¹	+	+
2*cvgqe3	-	+/- ¹	+	+
0.5*cvgqe3	+	+	+	-
2*cvgqe4	+/-	+/-	+	+
0.5*cvgqe4	+	+	+	-
2*cvgqe5	+	+	+	+
0.5*cvgqe5	+	+	+	+
2*cvgqe6	+	+	+	+
0.5*cvgqe6	+	+	+	+