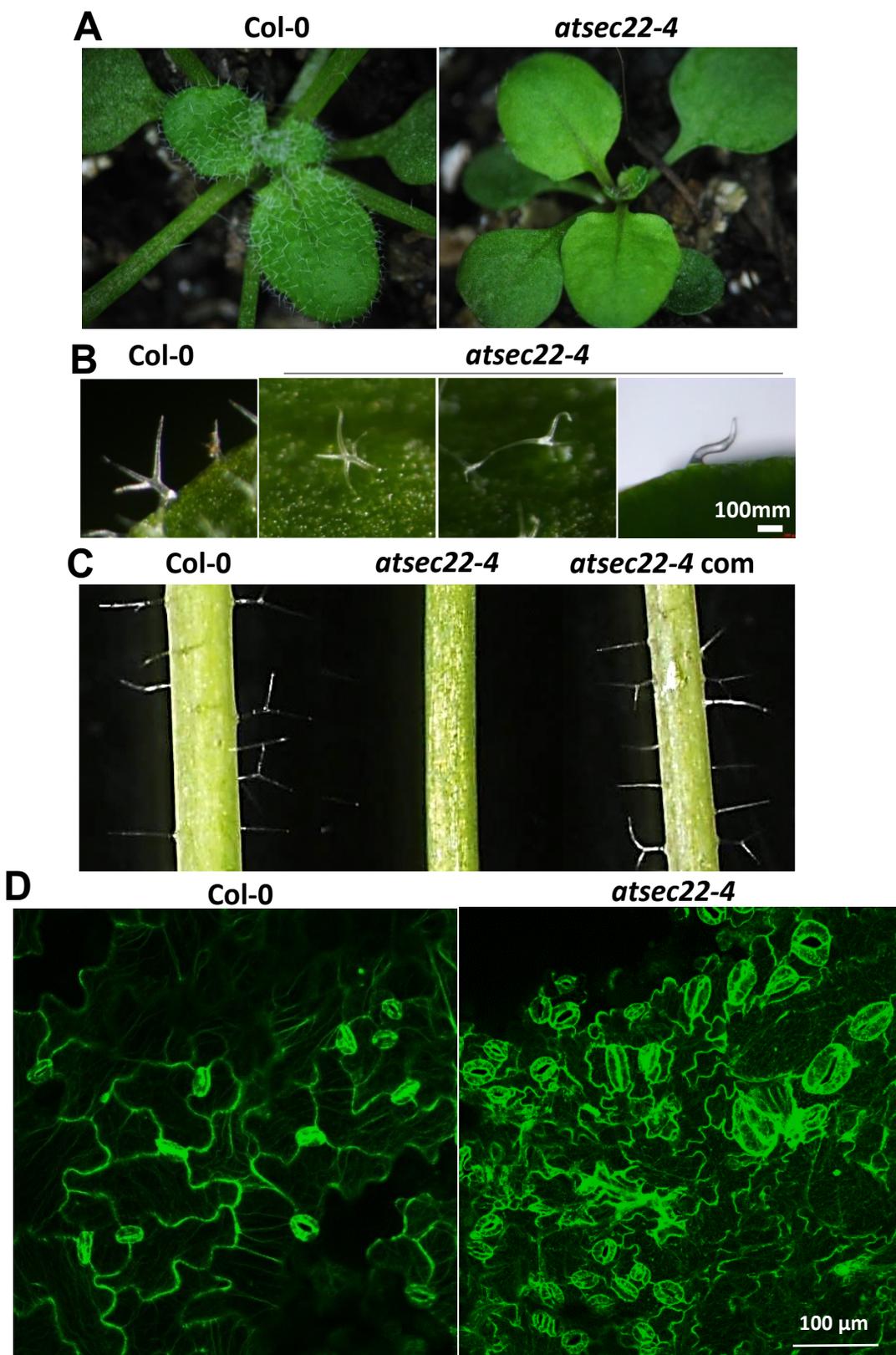


**Figure S1.** Development of *atsec22-4* was delayed.

(A) Germination of *atsec22-4* was delayed. Germination ratio was quantified using three-day-old seedlings.

(B) Statistics of (A).  $n \geq 30$ . Three independent experiments per sample. \*\* $P < 0.01$ .

(C) *atsec22-4* plants were dwarf.



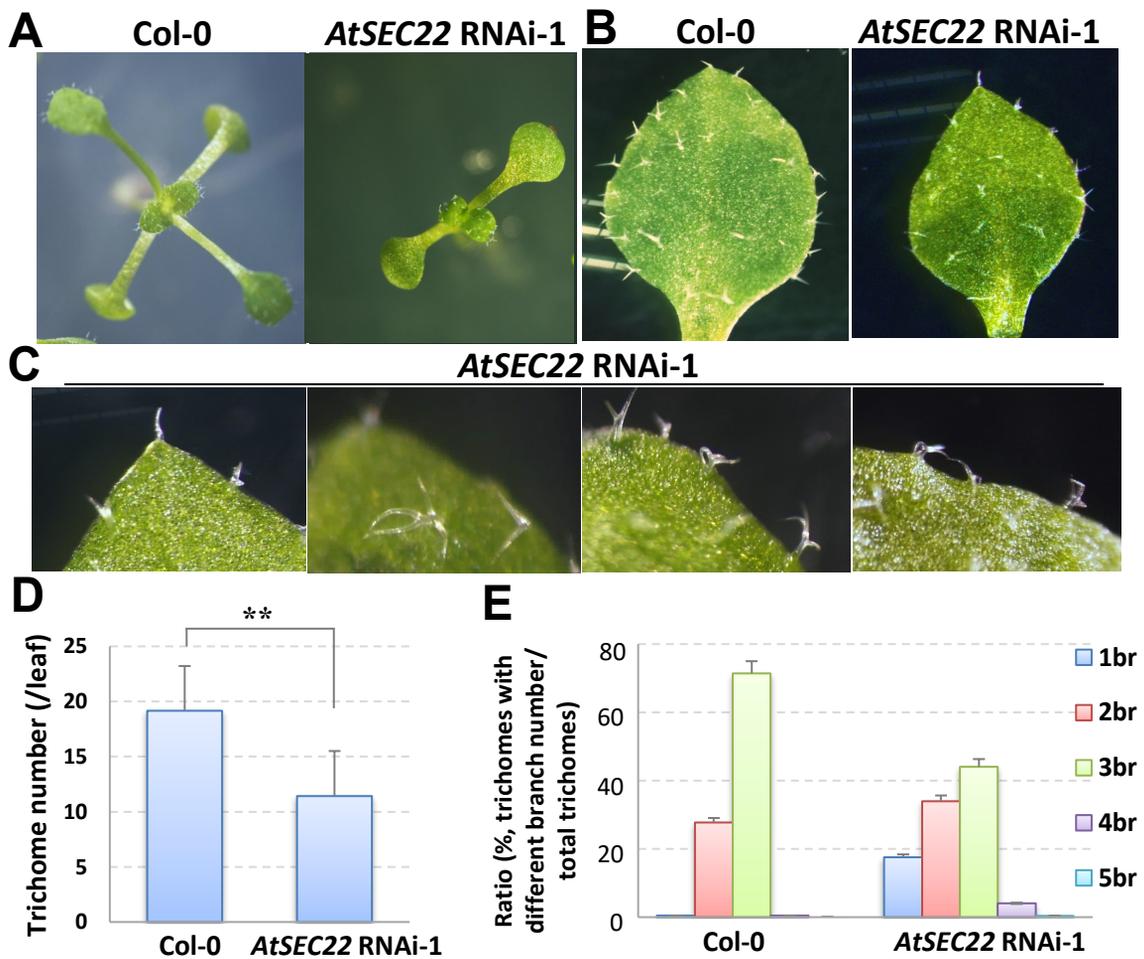
**Figure S2 |** Morphogenesis was disturbed in *atsec22-4*.

(A) There were less leaf trichomes in *atsec22-4* 40-day-old plants. .

(B) Morphology of leaf trichomes in *atsec22-4* were altered. Trichomes were from the 3rd/4th rosette leaves in seven-week-old plants.

(C) There were less hairs on stems in *atsec22-4* .

(D) Morphology of pavement cells and stomata were altered in *atsec22-4*.



**Figure S3.** Development and morphogenesis were disturbed in *AtSEC22* RNAi lines.

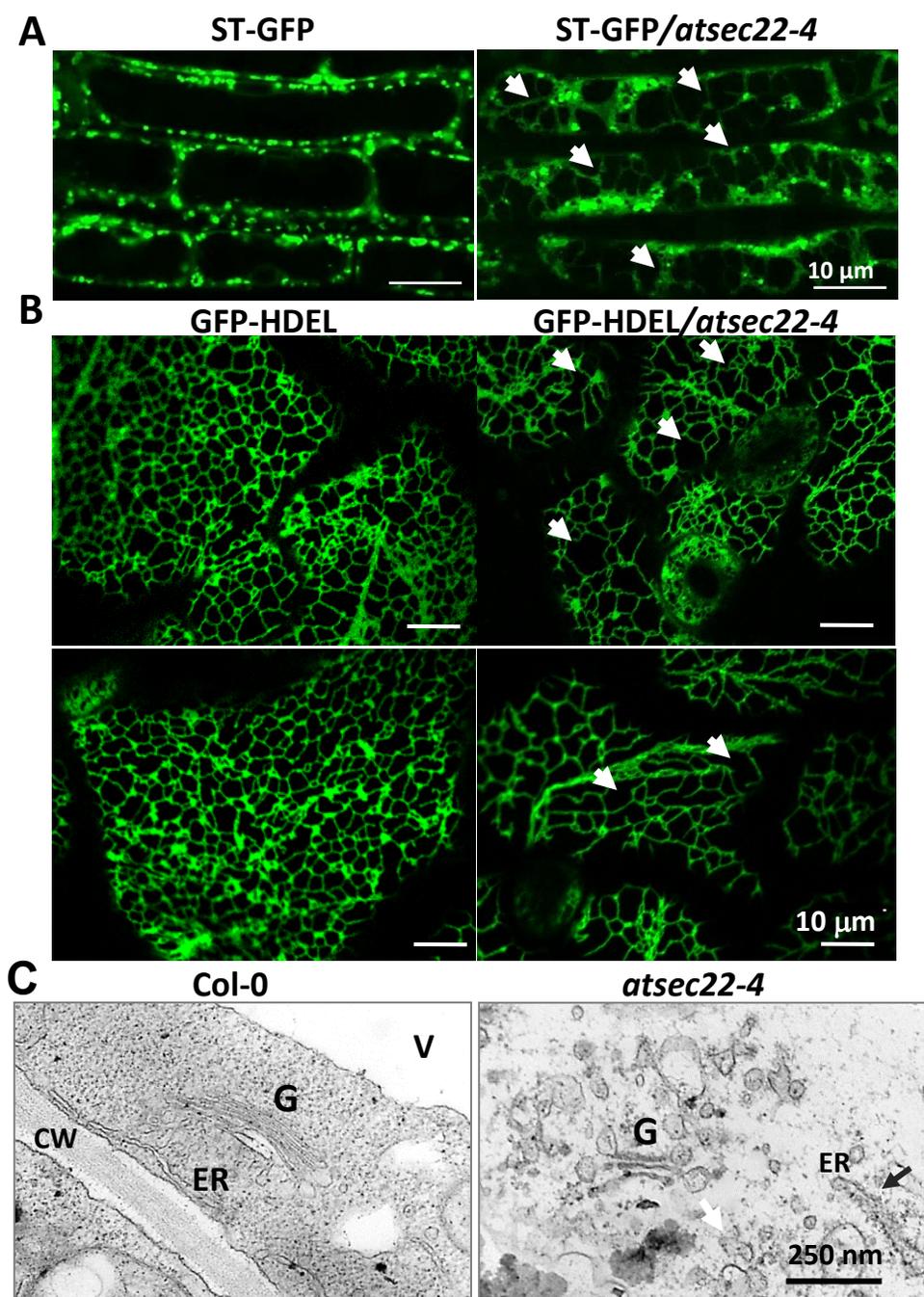
(A) Development of *AtSEC22* RNAi plant was delayed.

(B) Trichome number was decreased in *AtSEC22* RNAi leaves.

(C) Trichome morphology was altered in *AtSEC22* RNAi lines.

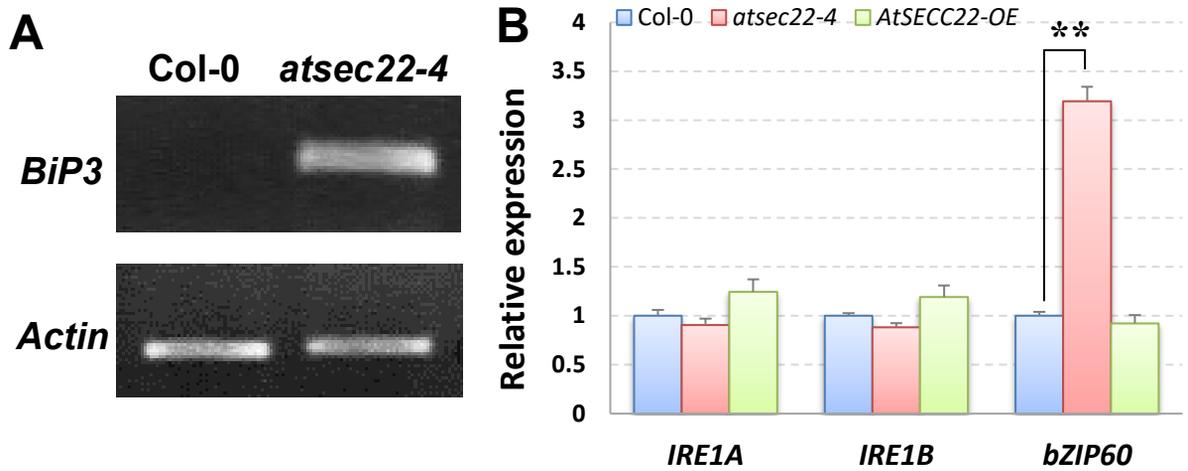
(D) Statistics of trichome number of (B).  $n \geq 10$  leaves.  $**P < 0.01$ .

(E) Statistics of leaf trichomes with different branch number in *AtSEC22* RNAi lines.  $n_{\text{Col-0}}=20$ ,  $n_{\text{RNAi}}=30$ .



**Figure S4.** Vesicle trafficking was disturbed in *atsec22-4*.

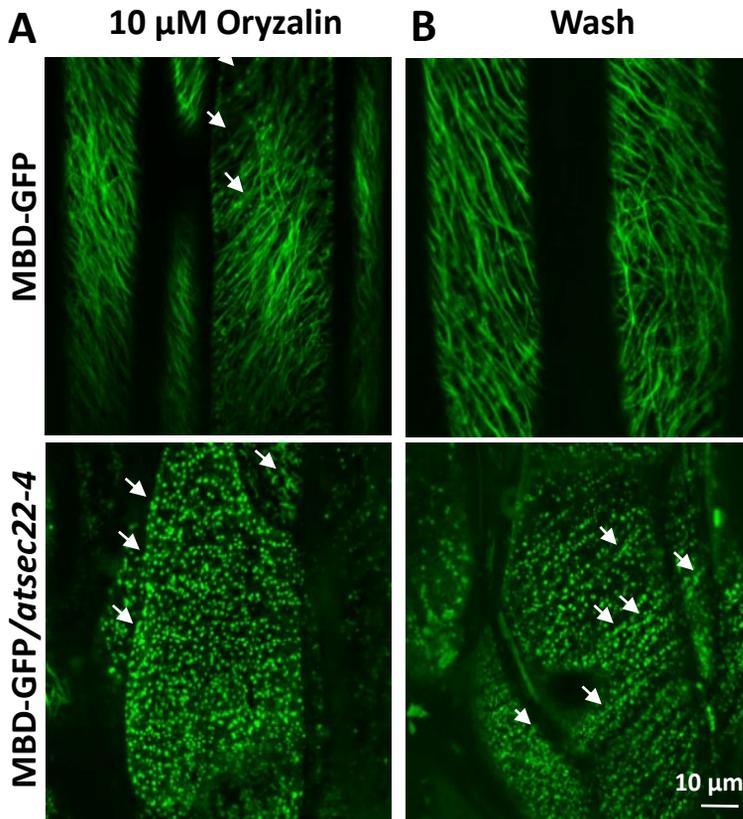
- (A) Confocal images of ST-GFP-visualized Golgi apparatus in root cells. ST-GFP was collapsed from the Golgi and redistributed in the ER in *atsec22-4* (arrows).
- (B) Confocal images of GFP-HDEL-visualized ER network in pavement cells. The ER exhibited relatively looser structure with larger space between the ER tubules in *atsec22-4* (arrows).
- (C) TEM images of leaf cells from 21-day-old plants. In *atsec22-4*, the ER tubules became expanded and fragmented (black arrows), and the Golgi stacks became smaller with less cisternae. V, vacuole; CW, cell wall; G, Golgi apparatus; ER, endoplasmic reticulum. Scale bars are as shown.



**Figure S5.** ER stress was induced in *atsec22-4*.

(A) Expression level of *BiP3* was detected by RT-PCR.

(B) Expression levels of *IRE1A*, *IRE1B* and *bZIP60* were detected by RT-qPCR.



**Figure S6.** Microtubule stability was perturbed in *atsec22-4*.

Confocal images of MBD-GFP-visualized cortical MTs in hypocotyls treated with 10 μM of oryzalin for 10 min (A), and followed by a 2 h wash (B). Arrows in (A), depolymerized MTs; Arrows in (B), MTs started to line up.