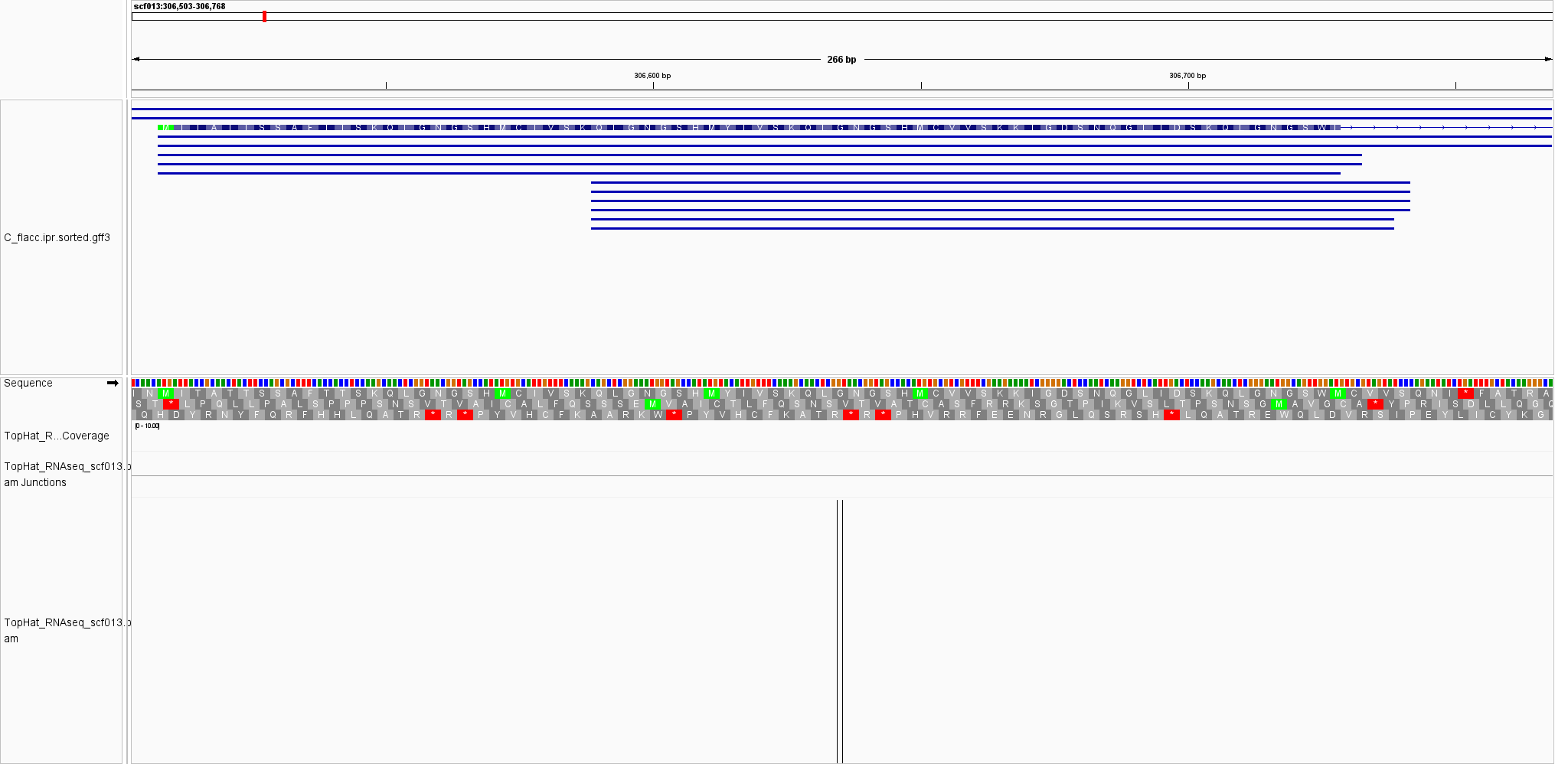
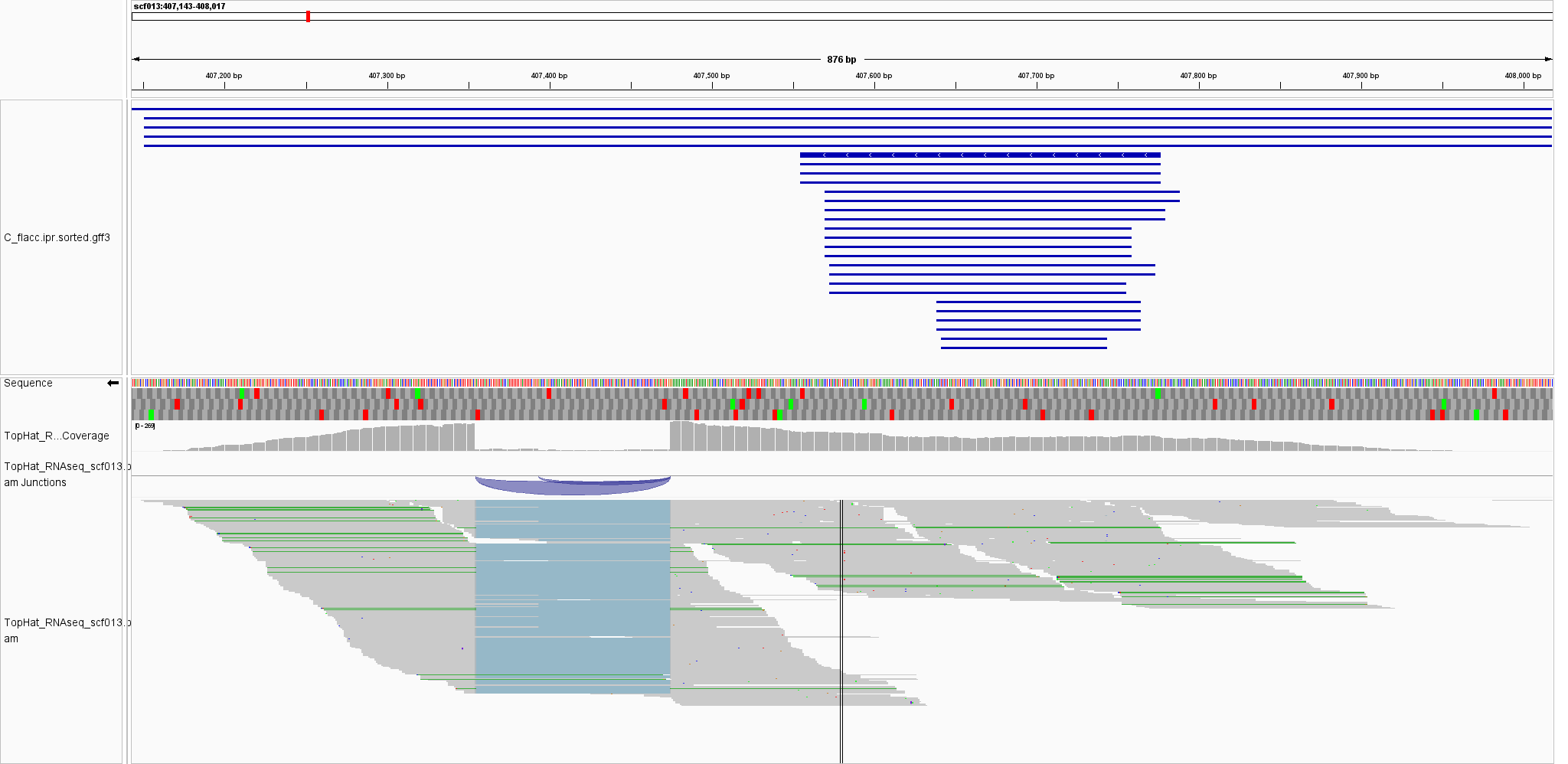


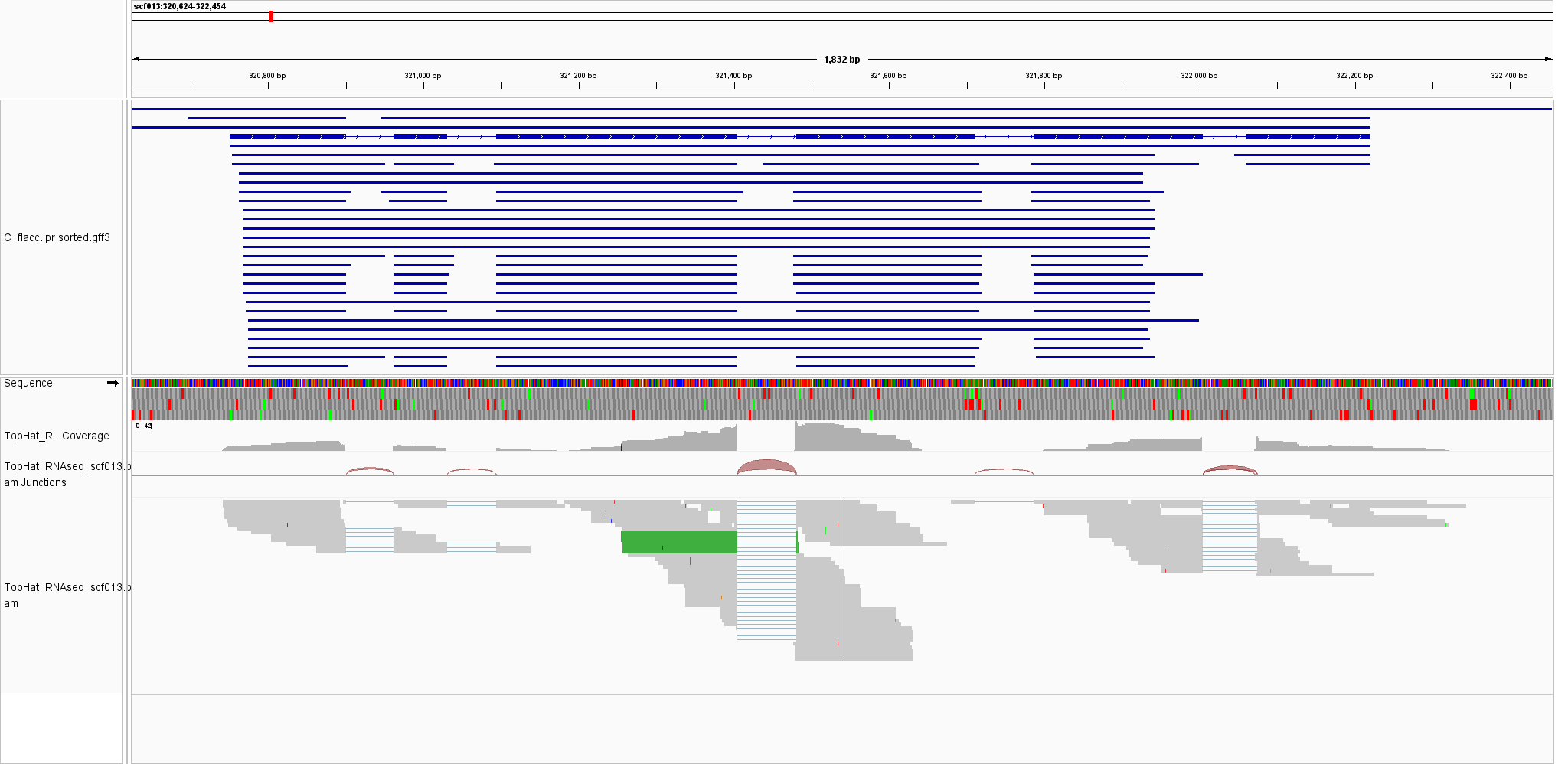
**Supplementary Fig. S1.** IGV views showing RNA‑seq coverage over first *MFA* gene in the reference genome (resting aeciospores).



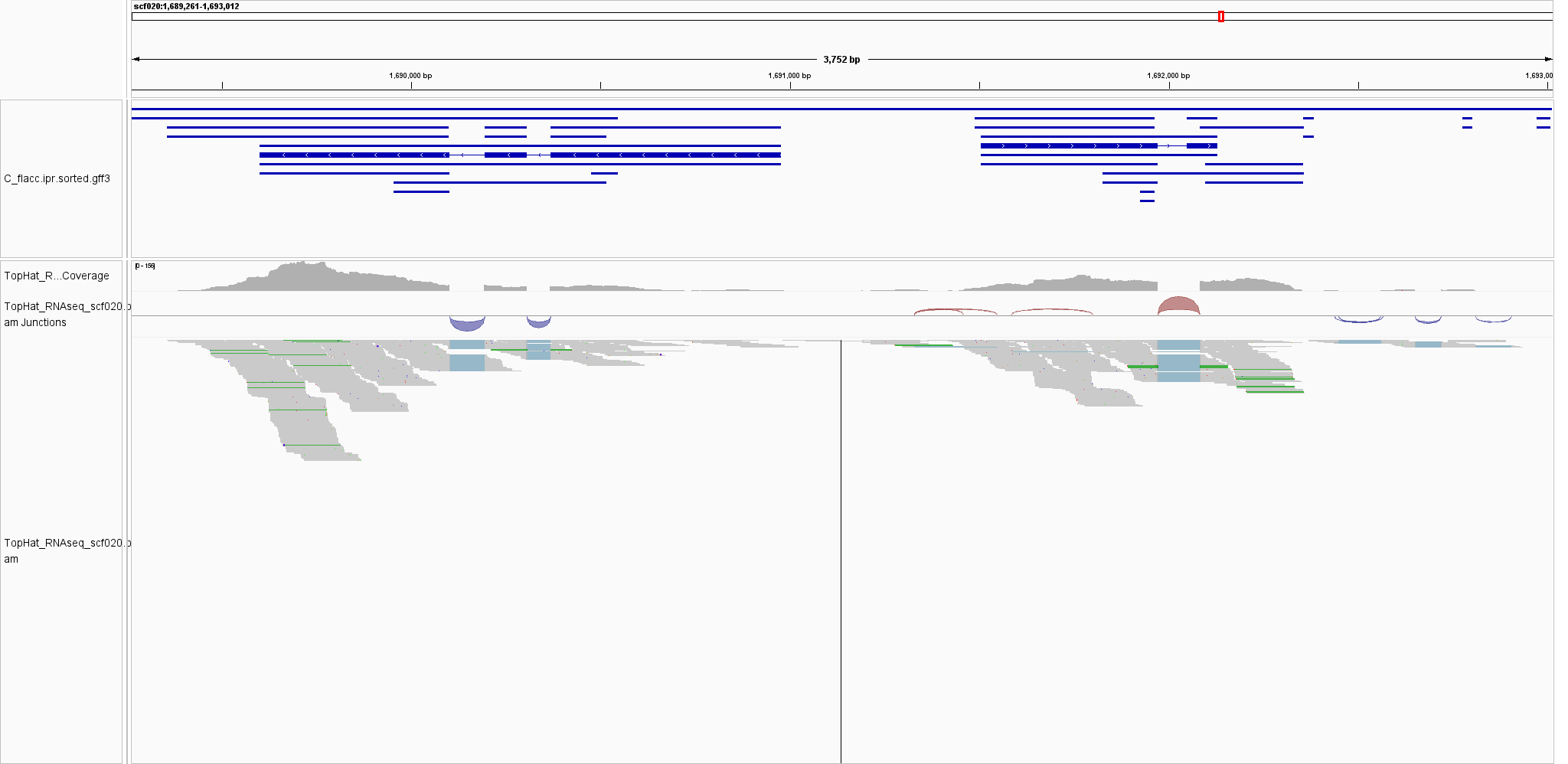
**Supplementary Fig. S2.** Lack of RNA-seq coverage at the second *MFA* gene in resting aeciospores (IGV view, reference genome).



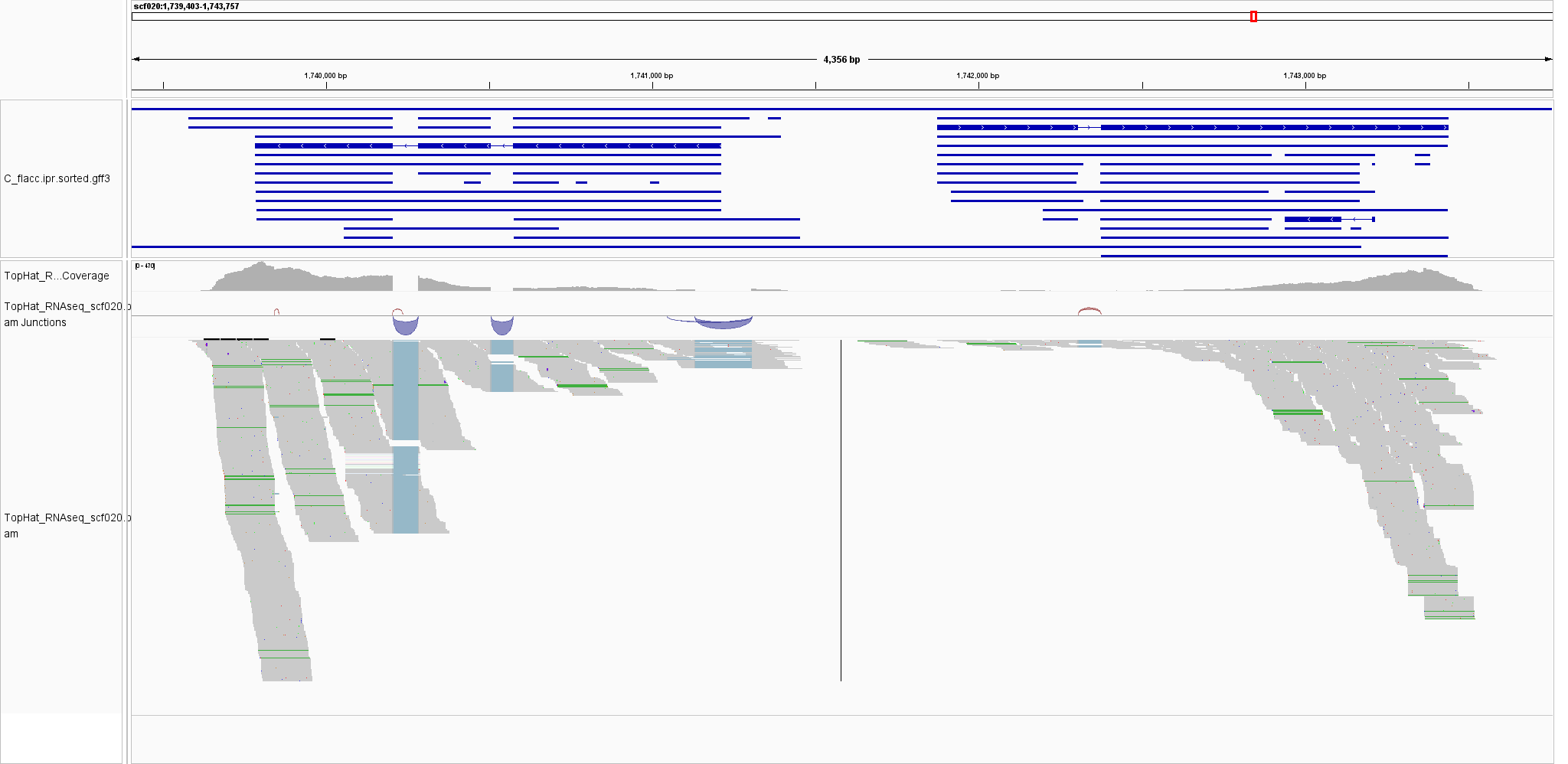
**Supplementary Fig. S3.** IGV views showing RNA‑seq coverage over third *MFA* gene in the reference genome (resting aeciospores).



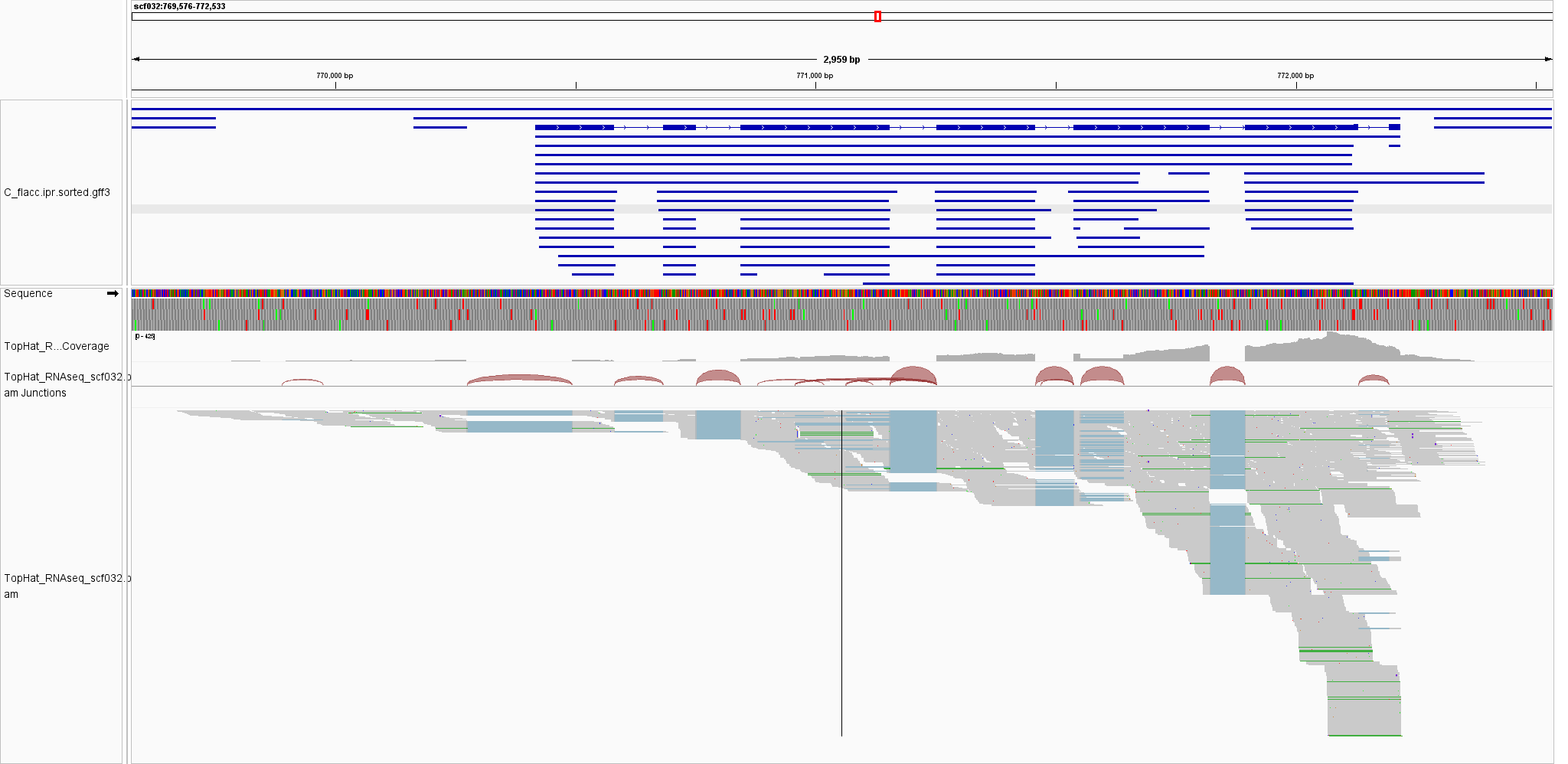
**Supplementary Fig. S4.** IGV views showing RNA‑seq coverage over *STE3.2* gene in the reference genome (resting aeciospores).



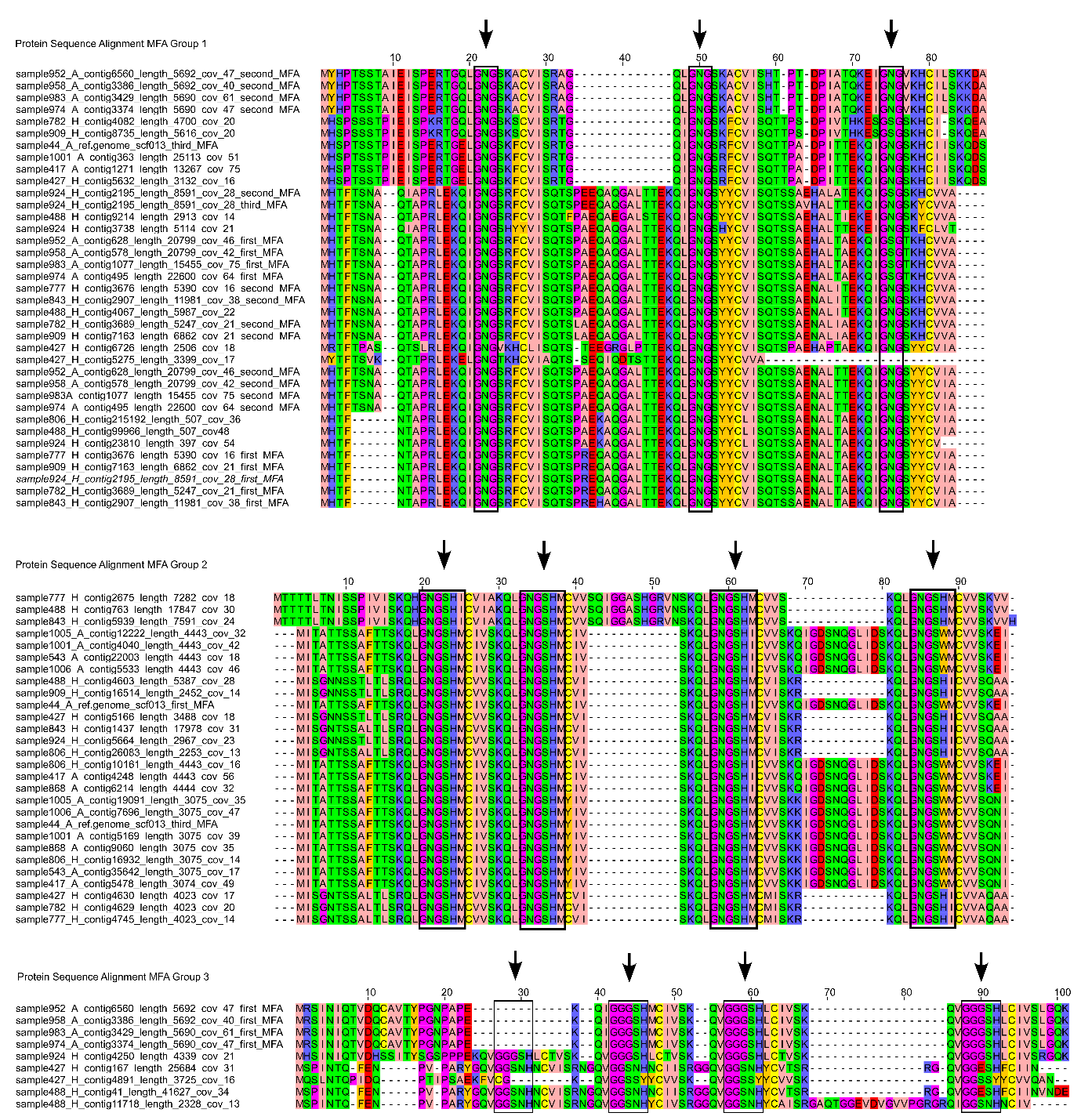
**Supplementary Fig. S5.** IGV views showing RNA‑seq coverage over second HD locus (*bW2-HD1*) in the reference genome (resting aeciospores).



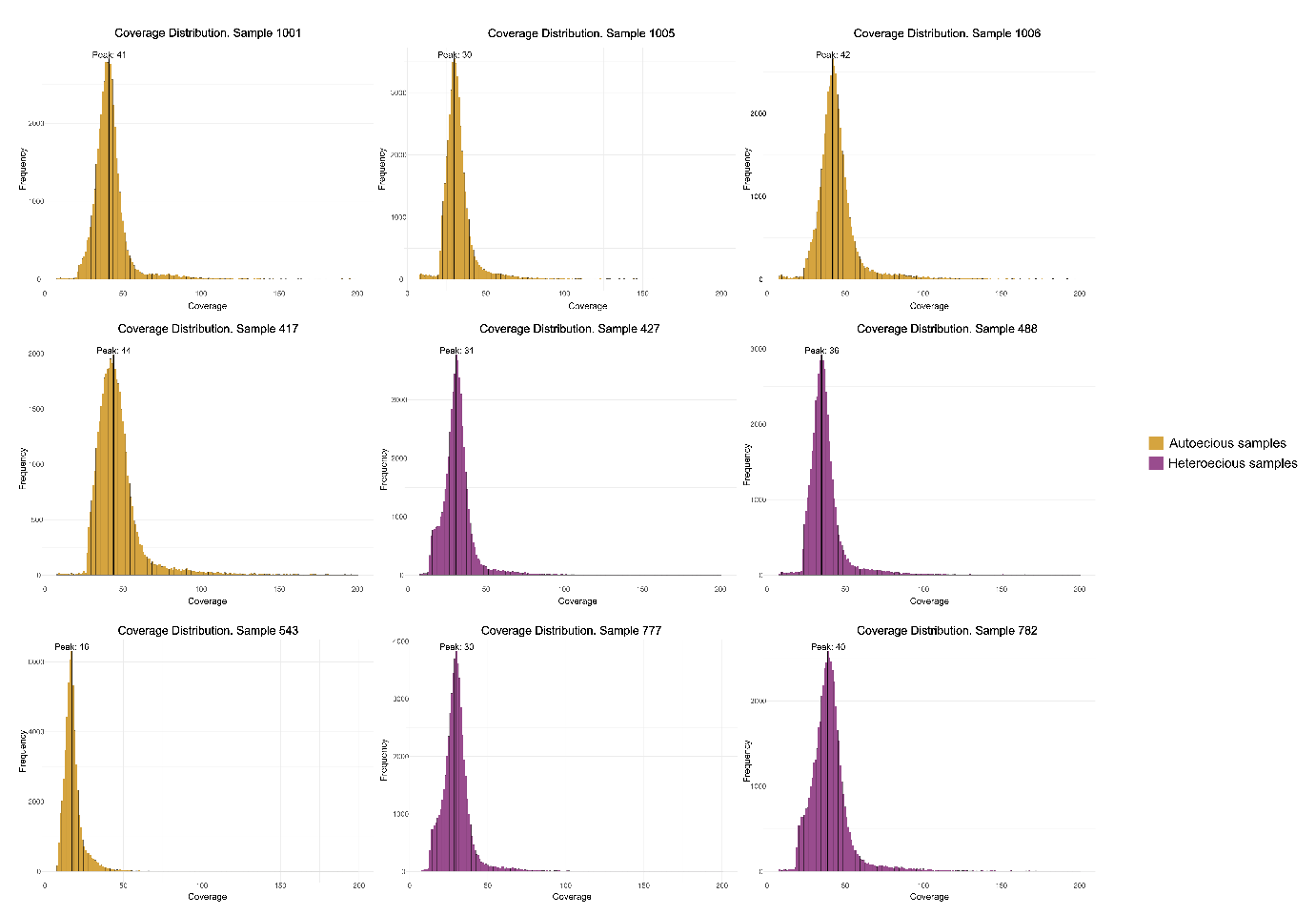
**Supplementary Fig. S6.** IGV views showing RNA‑seq coverage over first HD locus (*bW1-HD1 / bE1-HD2*) in the reference genome (resting aeciospores).

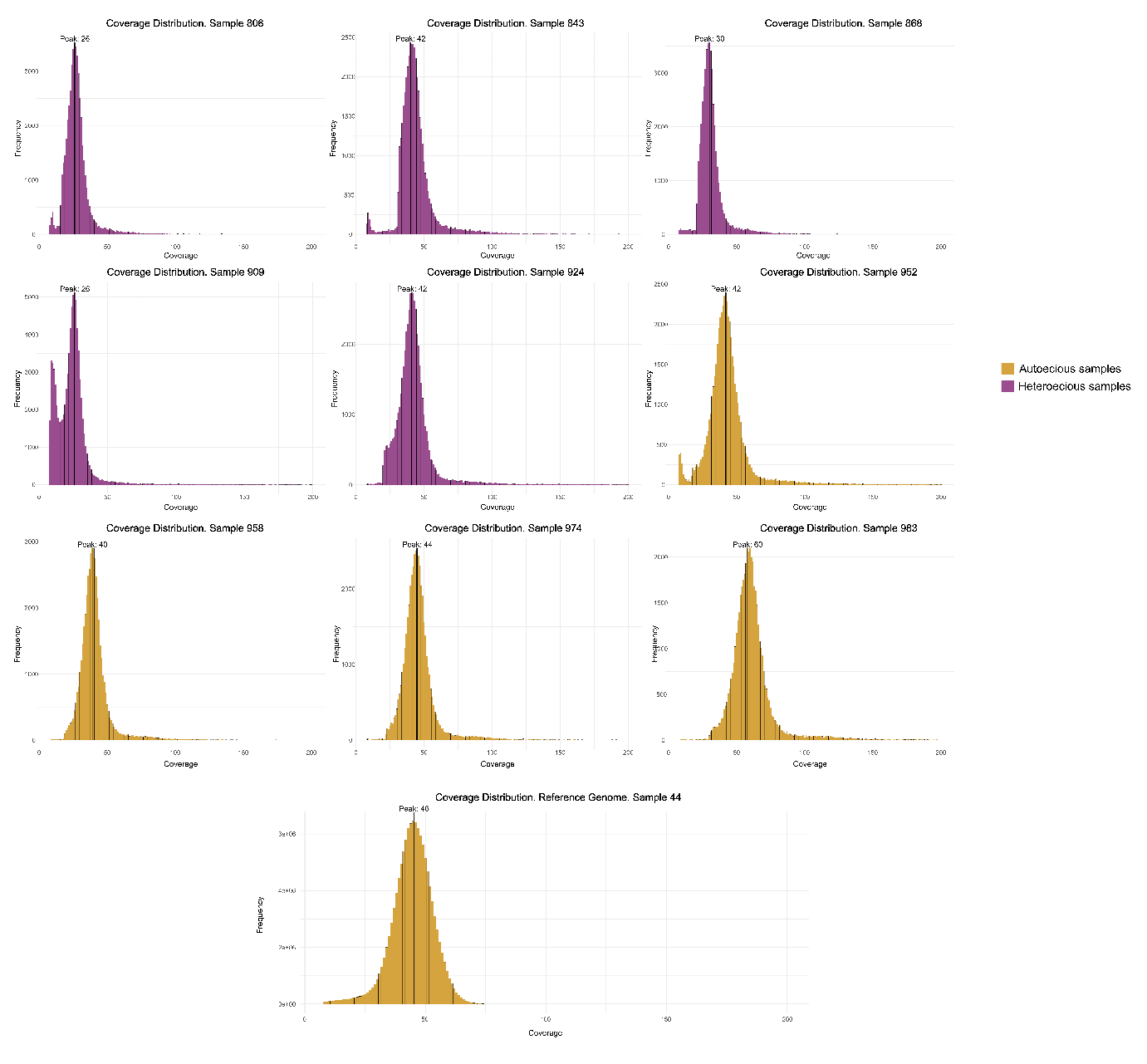


**Supplementary Fig. S7.** IGV views showing RNA‑seq coverage over *STE3.2-1* gene in the reference genome (resting aeciospores).



**Supplementary Fig. S8.** Tandem repeat motifs in MFA protein sequences of *Cronartium pini*. Arrows point out tandem repeats on each MFA group.



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**Supplementary Fig. S9.** Coverage distributions of *de novo* genome assemblies of *Cronartium pini* forms.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Form** | **Sample ID** | **Genome Coverage**  **= 2 copies** | **First HD locus** | | | | | | **Second HD locus** | | |
| ***BW1-HD1*** | | | ***BE1-HD2*** | | | ***BW2-HD1*** | | |
| **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** |
| Autoecious | 44\* | 46 | 20 | 46 = 1.0 | 2 | 20 | 53.48 = 1.16 | 2 | 20 | 47.9 = 1.04 | 2 |
| 1001 | 41 | 188 | 40 = 0.98 | 2 | 188 | 40 = 0.98 | 2 | - | - | - |
| 1005 | 30 | 823 | 29 = 0.97 | 2 | 823 | 29 = 0.97 | 2 | - | - | - |
| 1006 | 42 | 574 | 39 = 0.93 | 2 | 574 | 39 = 0.93 | 2 | - | - | - |
| 543 | 16 | 1737 | 16 = 1.0 | 2 | 1737 | 16 = 1.0 | 2 | - | - | - |
| 417 | 44 | 449 | 43 = 0.98 | 2 | 449 | 43 = 0.98 | 2 | 34 | 48 = 0.77 | 2 |
| 868 | 30 | 673 | 28 = 0.93 | 2 | 673 | 28 = 0.93 | 2 | 153 | 31 = 1.03 | 2 |
| 952 | 42 | 540 | 38 = 0.90 | 2 | 540 | 38 = 0.90 | 2 | - | - | - |
| 958 | 40 | 513 | 37 = 0.93 | 2 | 513 | 37 = 0.93 | 2 | - | - | - |
| 983 | 60 | 186 | 60 = 1.0 | 2 | 186 | 60 = 1.0 | 2 | - | - | - |
| 974 | 44 | 484 | 41 = 0.93 | 2 | 484 | 41 = 0.93 | 2 | - | - | - |
| Heteroecious | 427 | 31 | 14424 | 18 = 0.58 | 1 | 8503 | 18 = 0.58 | 1 | 2996 | 16 = 0.52 | 1 |
| 14703 | 16 = 0.52 | 1 | 7091 | 19 = 0.61 | 1 |
| 488 | 36 | 206 | 30 = 0.83 | 2 | 206 | 30 = 0.83 | 2 | 3311 | 18 = 0.50 | 1 |
| 4428 | 10 = 0.36 | 1 | 4428 | 10 = 0.36 | 1 |
| 806 | 26 | 11187 | 13 = 0.50 | 1 | 11187 | 13 = 0.50 | 1 | 9925 | 14 = 0.54 | 1 |
| 1205 | 21 = 0.81 | 2 | 1205 | 21 = 0.81 | 2 |
| 777 | 30 | 4569 | 16 = 0.53 | 1 | 4569 | 16 = 0.53 | 1 | - | - | - |
| 4615 | 15 = 0.50 | 1 | 4615 | 15 = 0.50 | 1 |
| 782 | 40 | 4678 | 21 = 0.53 | 1 | 4678 | 21 = 0.53 | 1 | - | - | - |
| 4794 | 24 = 0.60 | 1 | 4794 | 24 = 0.60 | 1 |
| 909 | 26 | 9246 | 13 = 0.50 | 1 | 9246 | 13 = 0.50 | 1 | - | - | - |
| 7223 | 13 = 0.50 | 1 | 7223 | 13 = 0.50 | 1 |
| 924 | 42 | 4206 | 20 = 0.48 | 1 | 4206 | 20 = 0.48 | 1 | 4127 | 20 = 0.48 | 1 |
| 130 | 40 = 0.95 | 2 | 130 | 40 = 0.95 | 2 |
| 843 | 42 | 9233 | 21 = 0.50 | 1 | 9233 | 21 = 0.50 | 1 | 15476 | 19 = 0.45 | 1 |
| 1360 | 34 = 0.81 | 1 | 1360 | 34 = 0.81 | 1 |

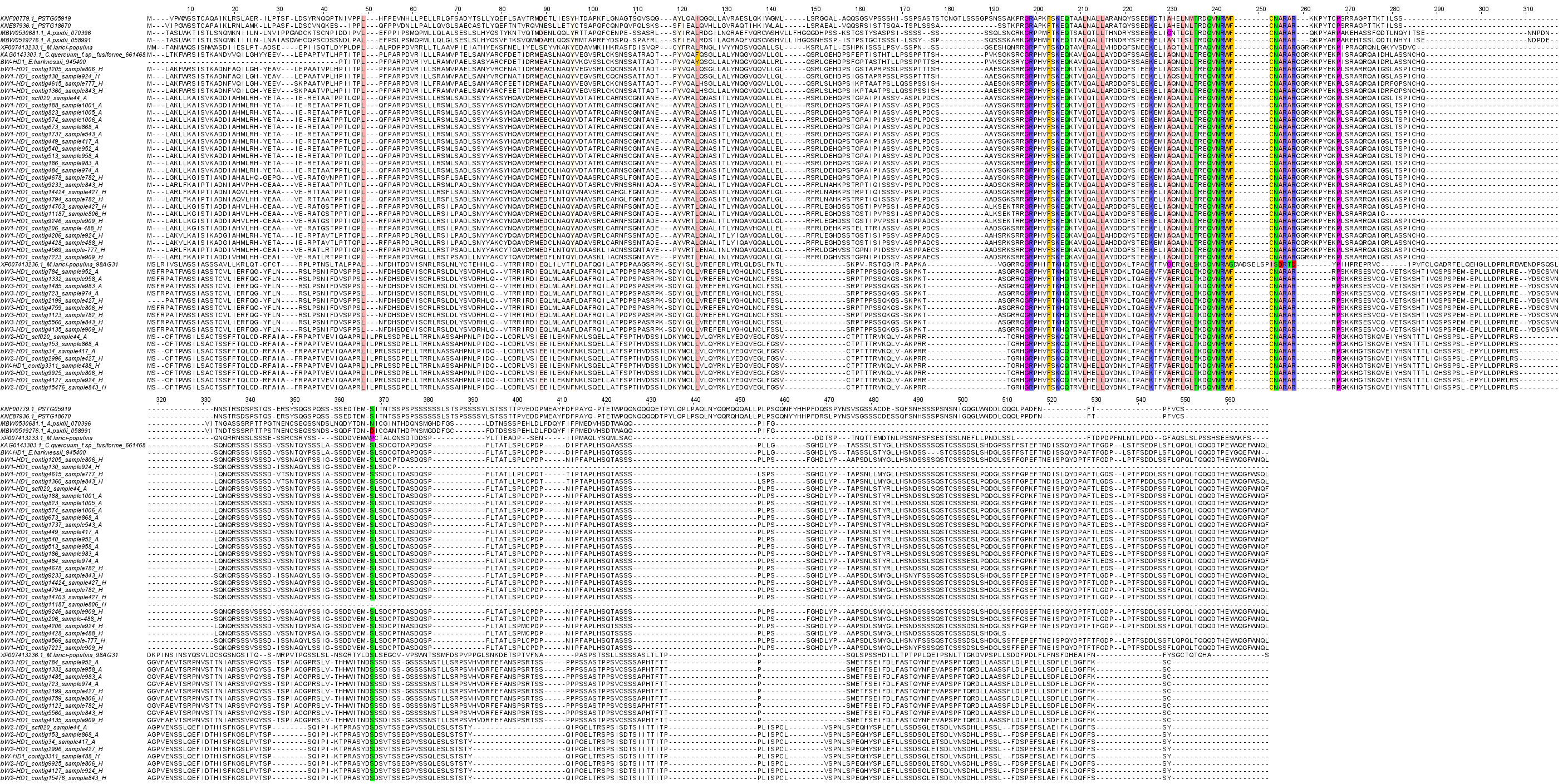
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Form** | **Sample ID** | **Genome Coverage = 2 copies** | **Third HD locus** | | | ***STE3.2-1*** | | | **STE3.2 Homologs** | | | | | |
| ***BW3-HD1*** | | | **Group 1** | | | **Group 2** | | |
| **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** |
| Autoecious | 44\* | 46 | - | - | - | 32 | 43 = 0.93 | 2 | 13 | 48.6 = 1.05 | 2 | - | - | - |
| 1001 | 41 | - | - | - | 2901 | 42 = 1.02 | 2 | 4833 | 42 = 1.0 | 2 | - | - | - |
| 1005 | 30 | - | - | - | 6935 | 29 = 0.97 | 2 | 16750 | 33 = 1.0 | 2 | - | - | - |
| 1006 | 42 | - | - | - | 3569 | 43 = 1.02 | 2 | 6975 | 44 = 1.0 | 2 | - | - | - |
| 543 | 16 | - | - | - | 11808 | 16 = 1.0 | 2 | 30973 | 18 = 1.0 | 2 | - | - | - |
| 417 | 44 | - | - | - | 2960 | 50 = 1.14 | 2 | 4846 | 75 = 1.5 | 3 | - | - | - |
| 868 | 30 | - | - | - | 3979 | 33 = 1.10 | 2 | 8102 | 36 = 1.0 | 2 | - | - | - |
| 952 | 42 | 784 | 36 =0.86 | 2 | 4751 | 42 = 1.0 | 2 | - | - | - | 7918 | 45 = 1.0 | 2 |
| 958 | 40 | 1332 | 36 = 0.90 | 2 | 392 | 42 = 1.05 | 2 | - | - | - | 3582 | 42 = 1.0 | 2 |
| 983 | 60 | 1485 | 58 = 0.97 | 2 | 2912 | 62 = 1.03 | 2 | - | - | - | 3623 | 62 = 1.0 | 2 |
| 974 | 44 | 723 | 38 = 0.86 | 2 | 2878 | 48 = 1.09 | 2 | - | - | - | 3564 | 46 = 1.0 | 2 |
| Heteroecious | 427 | 31 | 2199 | 15 = 0.48 | 1 | 2821 | 33 = 1.06 | 2 | - | - | - | - | - | - |
| 488 | 36 | - | - | - | 3405 | 36 = 1.0 | 2 | - | - | - | - | - | - |
| 806 | 26 | 4759 | 13 = 0.50 | 1 | 5719 | 30 = 1.15 | 2 | 14591 | 16 = 0.5 | 1 | - | - | - |
| 777 | 30 | - | - | - | 2806 | 32 = 1.07 | 2 | - | - | - | - | - | - |
| 782 | 40 | 1123 | 38 = 0.95 | 2 | 8499 | 41 = 1.03 | 2 | - | - | - | - | - | - |
| 909 | 26 | 4135 | 31 = 1.19 | 2 | 7077 | 28 = 1.08 | 2 | - | - | - | - | - | - |
| 924 | 42 | - | - | - | 2764 | 44 = 1.05 | 2 | - | - | - | - | - | - |
| 843 | 42 | 5560 | 20 = 0.48 | 1 | 6653 | 48 = 1.14 | 2 | - | - | - | - | - | - |

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| **Form** | **Sample ID** | **Genome Coverage = 2 copies** | ***STE3.2* Homologs** | | | | | | | | | | | |
| **Group 3** | | | **Group 4** | | | **Group 5** | | | **Group 6** | | |
| **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** |
| Autoecious | 44\* | 46 | - | - | - | - | - | - | - | - | - | - | - | - |
| 1001 | 41 | - | - | - | - | - | - | - | - | - | - | - | - |
| 1005 | 30 | - | - | - | - | - | - | - | - | - | - | - | - |
| 1006 | 42 | - | - | - | - | - | - | - | - | - | - | - | - |
| 543 | 16 | - | - | - | - | - | - | - | - | - | - | - | - |
| 417 | 44 | - | - | - | - | - | - | - | - | - | - | - | - |
| 868 | 30 | - | - | - | - | - | - | - | - | - | - | - | - |
| 952 | 42 | - | - | - | - | - | - | - | - | - | - | - | - |
| 958 | 40 | - | - | - | - | - | - | - | - | - | - | - | - |
| 983 | 60 | - | - | - | - | - | - | - | - | - | - | - | - |
| 974 | 44 | - | - | - | - | - | - | - | - | - | - | - | - |
| Heteroecious | 427 | 31 | - | - | - | - | - | - | - | - | - | - | - | - |
| 488 | 36 | - | - | - | - | - | - | 3757 | 12 = 0.5 | 1 | - | - | - |
| 806 | 26 | - | - | - | - | - | - | - | - | - | - | - | - |
| 777 | 30 | - | - | - | - | - | - | 2692 | 16 = 0.5 | 1 | - | - | - |
| 782 | 40 | 2930 | 28 = 0.5 | 1 | - | - | - | - | - | - | 3272 | 24 = 0.5 | 1 |
| 909 | 26 | 9625 | 14 = 0.5 | 1 | - | - | - | - | - | - | 8156 | 38 = 1.5 | 3 |
| 924 | 42 | - | - | - | 4060 | 25 = 0.5 | 1 | - | - | - | - | - | - |
| 843 | 42 | - | - | - | - | - | - | 7513 | 24 = 0.5 | 1 | - | - | - |

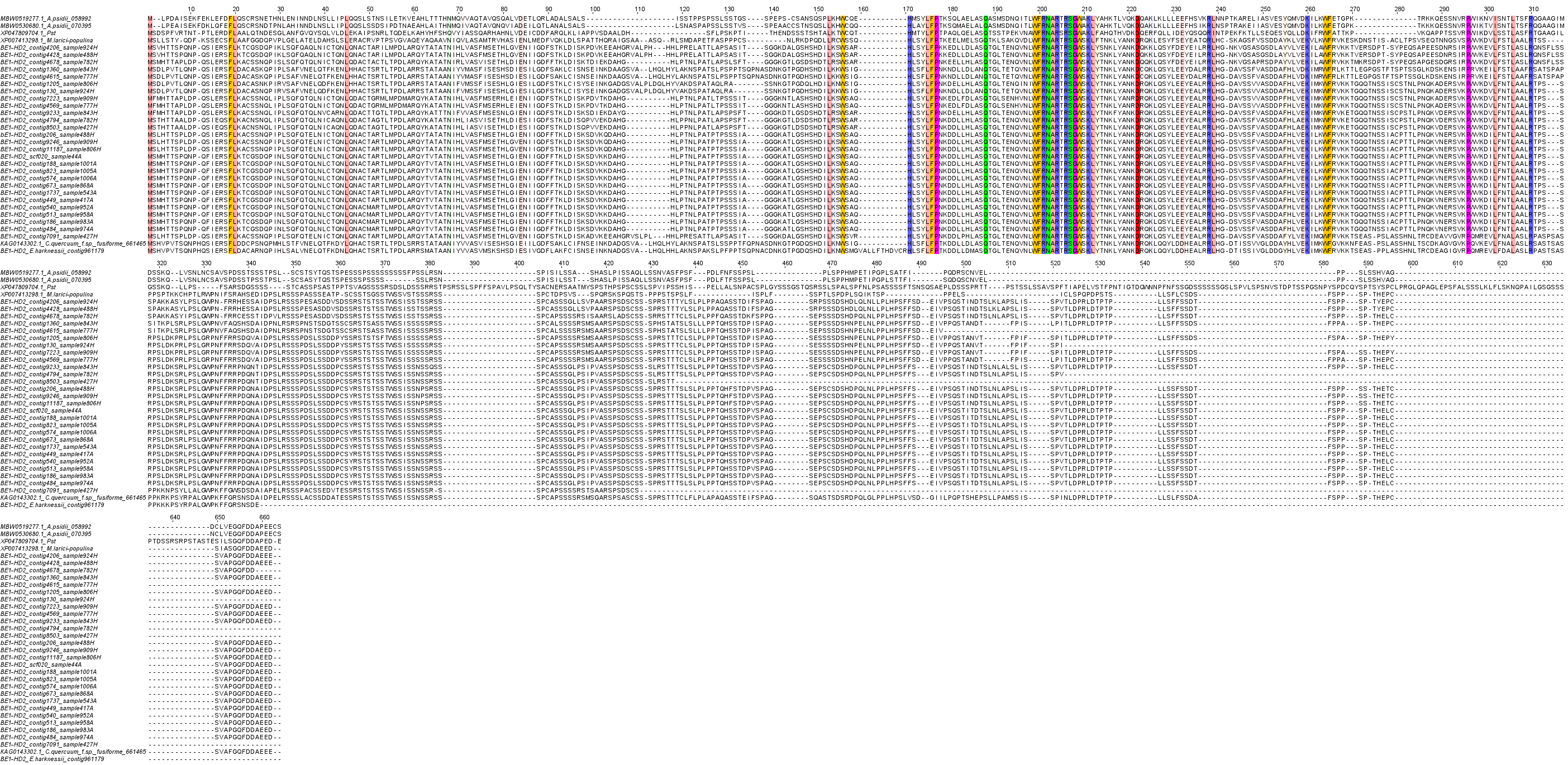
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Form** | **Sample ID** | **Genome Coverage = 2 copies** | ***STE3.2* Homologs** | | | | | | | | | | | |
| **Group 7** | | | **Group 8** | | | **Group 9** | | | **Group 10** | | |
| **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** |
| Autoecious | 44\* | 46 | - | - | - | - | - | - | - | - | - | - | - | - |
| 1001 | 41 | - | - | - | - | - | - | - | - | - | - | - | - |
| 1005 | 30 | - | - | - | - | - | - | - | - | - | - | - | - |
| 1006 | 42 | - | - | - | - | - | - | - | - | - | - | - | - |
| 543 | 16 | - | - | - | - | - | - | - | - | - | - | - | - |
| 417 | 44 | - | - | - | - | - | - | - | - | - | - | - | - |
| 868 | 30 | - | - | - | - | - | - | - | - | - | - | - | - |
| 952 | 42 | 22 | 48 = 0.88 | 2 | - | - | - | - | - | - | - | - | - |
| 958 | 40 | 77 | 40 = 1.0 | 2 | - | - | - | - | - | - | - | - | - |
| 983 | 60 | 75 | 62 = 0.97 | 2 | - | - | - | - | - | - | - | - | - |
| 974 | 44 | 85 | 45 = 0.98 | 2 | - | - | - | - | - | - | - | - | - |
| Heteroecious | 427 | 31 | - | - | - | - | - | - | 4093 | 28 = 0.90 | 2 | 2515 | 16 = 0.52 | 1 |
| 488 | 36 | - | - | - | - | - | - | - | - | - | - | - | - |
| 806 | 26 | - | - | - | - | - | - | - | - | - | - | - | - |
| 777 | 30 | - | - | - | - | - | - | - | - | - | 2808 | 15 = 0.5 | 1 |
| 782 | 40 | - | - | - | - | - | - | - | - | - | 2651 | 21 = 0.53 | 1 |
| 909 | 26 | - | - | - | - | - | - | 8806 | 26 = 1.0 | 2 | - | - | - |
| 924 | 42 | - | - | - | 4496 | 25 = 0.60 | 1 | - | - |  | - | - | - |
| 843 | 42 | - | - | - | - | - | - | 11258 | 38 = 0.90 | 2 | - | - | - |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Form** | **Sample ID** | **Dikaryotic Genome Coverage = 1.0** | ***STE3.2* Homologs** | | | | | | ***MFAs*** | | |
| **Group 11** | | | **Group 12** | | | ***MFA* Group 1** | | |
| **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** |
| Autoecious | 44\* | 46 | - | - | - | - | - | - | 13 (Second MFA) | 49.8 = 1.08 | 2 |
| 1001 | 42 | - | - | - | - | - | - | 363 | 50 = 1.19 | 2 |
| 1005 | 30 | - | - | - | - | - | - | - | - | - |
| 1006 | 42 | - | - | - | - | - | - | - | - | - |
| 543 | 16 | - | - | - | - | - | - | - | - | - |
| 417 | 42 | - | - | - | - | - | - | 1271 | 74 =1.76 | 4 |
| 868 | 30 | - | - | - | - | - | - | - | - | - |
| 952 | 42 | - | - | - | - | - | - | 628 (2x) | 45 = 1.07 | 2 |
| 6560 | 47 = 1.0 | 2 |
| 958 | 40 | - | - | - | - | - | - | 578 (2x) | 42 = 1.0 | 2 |
| 3386 | 40 = 1.0 | 2 |
| 983 | 60 | - | - | - | - | - | - | 1077 (2x) | 75 = 1.25 | 3 |
| 3429 | 60 = 1.0 | 2 |
| 974 | 44 | - | - | - | - | - | - | 495 (2x) | 64 = 1.45 | 3 |
| 3374 | 47 = 1.0 | 2 |
| Heteroecious | 427 | 31 | - | - | - | - | - | - | 6726 | 18 = 0.5 | 1 |
| 5275 | 17 = 0.5 | 1 |
| 5632 | 16 = 0.5 | 1 |
| 488 | 36 | 763 | 30 = 0.83 | 2 | 3142 | 33 = 0.92 | 2 | 99966 | 47 = 1.31 | 3 |
| 4067 | 22 = 0.61 | 1 |
| 9214 | 14 = 0.39 | 1 |
| 806 | 26 | - | - | - | 7321 | 15 = 0.58 | 1 | 215192 | 36 = 1.5 | 3 |
| 777 | 30 | 2675 | 18 = 0.60 | 1 | - | - | - | 3676 (2x) | 16 = 0.5 | 1 |
| 782 | 40 | - | - | - | - | - | - | 3689 (2x) | 21 = 0.5 | 1 |
| 4082 | 20 = 0.5 | 1 |
| 909 | 26 | - | - | - | - | - | - | 7163 (2x) | 21 = 1.0 | 2 |
| 8735 | 20 = 1.0 | 2 |
| 924 | 42 | - | - | - | 3640 | 22 = 0.52 | 1 | 23810 | 54 = 1.21 | 2 |
| 2195 (3x) | 27 = 0.64 | 1 |
| 3738 | 21 = 0.5 | 1 |
| 843 | 42 | 5939 | 24 = 0.57 | 1 | - | - | - | 2907 (2x) | 38 = 1.0 | 2 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Form** | **Sample ID** | **Dikaryotic Genome Coverage = 1.0** | ***MFAs*** | | | | | |
| ***MFA* Group 2** | | | ***MFA* Group 3** | | |
| **Scaffold** | **Coverage (reads = proportion)** | **Copies** | **Scaffold** | **Coverage (reads = proportion)** | **Copies** |
| Autoecious | 44\* | 46 | 13 (First MFA) | 42.5 = 0.92 | 2 | - | - |  |
| 13 (Third MFA) | 67 = 1.46 | 3 |  |  |  |
| 1001 | 42 | 5169 | 39 = 0.93 | 2 | - | - | - |
| 4040 | 42 = 1.00 | 2 |
| 1005 | 30 | 19091 | 35 = 1.17 | 2 | - | - | - |
| 12222 | 32 = 1.07 | 2 |
| 1006 | 42 | 7696 | 47 = 1.12 | 2 | - | - | - |
| 5533 | 46 = 1.10 | 2 |
| 543 | 16 | 35642 | 17 = 1.06 | 2 | - | - | - |
| 22003 | 18 = 1.13 | 2 |
| 417 | 42 | 5478 | 48 = 1.14 | 2 | - | - | - |
| 4248 | 56 = 1.33 | 3 |
| 868 | 30 | 9060 | 34 = 1.13 | 2 | - | - | - |
| 6214 | 32 = 1.07 | 2 |
| 952 | 42 | - | - | - | 6560 | 47 = 1.12 | 2 |
| 958 | 40 | - | - | - | 3386 | 40 = 1.0 | 2 |
| 983 | 60 | - | - | - | 3429 | 60 = 1.0 | 2 |
| 974 | 44 | - | - | - | 3374 | 47 = 1.07 | 2 |
| Heteroecious | 427 | 31 | 5166 | 18 = 0.58 | 1 | 167 | 31 = 1.0 | 2 |
| 4630 | 16 = 0.52 | 1 | 4891 | 16 = 0.52 | 1 |
| 488 | 36 | 4603 | 28 = 0.78 | 2 | 41 | 34 = 0.94 | 2 |
| 763 | 30=0.83 | 2 | 11718 | 13 = 0.36 | 1 |
| 806 | 26 | 16932 | 14 = 0.58 | 1 | - | - | - |
| 10161 | 16 = 0.67 | 1 | - | - | - |
| 26083 | 13 = 0.54 | 1 | - | - | - |
| 777 | 30 | 4745 | 15 = 0.50 | 1 | - | - | - |
| 2675 | 18 = 0.60 | 1 | - | - | - |
| 782 | 40 | 4629 | 20 = 0.5 | 1 | - | - | - |
| 909 | 26 | 16514 | 14 = 0.54 | 1 | - | - | - |
| 924 | 42 | 5664 | 22 = 0.52 | 1 | 4250 | 20 = 0.48 | 1 |
| 843 | 42 | 1437 | 30 = 0.71 | 2 | - | - | - |
| 5939 | 24 = 0.5 | 1 | - | - | - |

****

**Supplementary Fig. S10.** Alignment of bW-HD1 proteins from *Cronartium pini* and reference samples. Columns highlighted in color mark ≥90% conserved positions, including the homeodomain.



**Supplementary Fig. S11.** Alignment of *bE-HD2* proteins from *Cronartium pini* and reference samples. Columns highlighted in color mark ≥90% conserved positions, including the homeodomain.

**Supplementary Table S2.** Collected *Cronartium pini* samples.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sample ID** | **Site** | **Country** | **(Lat, Long)** | **Form** |
| 44 | Kallax | Sweden | N 65°, E 22° | Autoecious |
| 1001 | Jokela | Finland | N 60°, E 24° | Autoecious |
| 1005 | Jokkmokk | Sweden | N 66°, E 19° | Autoecious |
| 1006 | Jokkmokk | Sweden | N 66°, E 19° | Autoecious |
| 417 | Halland | Sweden | N 56°, E 13° | Autoecious |
| 427 | Gotland island | Sweden | N 57°, E 18° | Heteroecious |
| 488 | Gotland island | Sweden | N 57°, E 18° | Heteroecious |
| 543 | Halland | Sweden | N 56°, E 13° | Autoecious |
| 777 | Ätnarova | Sweden | N 67°, E 21° | Heteroecious |
| 782 | Ätnarova | Sweden | N 67°, E 21° | Heteroecious |
| 806 | Ätnarova | Sweden | N 67°, E 21° | Heteroecious |
| 843 | Övertorneå | Sweden | N 66°, E 23° | Heteroecious |
| 868 | Kallax | Sweden | N 65°, E 22° | Autoecious |
| 909 | Kolari | Finland | N 67°, E 24° | Heteroecious |
| 924 | Kolari | Finland | N 67°, E 24° | Heteroecious |
| 952 | Pudasjärvi | Finland | N 65°, E 27° | Autoecious |
| 958 | Pudasjärvi | Finland | N 65°, E 27° | Autoecious |
| 974 | Pudasjärvi | Finland | N 65°, E 27° | Autoecious |
| 983 | Pudasjärvi | Finland | N 65°, E 27° | Autoecious |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Form** | **Sample ID** | **First HD locus** | | **Second HD locus** | **Third HD locus** |
| ***BW1-HD1*** | ***BE1-HD2*** | ***BW2-HD1*** | ***BW3-HD1*** |
| Autoecious | 44 | ERZ26867828 | OZ259645 | OZ259767 | - |
| 1001 | ERZ26867829 | OZ259647 | - | - |
| 1005 | ERZ26867830 | OZ259616 | - | - |
| 1006 | ERZ26867831 | OZ259657 | - | - |
| 543 | ERZ26867832 | OZ259627 | - | - |
| 417 | OZ259535 | OZ259613 | OZ259668 | - |
| 868 | OZ259531 | OZ259649 | OZ259648 | - |
| 952 | OZ259526 | OZ259626 | - | OZ259806 |
| 958 | OZ259527 | OZ259655 | - | OZ259807 |
| 983 | OZ259534 | OZ259628 | - | OZ259861 |
| 974 | OZ259532 | OZ259660 | - | OZ259809 |
| Heteroecious | 427 | OZ259540 | OZ259656 | OZ259805 | OZ259761 |
| OZ259486 | OZ259618 |
| 488 | OZ259538 | OZ259665 | OZ259866 | - |
|  |  |  | - |
| 806 | OZ259537 | OZ259658 | OZ259670 | OZ259864 |
| OZ259539 | OZ259642 |
| 777 | OZ259542 | OZ259611 | - | - |
| OZ259543 | OZ259622 |
| 782 | OZ259528 | OZ259631 | - | OZ259862 |
| OZ259544 | OZ259663 |
| 909 | OZ259545 | OZ259617 | - | OZ259810 |
| OZ259547 | OZ259650 |
| 924 | OZ259282 | OZ259621 | OZ259868 | - |
| OZ259541 | OZ259646 |
| 843 | OZ259525 | OZ259651 | OZ259669 | OZ259863 |
| OZ259546 | OZ259615 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Form** | **Sample ID** | ***STE3.2-1*** | ***STE3.2* Homologs** | | | | | | | | | | | |
| **Group 1** | **Group 2** | **Group 3** | **Group 4** | **Group 5** | **Group 6** | **Group 7** | **Group 8** | **Group 9** | **Group 10** | **Group 11** | **Group 12** |
| Autoecious | 44\* | OZ259757 | OZ259640 | - | - | - | - | - | - | - | - | - | - | - |
| 1001 | OZ259750 | OZ259607 | - | - | - | - | - | - | - | - | - | - | - |
| 1005 | OZ259867 | OZ259633 | - | - | - | - | - | - | - | - | - | - | - |
| 1006 | OZ259758 | OZ259608 | - | - | - | - | - | - | - | - | - | - | - |
| 543 | OZ259860 | OZ259666 | - | - | - | - | - | - | - | - | - | - | - |
| 417 | OZ259865 | OZ259644 | - | - | - | - | - | - | - | - | - | - | - |
| 868 | OZ259760 | OZ259619 | - | - | - | - | - | - | - | - | - | - | - |
| 952 | OZ259752 | - | OZ259612 | - | - | - | - | OZ259632 | - | - | - | - | - |
| 958 | OZ259759 | - | OZ259652 | - | - | - | - | OZ259659 | - | - | - | - | - |
| 983 | OZ259764 | - | OZ259629 | - | - | - | - | OZ259667 | - | - | - | - | - |
| 974 | OZ259763 | - | OZ259653 | - | - | - | - | OZ259639 | - | - | - | - | - |
| Heteroecious | 427 | OZ259751 | - | - | - | - | - | - | - | - | OZ259662 | OZ259634 | - | - |
| 488 | OZ259808 | - | - | - | - | OZ259643 | - | - | - | - | - | OZ259606 | OZ259625 |
| 806 | OZ259753 | OZ259638 | - | - | - | - | - | - | - | - | - | - | OZ259664 |
| 777 | OZ259814 | - | - | - | - | OZ259610 | - | - | - | - | OZ259635 | OZ259637 | - |
| 782 | OZ259859 | - | - | OZ259578 | - | - | OZ259624 | - | - | - | OZ259636 | - | - |
| 909 | OZ259765 | - | - | OZ259605 | - | - | OZ259620 | - | - | OZ259630 | - | - | - |
| 924 | OZ259766 | - | - | - | OZ259661 | - | - | - | OZ259641 | - | - | - | OZ259609 |
| 843 | OZ259762 | - | - | - | - | OZ259654 | - | - | - | OZ259614 | - | OZ259623 | - |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Form** | **Sample ID** | ***MFAs*** | | |
| ***MFA* Group 1** | ***MFA* Group 2** | ***MFA* Group 3** |
| Autoecious | 44\* | OZ260002 | OZ259987 | - |
| OZ260045 |  |
| 1001 | OZ260029 | OZ260025 | - |
| OZ260051 |
| 1005 | - | OZ259984 | - |
| OZ259979 |
| 1006 | - | OZ259982 | - |
| OZ260030 |
| 543 | - | OZ260024 | - |
| OZ259986 |
| 417 | OZ260042 | OZ260027 | - |
| OZ260047 |
| 868 | - | OZ260010 | - |
| OZ259994 |
| 952 | OZ260008 / OZ260038 | - | OZ260021 |
| OZ260004 |
| 958 | OZ259992 / OZ260001 | - | OZ260033 |
| OZ259998 |
| 983 | OZ260005 / OZ260020 | - | OZ260039 |
| OZ260041 |
| 974 | OZ260015 / OZ260016 | - | OZ260034 |
| OZ259997 |
| Heteroecious | 427 | OZ259989 | OZ259980 | OZ260014 |
| OZ259996 | OZ260035 | OZ259990 |
| OZ260013 |
| 488 | OZ260019 | OZ260048 | OZ259988 |
| OZ259995 | OZ259993 | OZ260036 |
| OZ260037 |
| 806 | OZ260043 | OZ260031 | - |
| OZ259978 |
| OZ260040 |
| 777 | OZ260028 / OZ260000 | OZ260023 | - |
| OZ260049 |
| 782 | OZ260007 / OZ259999 | OZ260011 | - |
| OZ260050 |
| 909 | OZ259991 / OZ260044 | OZ260003 | - |
| OZ260012 |
| 924 | OZ260017 | OZ260026 | OZ260032 |
| OZ259985 / OZ260046 / OZ260009 |
| OZ260018 |
| 843 | OZ260006 / OZ260022 | OZ259981 | - |
| OZ259983 |

| **Species** | **Gene name** | **ID in phylogenetic tree** | **Protein ID** | **Reference** |
| --- | --- | --- | --- | --- |
| *Austropuccinia psidii* | *bW-HD1* | *A. psidii* 070396 / *A. psidii* 058991 | MBW0530681.1 / MBW0519276.1 | Ferrarezi et al., 2022 |
| *bE-HD2* | *A. psidii* 070395 / *A. psidii* 058992 | MBW0530680.1 / MBW0519277.1 |
| *Cronartium harknessii* | *bW-HD1* | *C. harknessii* 945400 / *C. harknessii* 113817 | Endocronartium\_harknessii\_PhW48OC\_contig945400 Endocronartium\_harknessii\_PhW48OC\_contig113817 | Feau et al., 2018 |
| *bE-HD2* | *C. harknessii* 961179 | Endocronartium\_harknessii\_PhW48OC\_contig961179 |
| *Cronartium quercuum f.sp. fusiforme* | *bW-HD1* | *C. quercuum* f.sp. *fusiforme* 661468 | KAG0143303.1 | Pendleton et al., 2014 |
| *bE-HD2* | *C. quercuum* f.sp. *fusiforme* 661465 | KAG0143302.1 |
| *STE3.2-1* | *C. quercuum* f.sp. *fusiforme*KAG0143345 | KAG0143345.1 |
| *STE3.2* | *C. quercuum* f.sp. *fusiforme*KAG0139918 / KAG0139804 | KAG0139918.1 / KAG0139804.1 |
| *Melampsora larici-populina* | *bW-HD1* | *M. larici-populina* XP\_007413233 / *M. larici-populina* XP\_007413236 | XP\_007413233.1 / XP\_007413236.1 | Duplessis et al., 2011 |
| *bE-HD2* | *M. larici-populina* XP\_007413298 | XP\_007413298.1 |
| *STE3.2-1* | *M. larici-populina* XP\_007405301 | XP\_007405301.1 |
| *STE3.2-2* | *M. larici-populina* MlpSTE3.2 | XP\_007418099.1 |
| *STE3.2-3* | *M. larici-populina* MlpSTE3.3 | XP\_007418988.1 |
| *STE3.2-4* | *M. larici-populina* MlpSTE3.4 | XP\_007419438.1 |
| *MFA1* | *M. larici-populina* MlPh1 | XP\_007419440.1 |
| *MFA2* | *M.* *larici-populina* MlPh2 | XP\_007418113.1 |
| *MFA3* | *M. larici-populina* MlPh3 | XP\_007418989.1 |
| *MFA4* | *M.* *larici-populina* MlPh4 | XP\_007418445.1 |
| *MFA6* | *M*. *larici-populina* MlPh6 | XP\_007418442.1 |
| *MFA8* | *M. larici-populina* MlPh8 | XP\_007414982.1 |
| *MFA10* | *M*. *larici-populina* MlPh10 | XP\_007415088.1 |
| *Puccinia graminis* f. sp. *tritici* | *STE3.2-1* | *P. graminis* f.sp. *tritici* PGTG00333 | XP\_003307383.2 | NCBI & Cuomo et al., 2017 |
| *STE3.2-2* | *P. graminis* f.sp. *tritici* PGTG19559 | XP\_003338083.1 |
| *STE3.2-3* | *P. graminis* f.sp. *tritici* PGTG01392 | XP\_003319218.2 |
| *MFA1* | *P. graminis* f.sp. *tritici* MFA1 | PgtSCCL-MFA1 |
| *MFA2* | *P. graminis* f.sp. *tritici* PgtSCCL MFA2 | PgtSCCL-MFA2 |
| *MFA3* | *P. graminis* f.sp. *tritici* MFA3 | PgtSCCL-MFA3 |
| *Puccinia triticina* | *STE3.2-1* | *P. triticina* PTTG28830 | OAV89066.1 | NCBI & Cuomo et al., 2017 |
| *STE3.2-2* | *P. triticina* PTTG09751 | OAV87231.1 |
| *STE3.2-3* | *P. triticina* PTTG09693 | OAV88334.1 |
| *MFA1.3* | *P. triticina* MFA1.3 | PtBBBD\_ Pt-MFA1.3 |
| *MFA2* | *P. triticina* PtBBBD MFA2 | PtBBBD\_ Pt-MFA2 |
| *Puccinia striiformis* f. sp.*tritici* | *bW-HD1* | *P. striiformis* f. sp. *tritici* PSTG05919 / *P. striiformis* f. sp. *tritici* PSTG18670 | KNF00779.1 / KNE87936.1 | NCBI & Cuomo et al., 2017 |
| *bE-HD2* | *P. striiformis* f. sp. *tritici* PSTG19315 | KNE87304.1 |
| *STE3.2-1* | *P. striiformis* f. sp. *tritici* PSTG02613 | KNF04269.1 |
| *STE3.2-2* | *P. striiformis* f. sp. *tritici* PSTG15127 | KNE91469.1 |
| *STE3.2-3* | *P. striiformis* f. sp. *tritici* PSTG15070 | KNE91511.1 |
| *MFA1* | *P. striiformis* f. sp. *tritici* MFA1 | XP\_047804355.1 |
| *MFA2* | *P. striiformis* f. sp. *tritici* Pst134EMFA2 | AAD56044.1 |
| *Ustilago hordei* | *PRA1* | *U. hordei* PRA1 | CAJ41875.1 | Bakkeren et al., 2006 |
| *PRA2* | *U. hordei* PRA2 | AAD56044.1 | Anderson et al., 1999 |
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