**Table A.1**: Primers utilized in the *Bacillus nakamurai* BDI-IS1 mutant strains construction

|  |  |  |
| --- | --- | --- |
| Targeted molecule (s) | Primer name | Oligonucleotide sequence |
| Bacillaene | baeJ verif | TACATGGACTCGCTGAACGAC |
| dwn baeJ F | GTAAAACGACGGCCAGTGAGGTTTAATGTGAAGAACTTC |
| dwn baeJ R | CCTTCAAGAGATGCGGAGAC |
| up baeJ F | TCAGACCGGGATAATCAAGC |
| up baeJ R | CAGGAAACAGCTATGACTTTCATAGAGCTGCCTCCAT |
| Bacilysin | bacA verif | GCTTGCTTTAATTTTCGGCG |
| dwn bacA F | GTAAAACGACGGCCAGTACTGAACAAGATTTGCAGG |
| dwn bacA R | CGTATCAATCGCTGACTGGA |
| up bacA F | ATGGACGTTTTGGATTTTCG |
| up bacA R | CAGGAAACAGCTATGACAATCATGAGCACCAACCAAT |
| Iturin A | ituA verif | GGAGAATATTCAGCTCTTGTCT |
| dwn ituA F | GTAAAACGACGGCCAGTAACTTTTAGGAAGCAAGGGGA |
| dwn ituA R | AGTTCGGCTTCCAGGGTAAT |
| up ituA F | TTGATGCAAAATGCAGATCC |
| Up ituA R | CAGGAAACAGCTATGACAAACATAGGTTTCCTCCAAGG |
| Plantazolicin A | pznA verif | CCCGGAGTTAAATACCTATGT |
| dwn pznA F | GTAAAACGACGGCCAGTACGTTCTAACCTCTAAGACAAA |
| dwn pznA R | ACCGCTGTAGAATTGGGACA |
| up pznA F | GCCATCAACAATAACGCAAA |
| Up pznA R | CAGGAAACAGCTATGACAACCATATTGTGATTTATAT |
| Bacillibactin | dhbC verif | TAATCAGCCGTGCCCTGCGG |
| dwn dhbC F | GTAAAACGACGGCCAGTATGTAATGGAGAAAGGGGAA |
| dwn dhbC R | AGCACTTGGAGGCTGGATAA |
| up dhbC F | TCGGACTAAAAACGGCTGAT |
| Up dhbC R | CAGGAAACAGCTATGACTGACATGTCTGTACCTCCTT |
| Amylocyclicin | acnA verif | AGTGTTCCCGTAACAATTACTGA |
| dwn acnA F | GTAAAACGACGGCCAGTATTTAGCCCGGGGGAGAGCA |
| dwn acnA R | TGACTGCCCGATAAACACAG |
| up acnA F  | TTACGGAATGGGTTTTGAGC  |
| up acnA R  | CAGGAAACAGCTATGACACCTATCATATTACCATCCT |
| Surfactin | srfAA verif | TGATCTCGGAGGACGGGGTT |
| down srfAA F | GTAAAACGACGGCCAGTGCTTGGACCAGCTCCCTCTT |
| down srfAA R | GGGATTTGCCTTTCCATGCG |
| up srfAA F | CCATTCCGGAGCTTGTGTCC |
| up srfAA R | CAGGAAACAGCTATGACCGCCTCCGGCTTTCAAAATC |
| NRPs | sfp verif | CGATTCAGCCTGAGCTGATG |
| down sfp F | GTAAAACGACGGCCAGTGCACAGCCCGATTTTTGTGA |
| down sfp R | CGATGCAGTCCCCGGATTAT |
| up sfp F | GGCTGGACAATGGTTGTCGT |
| up sfp R | CAGGAAACAGCTATGACGTCCAACATCCTCCGTCTGC |

**Table A.2**: Antibacterial activity (mm of inhibition diameter ± SE) of the isolated bacterial strains from Burundian soils against 6 plant pathogenic bacteria

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Samples/pathogen | *Xanthomonas campestris* | *Clavibacter michiganensis* | *Pseudomonas cichorii* | *Pseudomonas fuscovaginae* | *Rhodococcus fascians* | *Pectobacterium carotovorum* |
| BDI-M1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| BDI-M2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| BDI-M3 | 6.0 ± 0.6 | 3.2 ± 0.2 | 5.5 ± 1.0 | 0.0 | 12.5 ± 0.3 | 0.0 |
| BDI-M4 | 25.5 ± 0.3 | 19.7 ± 0.4 | 8.3 ± 0.3 | 8.6 ± 0.2 | 9.3 ± 0.2 | 0.0 |
| BDI-M5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| BDI-M6 | 0.0 | 0.0 | 8.3 ± 0.4 | 8.7 ± 0.4 | 0.0 | 0.0 |
| BDI-M7 | 3.5 ± 0.4 | 0.0 | 7.7 ± 0.6 | 0.0 | 11.0 ± 0.3 | 0.0 |
| BDI-M8 | 5.5 ± 0.4 | 0.0 | 4.3 ± 0.2 | 0.0 | 12.5 ± 0.6 | 0.0 |
| BDI-M9 | 4.8 ± 0.4 | 0.0 | 5.5 ± 0.9 | 0.0 | 8.5 ± 0.3 | 0.0 |
| BDI-M10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| BDI-M11 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| BDI-M12 | 24.8 ± 0,2 | 20.0 ± 0.3 | 6.6 ± 0.3 | 8.7 ± 0.4 | 5.8 ± 0.2 | 0.0 |
| BDI-M13 | 14.0 ± 0.5 | 17.3 ± 0.4 | 8.2 ± 0.7 | 8.7 ± 0,4 | 10.3 ± 0.2 | 0.0 |
| BDI-IS1 | 27.8 ± 0.5 | 26.7 ± 0.6 | 6.8 ± 0.2 | 8.8 ± 0.3 | 28.6 ± 0.3 | 7.0 ± 0.3 |
| BDI-IS2 | 5.8 ± 0.2 | 7.0 ± 0.3 | 5.3 ± 0.4 | 0.0 | 4.5 ± 0.3 | 0.0 |
| BDI-IS3 | 26.3 ± 0.8 | 24.3 ± 0.3 | 8.0 ± 0.5 | 8.0 | 5.7 ± 0.2 | 0.0 |
| *Bacillus velezensis*QST713 | 26.2 ± 0.3 | 27.6 ± 1.2 | 7.6 ± 0.1 | 8.7 ± 0.4 | 19.2 ± 0.3 | 6.6 ± 0.2 |

**Legend**: BDI-M and BDI-IS imply the sites where bacteria were isolated from, Burundi-Murwi and Burundi-Isare respectively and 1,2… stands for the isolate’s number (BDI-IS1: isolate 1 from Burundi-Isare)

**Table A.3**: Antifungal activity (mm of inhibition radius ± SE) of the isolated bacterial strain BDI-IS1 against nine phytopathogenic fungi

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Samples/pathogen | *Aspergillus niger* | *Botrytis cinerea* | *Alternaria solani* | *Aschochyta rabiei* | *Exserohilum turcicum* | *Fusarium oxysporum* | *Rhizoctonia solani* | *Pyricularia oryzae* | *Colletotrichum sp.* |
| BDI-IS1 | 5.4 ± 0.2 | 8.8 ± 0.2 | 14.0 ± 0.1 | 12.0 ± 0.4 | 16.0 ± 0.3 | 8.3 ± 0.2 | 14.0 ± 0.7  | 21.0 ± 0.5 | 21.0 ± 0.4 |
| *B. velezensis* QST713 | 9.4 ± 0.2 | 14.0 ± 0.7 | 17.0 ± 0.3 | 15.0 ± 0.4 | 20.0 ± 0.3 | 12.0 ± 0.3 | 16.0 ± 0.6 | 21.0 ± 0.4 | 21.0 ± 0.4 |

**Table A.4**: Analysis of the daily variation (DAI) in the severity of early blight in tomato using a general linear mixed model by trial and by treatment method (trial 1&2)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Trial | Days post inoculation | Treatment method | BDI-IS1 | QST713 | Control | Trial | Days post inoculation | Treatment method | BDI-IS1 | QST713 | Control |
| 1 | 4DAI | R | 2.08a | 4.17a | 8.10a | 2 | 3DAI | R | 18.52a | 16.67a | 23.15a |
| 1 | L | 9.03a | 19.60a | 8.10a | 2 | L | 20.37a | 25.31a | 23.15a |
| 1 | 5 DAI | R | 10.19a | 17.82a | 12.27a | 2 | 4 DAI | R | 22.84ab | 19.75a | 30.86b |
| 1 | L | 9.03a | 19.60a | 12.27a | 2 | L | 22.22a | 28.40a | 30.86a |
| 1 | 6DAI | R | 11.34a | 20.37a | 14.81a | 2 | 5DAI | R | 31.48a | 33.95a | 40.74a |
| 1 | L | 10.88a | 23.84a | 14.81a | 2 | L | 33.33a | 45.06a | 40.74a |
| 1 | 7DAI | R | 12.50a | 25.46a | 30.09a | 2 | 6DAI | R | 32.72a | 35.19ab | 43.83b |
| 1 | L | 10.6a5 | 32.18a | 30.09a | 2 | L | 33.95a | 46.30aa | 43.83 |
| 1 | 8DAI | R | 26.39a | 30.09a | 36.57a | 2 | 7DAI | R | 35.19a | 35.19a | 45.68a |
| 1 | L | 18.98a | 43.98a | 36.57a | 2 | L | 38.89a | 50.62a | 45.68a |
| 1 | 9DAI | R | 34.03a | 35.19a | 50.00a | 2 | 8DAI | R | 37.04a | 41.36a | 52.47b |
| 1 | L | 24.07a | 48.92ab | 50.00b | 2 | L | 41.98a | 56.79a | 52.47a |
| 1 | 10DAI | R | 42.36a | 36.34a | 52.31a | 2 | 9DAI | R | 40.74a | 44.44a | 59.88b |
| 1 | L | 30.56a | 51.70a | 52.31a | 2 | L | 46.30a | 59.88a | 59.88a |
| 1 | 11DAI | R | 43.29a | 36.81a | 53.24a | 2 | 10DAI | R | 46.91a | 50.62a | 63.58b |
| 1 | L | 31.48a | 51.70a | 53.24a | 2 | L | 50.62a | 61.73a | 63.58a |
| 1 | 12DAI | R | 45.14a | 37.27a | 53.24a | 2 | 11DAI | R | 51.23a | 50.62a | 67.28b |
| 1 | L | 31.48a | 52.16a | 53.24a | 2 | L | 54.94a | 67.28a | 67.28a |
| 1 | 13DAI | R | 45.60a | 37.27a | 59.72a | 2 | 12DAI | R | 56.17a | 50.62a | 69.14b |
| 1 | L | 31.48a | 52.16ab | 59.72b | 2 | L | 59.26a | 67.90a | 69.14a |
| 1 | 14DAI | R | 45.60a | 39.58a | 62.50a | 2 | 13DAI | R | 56.79a | 51.23a | 69.75b |
| 1 | L | 31.94a | 52.85ab | 62.50b | 2 | L | 59.26a | 68.52a | 69.75a |
| 1 | 15DAI | R | 46.99a | 39.58a | 63.89b | 2 | 14DAI | R | 56.79a | 52.47a | 70.99b |
| 1 | L | 35.19a | 52.85ab | 63.89b | 2 | L | 60.49a | 69.14a | 70.99a |
| 1 | 16DAI | R | 46.99a | 39.58a | 63.89b | 2 | 15DAI | R | 58.02a | 53.09a | 71.60b |
|   | L | 35.19a | 52.85ab | 63.89b | 2 | L | 61.73a | 69.75a | 71.60a |
|   |  |  |  |  |  | 2 | 16DAI | R | 58.02a | 53.09a | 71.60b |
|   |   |   |   |   |   | 2 | L | 61.73a | 69.75a | 71.60a |

Legend: R: Root treatment, L: Leaf treatment. Values with different letters are significantly different at 0.05 threshold.

**Table A.5**: Analysis of the daily variation in the severity of the northern corn leaf blight disease using a general linear mixed model by trial and by treatment method (trial 1 & 2)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Trial | Days post inoculation | Treatment method | BDI-IS1 | QST713 | Control |
| 1 | 23DAI | R | 23.44a | 26.70a | 56.71b |
| 1 | L | 27.08a | 22.38a | 56.71b |
| 1 | 38DAI | R | 47.19a | 55.94a | 78.02b |
| 1 | L | 54.06a | 53.44a | 78.02b |
| 2 | 7DAI | R | 0.10a | 0.00a | 2.58a |
| 2 | L | 0.08a | 0.08a | 2.58a |
| 2 | 10 DAI | R | 0.58a | 5.92a | 14.08a |
| 2 | L | 0.58a | 4.42a | 14.08a |
| 2 | 12DAI | R | 5.17a | 7.92a | 27.42a |
| 2 | L | 9.63a | 13.67a | 27.42a |
| 2 | 13DAI | R | 8.38a | 10.08a | 37.1b |
| 2 | L | 15.13a | 17.50a | 37.1a |
| 2 | 15DAI | R | 12.67a | 10.54a | 37.1b |
| 2 | L | 17.63a | 18.83a | 37.1a |
| 2 | 17DAI | R | 12.96a | 12.79a | 40.21b |
| 2 | L | 17.79a | 18.88b | 40.21b |
| 2 | 19DAI | R | 13.83a | 16.96a | 44.58b |
| 2 | L | 22.22a | 21.58a | 44.58b |
| 2 | 21DAI | R | 14.46a | 16.96a | 44.75b |
| 2 | L | 22.69b | 21.58a | 44.75b |
| 2 | 25DAI | R | 15.88a | 18.21a | 58.17b |
| 2 | L | 23.99a | 23.17a | 58.17 b |
| 2 | 27DAI | R | 17.75a | 22.79a | 63.17 b |
| 2 | L | 26.78a | 24.50a | 63.17b |
| 2 | 29DAI | R | 17.75a | 24.46a | 68.17b |
| 2 | L | 27.64a | 27.00a | 68.17b |
| 2 | 33DAI | R | 17.75a | 24.46a | 70.04b |
| 2 | L | 28.47a | 27.04a | 70.04b |

Legend: R: Root treatment, L: Leaf treatment. Values with different letters are significantly different at 0.05 threshold.

**Table A.6:** Area under the disease progression curve (AUDPC) and protection index (PI) of BDI-IS1 and QST713 against northern corn leaf blight and tomato early blight

|  |  |
| --- | --- |
| Northern leaf blight | Tomato early blight |
| Trial | Treatment | AUDPCR | AUDPCL | PIR | PIL | AUDPCR | AUDPCL | PIR | PIL |
| 1 | BDI-IS1 | 799.31±97.24 | 920.01±62.09 | 51.93±5.85 | 44.67±3.73 | 388.19±48.30 | 287.85±34.93 | 23.59±12.96 | 43.70±9.39 |
| 1 | QST713 | 926.91±146.90 | 825.94±45.27 | 44.25±8.84 | 50.32±2.72 | 377.66±100.11 | 518.40±114.78 | 26.67±19.80 | -0.15±23.96 |
| 2 | BDI-IS1 | 316.08±48.75 | 487.44±22.68 | 72.76±4.20 | 58.00±1.95 | 564.81±35.02 | 604.01±41.98 | 22.96±4.78 | 17.62±5.73 |
| 2 | QST713 | 395.75±103.14 | 494.83±107.49 | 65.90±8.89 | 57.36±9.26 | 553.40±23.52 | 738.89±27.61 | 24.52±3.21 | -0.78±3.77 |

Legend: AUDPCR: Area Under Disease Progress Curve after root treatment. AUDPCL: Area Under Disease Progress Curve after leaf treatment. PIR: Protection Index after root treatment. PIL: Protection Index after foliar treatment.

**Table A.7:** Temperature and relative humidity in greenhouses during the experimental period

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Pathosystem | Trial | Period | Temperature (°C) | Relative humidity (%) |
| minima | mean | maxima | minima | mean | maxima |
| Maize + *E. turcicum*    | 1 | Day | 14.40 | 20. 8 | 26.00 | 59.00 | 72.00 | 85.00 |
|   | Night | 14. 40 | 16. 05 | 17. 60 | 73.00 | 80.00 | 86.00 |
| 2 | Day | 15. 40 | 21. 95 | 26 | 55.00 | 70.00 | 85.00 |
|   | Night | 15. 80 | 17.06 | 18. 90 | 71.00 | 78.00 | 85.00 |
| Tomato + *A. solani*    | 1 | Day | 13. 90 | 19. 91 | 24.00 | 62.00 | 81.00 | 96.00 |
|   | Night | 14,00 | 16.00 | 20.00 | 73.00 | 86.00 | 96.00 |
| 2 | Day | 17. 30 | 20. 85 | 24.00 | 69.00 | 82.00 | 99.00 |
|   | Night | 17. 20 | 17. 5 | 18.00 | 83.00 | 88.00 | 95.00 |