**Supplemental file 5: promoter analysis**

Mp*FRH1* promoter construct:

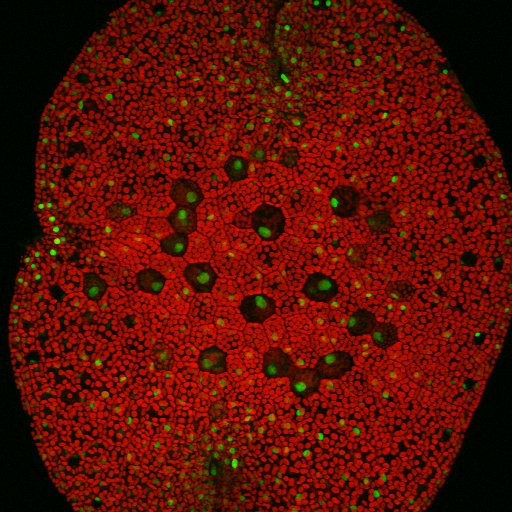
3.5 kb region immediately 5’ of the Mp*FRH1* transcript producing genomic region was cloned as the Mp*FRH1* promoter. This corresponds to scaffold\_43:382450-378958 in the *M. polymorpha* genome sequence published in Bowman et al., 2017.

>ProMp*FRH1*

ATTTAAATGAAATCTGAGTTTCCTGTCGATTCAATCTCTCATTGTGTATCATAAACCATACTTCGCAATCTGCGAATGTTCGGGTAAAGCTTTGCGCATTTTTTATTTCCTCACCGAGAATCTTTTGCTCTGCCTTGACCTCACTTTCTTAAAATTCCGTCTGTGGAAGAAAAGCTAATCTGAAAGGCTATAATTTGGTCATTGAAGATAACCTTGATAATATAGGAAACTCGCTGTCAGGGTTGTAAAGAGCCGTGAAACAAAACAGTGACGAGAGAGCTACCTGAAGTTTCCTACAAAGGGAGTTGATTTGAACGACGGAAACAAATGTTATGTGCTCTTGTGAGTGGAAGCAGAAAGAAACAAGCATCAGAGAGGTTTCCATCACAATCTTGACAGCTGAAGTAACAAGTCGACGATAGAAACATCAGGGAAACTAACGGAAGAGGAAGAAAACCGTTTCTGGGACAACAGTTTGACGACATAGTTCCAATAAGACCGATAGCTCGTACTCCATAATCAGTTCTTCTGCCGTATAAAGTCAGCAACATTGCTATCATAACATGGAAGAAAACTTGTAGCATGTACTTGTTCATTCTGATTTGCGTCTGTTGAAATTTGCATTGATTGCACAATGTTGGACAACGAAGAAACAAATCTCTTGCAGAACCTTCTTCCTCATCATTTTCACGAAAGTGGACGCAATTTAAACCGTCGGCACTGGACTTTCAAAGCAACTTGGACCTTAGCTTACCTCCTTCTCGCCAGTAAATTCGTAGATTGCGTACAGAAAGTCGAGCAGTCACATTTTGCCCTCAACAAAATCTTGTTCTTCAAGCAGTTAGAACCATCGAATTTCTATCAGTGCTCTTGCATCTACTCTAGCCTGGAGCTGCCTCTGTGGATCAGATGGTCCGCAGTTGAGACACAGCCGCTTCACACCTGGAAATTAATTTAATGTGAGAGAGAACCTTCAGTATCAAGCGCAATCTGTCATTTCTACTACGACCCAAGACGTAATACAAACCTCTTTCTCCAATCGGCCATACCGAACACGGCAGATCCATTTGATTGGATCAATAAGTCAAAGGAAAGAGAGAAACGTCATTCATTCAAAGGTTTGAACAGAATGATAATCATATCTAGCGTCTGAATTTTGATATAGAGGTACTTACTTTCTAATCCGATAAGTTTTGAGTGATTCTGATCTCGGGGCGCCCGGTGATGTCAGAAGGGAAGCCAAGATTGAGCAGCAAATTTCCGGAGATTAACAAAATGCTAGAGCTTATCGGTGTTACTTTATGTCTGGCTGGGTCTATGAAACCTACAGGGGCTCTGGGTTACTAGAGTCAGACACGAGGAGCTTCACGAGGAACTACTGACCGGCGAATACCGTGGACAGAAGATACCGTATGAGACCGACAAGAGGTCGTGAGGCATGAATCAAATCTGGAGAAAGCTTTTCAAGGCACGAATGGACCCGATGCACACTTAGAGCGATTTGGAGGATTGGAGCCAGCGAGCCGACGACTGAAGTTGCGCCTGTTTAAATGTGCCGTCTCGAGTAACTTTGGGAAAATCTGGACATAATGCGTCGCAGAGTTGCACGTGAAAGCTGCGGCCGGATCAGAGCTGTCATCTGAATATTCAAAACCTAAGAATCTGTGGGGGACGAGCTCGTGAAGCCTCAGGGCCGGGCGCGTGAGATTATGCTGGCGTCACTTTTTGCAGAAGCCAGTCAGGGTGGGAGTTAAGTCGAAGAGCCGAGAATGATATTCCAAATGCGAGATCCGATGTCGAGAGATCGTGACGGCGAAAGGCAGGATGAGATTGTTATGGCATCATCCTCTGCATTCGCGAAGCACAGGTGCGTATTAAGTCGGAAAGCAGGAGAATGACGCGCAATTGTTCCAGCATCCGGTTGTTGTCAACTTATTACTGCTCGAGGACAGCCACGGACACGATCGTGGAACCCGGGGCAGCCCTAGCGTACGAGAAGTCCGTTTTCAAGCAGAGGCATAAACCTCAAGATCTGCTGCTAGTAAGTTCAGGCCTTATATATCGATCATGAAGAACGTGACATTTGAGGTGCAACATGTGACAGCCTTGAATTACTCAGACATGATCTGCAGCAGTGGCAGACCTGTTGTCTAGAGAATGGCCGTGAAAGCACGATAGGCGAGCACGTCAGACTTGCCAGATTTTCCAAGCGCAGGGCAGCGAGCTCGGAGGACCCGTTTTTCCAGTGCAAGCACATTGAAGCTCTGGGTCGTAGAGAGGCGCTCCATTATCGTTGCGAAATACACATTAATGCAAATGAAAGGACACCTTTCTCGACTCGCACATCGTGACATATGAATTTAGGTCGACATGTGAGAACGTGATCTTGAGACCGAAAACTCTAATTATGTGCCCACACAGTCGACTCCCCTTCACCGTCGTAGGCTGCCTGTGTGATTCCGCCTGACTTAGCCCCGAGCGCTGCTGCAACGTGAGCGTTTTAGTGCAAATCTCTGCCACTAATGATCCACACAAGGACAGAACGTGAGATATGAAGCACGACATGTCCGAACGTGAGATCCCCGTCACGGAAAAAGGAATCGACCTTGTGCCACCCTCTCCCTGGATTGATCCAGGTTCATCAATCCCACCCATAAGCCCAATCACGGGCTCCGCTTCACATCGTCAATCCTCTCTCTCTCTCTCTCTCTCTCTAGAACTGCGTGCATCTTTCTTTCCCTTCTGAATCTACAATTCTCTGTGTCTGTAGGACAAGAGCATTTCTCACTCTACTGACTGACTGGCGCTGCTGCGGCGCGGTGGTCCGGTCCCGGTCAAGTCAAAGGCAGTCGTGTCCGGTGAAGTGCAGTGTCCGCTGTCTAATTCGTCGGCACGAACCGACCGCCCCCGGAGCTAATAATCGTCGCAGGTCGCAGGGAGAAGGTCGCAGGCGCGCGCAGTCGTCACAGTCGGGGAGGGGAAGAGAGAGCGCAGCGCAGCGGCTGAGAGGGGAGGGGAACTAAGAGCTGAGAGCTGAGAGATTTTCACGTTCTGGAACACGACGGGCGCGCAATCCACGATAGATCCGCGCTGGCAAAAGGTGGCCAGGCGAGCAGGGGGCACATGGAGGGGGAAAATCGGAAAATCGCGGTCCCATAAGCAGGGAAGGGTTAAGATTAGGGGCCGGGTTAGGGCTAAATATGGGGCGAGGGGAACAGAGTGGCGCGGGAATGTTTAAGGGGCAAGTTAACAAAACTCCAGGCATTAACGGCAGTAGGCGACGTGGAAGGCTCGGGGAGGCGAACGTGAGGCCTCATAACTGCGCCCGAGTCCCACTTGGCGTTTAATACAGTGGTTGCTGCAGTGCTAAGGCCCTCATCTCCTCCATCACTCCACCATATTTTTCATGCCTCTTCATCCGTGCACTGTGTTCGGCCCTTTGCGCGGACCCGCTCGCTTCCTATATAAATGCCCGCAGGCGCTCTTTCTCCCTCATCATT

Control promoter construct:

Mp*INCOMPLETE ROOTHAIR ELONGATION* (Mp*IRE*) Mapoly0084s0015.1 encodes for a predicted serine-threonine kinase. We previously identified Mp*IRE* in a screen for mutants defective in rhizoid development (Honkanen et al., 2016). The 3.5 kb region 5’ of the Mp*IRE* coding sequence drives ubiquitous 3xYFP-NLS expression in gemmae.

Mp*IRE* promoter expression pattern in one day old gemma.

>proMp*IRE* Mapoly0084s0015.1

AAACAAGATCAGGCTCATCAGACGTGCGAACACGGGGTCAAGGAAGACGCTGGGATCAAGATGACGGGATCGGAACCATGCGGTCGCACTGTGGGCAAAGTCCAAACCGCCGGATCACAGTGAGCAAGGAGATTACGTGGTCAATGTAGCTCGTCAAGCATAAGTAAATCACAATGGAGTGATGGCACTCTATCAACATTAATGGCTGGACATTCCATGGAAGTATAGCATTAAGGTCCATCCACATGCATGAAGTACCCGTATTAATACACGTAGAGCCACGTAGGTAGACATGGGCATCCGGAAACTGGTACGTAGGGGCGAGCGTGTGGTCGATTCTGTTGGATCGGTAATCAGAGAAAATCGGATTGTAAATCCGAACGACTGAATTTCTGCCTCGACTGGAATCACGTCGTCGGCCGACGGGCGGGAGGGAGGGACTACAGGTGCCGCCACCGGCGCGACGCCCTGAATTACCATTGGCCCCCACGAGCCACAATGGGTTATAGGGTGGCATCGGGGGAATTTTATGTTGGCAGATTTTTTCCCCTTTCCTGCCGGGACTTACCGCCGGCACATTTCTTTCCCATCCGCGGAGGCCTTTTCTTTTGGTGACGTGCTCCATCGAGGCGAATTATCCCTCTATGGCTGCAGCAGGAGCTGCCACGTGGCGGCGAGTTGCCGCTTTCCTTCACCGCCCGCTTGCGCGGGCGCGGGTGGTGGGAGCGAGCGGAGCCCTCCTCGTCCTAGTCGGACCTCTCTGCGTTGCCTTGGCCTTTGTTCGGAGCTCCGGGGCAGGGGCAGGGGCAGGGCACGCACGCACGCACTCCTCCGTCCGTTGCTGCCCTGCCTGCCTTCCTTCCTTCCTTCCTTCCTTCCTGCCCGCGCCCGCCCGCCCGCCTTCGCAGTGCACATATGGCAATGTCCATCTGCGTCTGTTTCTCCGGCAATGAGTTCGTTGAGCTGGCACAAGGCAGAGCTGACTGTACCCACCTGACAACCCCATGCCCGCAGATTGACATAAGCCGCATTTCTTTCATGTTCCGTGAGAGGTCGCTCCCGCAGTTTGCCCGGATTTCGCTCGGAAGGACGGTATCCCCGACTGAGGCCCGACCCCTCGACGAGAGAGCGTTCAAATCTTCAATATTTTCCGCGCGGACTTGCGCGGAAAAGAGTTTCTTAGGGTGTCATTGCGGCACAGTAGCCGCGAAGATGGAGTGTCGAAAAATATCCCTCCCCAGACGTAGAACTCACGCTTGCAGAGTGACCTCATTCGCCCGTCATCTTCCAAAGATCCCAGTTCACGTCCGATTTGCAGCGTCGGGTAGTTCGTCCCGCCTGCTGCGAGCGGAGCCCACTGTGCGTCCGGCCGGCCGGACCTCCGGGCGCCTTTGCGTCCTCATCTCCGGCACCGTCATTAACAGGGAAATCGAATCATCAGCCGTACTTGGATGTCATTATTGCGGCGCCGGACTGCCAGAATCCACCTATGGATGCACCGAGCGAGGGAAGGATTTGGCCGCAGCAGCTCCAGCGCCAGTCTCGCAGGGAAAAAGTGCGGCCTGGATCCCGAGCTGTCACCGCAGACGAAAAAGTCCGCCCTGAGCCGCCCCGTGGTGACCTGTGCGTCCTCGGTCGAAACTCAAGACTCGGATTTACGGAAATCCCCCCCGTTCTTGGCTTCCCGTGCGACGGAAGTTAATTATCTCGTCCTTTAAGCCCAGGTCAACGAGTAACTCTTGCCGTCTGGCACGTCCGGCTCTCGATCGGGTTCGCGCGAAGTCCTTCCCTCCCTCAACTGTTGCGCACTGATGGGGGAGCTGGACAGCGGACGCGACCCGACCCGCCAGTGGGCCGTGAAGTGGTGGCGGAATCGGTCGTTTGCGCGTCCCAGAAAGACACGGAGGCCGGAAAGAGCAGGGGGTGCCGGATCCGATCGACAGATCGGAGCGTGTGTGGGTGTGTGTGCGTGCGTGCGTGCGTTCGCAGAGACGGACGGGGAGCCTGGATGGAAATGCCATCGCAGCGTCGCAGGCGGGAGGACGAGGAGGGAGGGGCCGGGCAGGGGACTCGGGAGGGAAGGCGAGGGCAGGGCCCGGCGAGAAAGGGTGAGTTGAGGGTGCTGGCGTTCCTGTTCCGACTGGTCCATTGAGTCTCGGGTCTTCCGATCGCCTCTCTTTCTGCTCCCGCTCGACCTACAGGCAGACAGAGTGACCTATGTAATGTATGTATGCAATTGGCGATTGATCCATCTTCTCCTTTGCCTTCCCGGGCATCGCAGTCGGATGCGCTTTCTTTGCAGCACCACCAAAGCCTTTTTCCGCGCGGGTCCCACTCATTCACTTACAGACGAAATTGTTTGCACAAGTCGGGGACTCGGGGCCGTGCAGGTGAGGAGTTTTTGCGGCAATTCCTCGACAGCCTGCTCTTTCTTTCTCCTTTTTTTTTCGGTTGTTTCTCTGGTGCAAGCGCTGAGAGGGAGCGAGAGAGAAGTAGAGTTGTGGCACACTTGCCCGCCCTGCTGAGAGTGAGTTGCGAGAGGAAGCGAAGACCTAATATACAATCCATCTTTTCGGTTCCGGAGAAAGAAGAGAAGCGAAGCGAGCAGGTTGCAGAGAGGAGAGTGAGGGGGAGATAGAGAGAGGGAGAGAGGGACGGAAAGCAGGAAGGGAGGGCGGGTGTAGGGAGGGGAAGGGAAGGGAAGGGAAGGAAAGGAAAGGGATGAAGAAGAAAATCGATTGAGTGGAAGTGGTTATTTTTTGGGGTCATGAGTTTCCAAGATTCATCCTTTGGAGGAGTACATCTTTTTCTTCAATTGTCGGATTTCATCAAGAAGCCAGTGACAGGGCCTGTGAATCGATAAAGCGCGTGCTGGAGTCAGTGTGTAGGCCATTGTGCTTTGTTGTGTGTAACATGGATTGCCAGGTCTCATCCTCATCGTCATCGTCAGCTAGCTTTGATTTGATAGCGTGATTTTCATGCTATGAACTGCAACTCCTCCTTCGTGTCCATACCCGTATCTGGAGAGGGCGAACTGCAATCTACGTCCCGATGGTAGATAGAAATGCCTGTGATGCCACTTTGCTCCAGAGGGCCCTCTTTAGGCCTGCAGCGACAATCTTCACCTCGTCCCCCGCCAATTATGCGTTGGTATCGCGGAGTGAATTGAAGGAAGTTAATGGTTATCTCAACAGGAATTGGATGTGGCAACCCATTGGATCTGCTGAAACAGAACGCAAAATGGGGAAATTATGGTGAGCCGGCCTTTTGCATGTACCCAGTCTTTCTACCCTTTGCCCACGGATCGAGAGTCGCCAGATGGACGATTACATGTACACTTGTTTCGAAAGTCGATGTTGGATGGATTGTGGACGGACGACTGTTCTTGGCACCTACTAGTTAAACCCTTCCTCTCCTCTTGAACGAAGTACACGCAGAGCATGCTGGGGCGCATCCCTAGATTAGTACATTAGGGAGCGTTCCGTGCACGGTCAATTTTG