

**Table 1. Representative stable QTLs on each chromosome for four nutritional quality traits**

| Traits <sup>a</sup> | QTL                    | Chromosome | Position (Mb) | Number of significant SNPs | PVE (%)     | References             |
|---------------------|------------------------|------------|---------------|----------------------------|-------------|------------------------|
| ANs                 | <i>ANs.pkuias.1A.1</i> | 1A         | 354.09-355.45 | 2                          | 38.33-39.34 | Zhou et al., 2017      |
|                     | <i>ANs.pkuias.1B</i>   | 1B         | 441.40-441.40 | 3                          | 30.73-30.91 |                        |
|                     | <i>ANs.pkuias.2B</i>   | 2B         | 102.09-102.35 | 2                          | 2.58-39.10  |                        |
|                     | <i>ANs.pkuias.2D</i>   | 2D         | 34.49-34.49   | 5                          | 41.42-43.40 | Rasheed et al., 2016   |
|                     | <i>ANs.pkuias.3A</i>   | 3A         | 78.57-79.83   | 2                          | 23.55-35.11 |                        |
|                     | <i>ANs.pkuias.3B.1</i> | 3B         | 423.15-423.15 | 2                          | 29.42-32.38 |                        |
|                     | <i>ANs.pkuias.4B.1</i> | 4B         | 86.31-86.31   | 2                          | 39.50-39.50 | Zhou et al., 2017      |
|                     | <i>ANs.pkuias.5B.1</i> | 5B         | 288.26-288.26 | 2                          | 38.96-39.77 |                        |
|                     | <i>ANs.pkuias.5D.1</i> | 5D         | 350.63-350.63 | 2                          | 26.58-31.68 |                        |
|                     | <i>ANs.pkuias.6A.1</i> | 6A         | 59.62-61.06   | 11                         | 20.11-46.41 | Zhou et al., 2017      |
|                     | <i>ANs.pkuias.6B.1</i> | 6B         | 485.51-485.51 | 7                          | 30.39-39.95 |                        |
|                     | <i>ANs.pkuias.7A</i>   | 7A         | 619.24-620.06 | 4                          | 6.34-32.77  |                        |
|                     | <i>ANs.pkuias.7B.3</i> | 7B         | 733.83-735.74 | 35                         | 26.28-43.21 | Jiang et al., 2018     |
|                     | <i>ANs.pkuias.7D</i>   | 7D         | 517.57-518.31 | 2                          | 44.81-44.86 |                        |
| CF                  | <i>CF.pkuias.1A</i>    | 1A         | 315.74-315.74 | 3                          | 35.14-38.90 |                        |
|                     | <i>CF.pkuias.1D</i>    | 1D         | 315.04-315.04 | 5                          | 33.04-39.89 |                        |
|                     | <i>CF.pkuias.2B.4</i>  | 2B         | 405.15-428.79 | 75                         | 0.85-40.92  |                        |
|                     | <i>CF.pkuias.3B.1</i>  | 3B         | 45.54-48.35   | 5                          | 25.00-32.63 |                        |
|                     | <i>CF.pkuias.4A</i>    | 4A         | 614.32-614.32 | 2                          | 35.13-41.94 |                        |
|                     | <i>CF.pkuias.5A.1</i>  | 5A         | 489.98-494.14 | 6                          | 37.32-50.70 |                        |
|                     | <i>CF.pkuias.5B.1</i>  | 5B         | 256.65-257.85 | 3                          | 21.17-34.68 |                        |
|                     | <i>CF.pkuias.5D</i>    | 5D         | 30.02-30.02   | 2                          | 27.09-30.22 |                        |
|                     | <i>CF.pkuias.6A</i>    | 6A         | 571.23-573.57 | 2                          | 28.22-48.05 |                        |
|                     | <i>CF.pkuias.6B.1</i>  | 6B         | 42.89-42.89   | 6                          | 32.17-45.73 |                        |
|                     | <i>CF.pkuias.6D</i>    | 6D         | 434.75-434.75 | 2                          | 35.57-39.72 |                        |
|                     | <i>CF.pkuias.7B.1</i>  | 7B         | 440.85-442.90 | 4                          | 4.86-50.31  |                        |
| FAA                 | <i>FAA.pkuias.1A</i>   | 1A         | 558.43-562.63 | 9                          | 4.40-49.01  | Peng et al., 2018      |
|                     | <i>FAA.pkuias.1B</i>   | 1B         | 650.10-650.55 | 6                          | 27.38-36.77 |                        |
|                     | <i>FAA.pkuias.2A</i>   | 2A         | 699.77-702.42 | 4                          | 25.28-38.30 | Gao et al., 2016       |
|                     | <i>FAA.pkuias.2B</i>   | 2B         | 792.65-793.03 | 3                          | 29.11-37.25 |                        |
|                     | <i>FAA.pkuias.3B</i>   | 3B         | 802.51-802.74 | 5                          | 29.68-38.20 | Lavoignat et al., 2024 |
|                     | <i>FAA.pkuias.4A.1</i> | 4A         | 101.34-105.86 | 6                          | 4.60-35.58  |                        |
|                     | <i>FAA.pkuias.4B</i>   | 4B         | 690.70-692.48 | 2                          | 32.99-44.69 |                        |
|                     | <i>FAA.pkuias.5A</i>   | 5A         | 480.09-480.11 | 2                          | 31.79-36.93 |                        |
|                     | <i>FAA.pkuias.5B.1</i> | 5B         | 417.76-417.76 | 3                          | 28.29-30.23 |                        |
|                     | <i>FAA.pkuias.5D.1</i> | 5D         | 152.39-152.39 | 2                          | 34.41-34.48 |                        |

|    |                        |    |               |     |             |                 |
|----|------------------------|----|---------------|-----|-------------|-----------------|
| TN | <i>FAA.pkuias.6B.1</i> | 6B | 65.22-68.99   | 3   | 29.69-34.02 | Li et al., 2023 |
|    | <i>FAA.pkuias.7A</i>   | 7A | 6.76-10.69    | 2   | 24.40-37.28 |                 |
|    | <i>FAA.pkuias.7B</i>   | 7B | 666.12-671.64 | 9   | 6.36-37.24  |                 |
|    | <i>FAA.pkuias.7D</i>   | 7D | 595.27-597.09 | 4   | 3.90-33.92  |                 |
|    | <i>TN.pkuias.1A.1</i>  | 1A | 4.34-4.34     | 2   | 15.04-15.84 |                 |
|    | <i>TN.pkuias.1B.1</i>  | 1B | 353.06-353.06 | 2   | 44.86-46.61 |                 |
|    | <i>TN.pkuias.1D.1</i>  | 1D | 148.56-150.10 | 3   | 7.77-26.66  |                 |
|    | <i>TN.pkuias.2A.1</i>  | 2A | 0.44-0.81     | 2   | 16.05-25.74 |                 |
|    | <i>TN.pkuias.2B.1</i>  | 2B | 270.56-274.21 | 8   | 16.40-36.11 |                 |
|    | <i>TN.pkuias.2D.1</i>  | 2D | 180.96-181.63 | 4   | 28.81-42.55 |                 |
|    | <i>TN.pkuias.3A.1</i>  | 3A | 609.45-609.45 | 3   | 43.83-48.90 | Li et al., 2023 |
|    | <i>TN.pkuias.3B.1</i>  | 3B | 21.92-23.47   | 16  | 16.26-31.83 |                 |
|    | <i>TN.pkuias.4A.1</i>  | 4A | 39.32-44.57   | 22  | 0.23-50.39  |                 |
|    | <i>TN.pkuias.4B.1</i>  | 4B | 1.36-1.36     | 2   | 34.85-35.99 |                 |
|    | <i>TN.pkuias.4D</i>    | 4D | 525.29-525.29 | 3   | 26.05-26.15 |                 |
|    | <i>TN.pkuias.5A.1</i>  | 5A | 218.79-220.62 | 2   | 22.41-37.38 |                 |
|    | <i>TN.pkuias.5B.1</i>  | 5B | 79.23-79.23   | 2   | 16.09-18.43 |                 |
|    | <i>TN.pkuias.5D</i>    | 5D | 388.99-388.99 | 7   | 24.57-25.02 |                 |
|    | <i>TN.pkuias.6A.1</i>  | 6A | 225.46-225.46 | 3   | 14.33-19.77 |                 |
|    | <i>TN.pkuias.6B.4</i>  | 6B | 731.43-737.56 | 303 | 30.95-53.18 | Li et al., 2023 |
|    | <i>TN.pkuias.6D.1</i>  | 6D | 29.00-29.00   | 4   | 16.03-16.83 |                 |
|    | <i>TN.pkuias.7A.1</i>  | 7A | 124.33-132.19 | 33  | 16.35-28.46 |                 |
|    | <i>TN.pkuias.7B.1</i>  | 7B | 215.70-215.70 | 3   | 29.84-32.23 |                 |
|    | <i>TN.pkuias.7D.1</i>  | 7D | 376.50-376.50 | 3   | 32.90-36.14 | Li et al., 2023 |

<sup>a</sup> TN, total nitrogen; CF, crude fat; ANs, anthocyanins; FAA, free amino acids