

## Description of Additional Supplementary Files

### File Name: Supplementary Movie 1

**Description:** Timelapse movie of arbuscule development and collapse in rice, showing diverse arbuscule developmental trajectories and lifespans. *pSCAMP:eGFP-SCAMP* reporter rice plant was colonised by *R. irregularis* in an AMSlide and imaged non-invasively at 2-hour intervals. Images are maximum intensity z projections. Green = eGFP, scale bar = 10  $\mu$ m. Arbuscules and their developmental stages are highlighted in Supplemental Fig. S2.

### File Name: Supplementary Movie 2

**Description:** Timelapse movie showing PT11 dynamics throughout arbuscule development and collapse. *pSCAMP:eGFP-SCAMP* ; *pPT11:PT11-mRFP1* co-expression rice line was colonised by *R. irregularis* in an AMSlide and imaged non-invasively at 2-hour intervals. Images are maximum intensity z projections. Green = eGFP, magenta = mRFP1, scale bar = 10  $\mu$ m.

### File Name: Supplementary Movie 3

**Description:** Timelapse of PT11-mRFP1 and eGFP-SCAMP dynamics in arbuscules that collapse after 8-16 hours. *pSCAMP:eGFP-SCAMP* ; *pPT11:PT11-mRFP1* co-expression rice line colonised by *R. irregularis* live imaged in AMSlide3. Images taken at 2-hour intervals over 22 hours. Green = eGFP, magenta = mRFP1 (and autofluorescence). Scale bar = 20  $\mu$ m. Arbuscules and lifetimes annotated in Supplemental Fig. S9A.

### File Name: Supplementary Movie 4

**Description:** Timelapse of PT11-mRFP1 and eGFP-SCAMP dynamics in arbuscules that collapse after 14-22 hours. *pSCAMP:eGFP-SCAMP* ; *pPT11:PT11-mRFP1* co-expression rice line colonised by *R. irregularis* live imaged in AMSlide3. Images taken at 2-hour intervals over 28 hours. Green = eGFP, magenta = mRFP1 (and autofluorescence). Scale bar = 20  $\mu$ m. Arbuscules and lifetimes annotated in Supplemental Fig. S9B.

### File Name: Supplementary Movie 5

**Description:** Timelapse of PT11-mRFP1 and eGFP-SCAMP dynamics in an arbuscule that collapses after 36 hours. *pSCAMP:eGFP-SCAMP* ; *pPT11:PT11-mRFP1* co-expression rice line colonised by *R. irregularis* live imaged in AMSlide3. Images taken

at 2-hour intervals over 52 hours. Green = eGFP, magenta = mRFP1 (and autofluorescence). Scale bar = 20  $\mu$ m. Arbuscules and lifetimes annotated in Supplemental Fig. S9C.

**File Name:** Supplementary Movie 6

**Description:** Timelapse of PT11-mRFP1 and eGFP-SCAMP dynamics in arbuscules that collapse after 26-50 hours. *pSCAMP:eGFP-SCAMP* ; *pPT11:PT11-mRFP1* co-expression rice line colonised by *R. irregularis* live imaged in AMSlide3. Images taken at 2-hour intervals over 52 hours. Green = eGFP, magenta = mRFP1 (and autofluorescence). Scale bar = 20  $\mu$ m. Arbuscules and lifetimes annotated in Supplemental Fig. S9D.