**Table S3 170 quantitative trait loci identified using linkage mapping or association analysis for wheat GNS in the previous studies**

| No | Reported QTL name | Chr[a] | IR[b] (Mb) | References |
|---|---|---|---|---|
| 1 | - | 1A | 36.8–42.5 | Li *et al.* (2019) |
| 2 | - | 1A | 497.5–498.1 | Li *et al.* (2019) |
| 3 | QSns.crc-1A | 1A | 552.8 | Janice *et al.* (2008) |
| 4 | wsnp_Ex_c41953_48657850 | 1A | undetermined | Shi *et al* .(2017) |
| 5 | QGne.nfcri-1A | 1A | 229.3 | Lin *et al.* (2008) |
| 6 | QKns-1A.1 | 1A | undetermined | Xu *et al* .(2017) |
| 7 | - | 1A | 109bp | Muhammad *et al* .(2020) |
| 8 | QGnps.cd-1A | 1A | 8.1-458.4 | Chen *et al.* (2017) |
| 9 | qGN-WY.1A.1 | 1A | 494.5 | Ding *et al.* (2011) |
| 10 | - | 1A | 26.96 | Gerard *et al.* (2019) |
| 11 | BS00010868_51 | 1B | undetermined | Shi *et al.* (2017) |
| 12 | QGns.cau-1B.1 | 1B | undetermined | Zhai *et al.* (2018) |
| 13 | QKNS.caas-1BL.1 | 1B | 64.5 | Li *et al.* (2018) |
| 14 | QKNS.caas-1BL.2 | 1B | 565.6 | Li *et al.* (2018) |
| 15 | QKNS.caas-1BS | 1B | undetermined | Li *et al.* (2018) |
| 16 | QKns.sdau-1D.e2 | 1D | 8.5-17.3 | Li *et al.* (2007) |
| 17 | QGns-3D | 1D | 9.4-196.4 | Liu *et al.* (2014) |
| 18 | - | 1D | 33.9-80.3 | Pang *et al.* (2020) |
| 19 | - | 2A | 117.2–117.3 | Li *et al.* (2019) |
| 20 | QGn.nau-2A | 2A | 281.5-728.6 | Jia *et al* .(2013) |
| 21 | QKnps-2A.2 | 2A | 773.1 | Cui *et al.* (2013) |
| 22 | QKns.sdau-2A.e1 | 2A | 200.2 | Li *et al.* (2007) |
| 23 | QKns.sdau-2A.e2 | 2A | 31.8 | Li *et al.* (2007) |
| 24 | GENE-1086_1111 | 2A | undetermined | Shi *et al.* (2017) |
| 25 | Qgns.iiwbr-2A | 2A | 154.4 | Bhusal *et al.* (2017) |
| 26 | Qgns.iiwbr-2A | 2A | 154.4 | Bhusal *et al.* (2017) |
| 27 | Qlgns.iiwbr-2A | 2A | 203.3 | Bhusal *et al.* (2017) |
| 28 | Qgns.iiwbr-2A | 2A | 78.3–80.9 | Bhusal *et al.* (2017) |
| 29 | Q.Gnu.uwa-2A | 2A | 709.0–717.8 | Onyemaobi *et al.* (2018) |
| 30 | QKns-2A | 2A | 709.0–717.8 | Xu *et al.* (2017) |
| 31 | - | 2A | 82 | Zheng *et al.* (2021) |
| 32 | - | 2A | 691.2 | Liu *et al.* (2018) |
| 33 | - | 2A | 691.2 | Liu *et al.* (2018) |
| 34 | - | 2A | 691.2 | Liu *et al.* (2018) |
| 35 | - | 2A | 691.2 | Liu *et al.* (2018) |
| 36 | - | 2A | 78.3 | Guo *et al.* (2017) |
| 37 | QGne.nfcri-2B.1 | 2B | 8.7 | Lin *et al.* (2008) |
| 38 | QGne.nfcri-2B.2 | 2B | undetermined | Lin *et al.* (2008) |
| 39 | QGns-2B1 | 2B | 672.1 | Liu *et al.* (2014) |
| 40 | QGns-2B2 | 2B | 672.1 | Liu *et al.* (2014) |
| 41 | QGns-2B3 | 2B | 165.6 | Liu *et al.* (2014) |
| 42 | - | 2B | 48.9 | Jung *et al.* (2021) |
| 43 | - | 2B | 775.8 | Liu *et al.* (2018) |
| 44 | - | 2B | 776.7 | Liu *et al.* (2018) |
| 45 | - | 2B | 776.7 | Liu *et al.* (2018) |

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|---|---|---|---|---|
| 46 | - | 2B | 776.9 | Liu *et al.* (2018) |
| 47 | - | 2B | 776.9 | Liu *et al.* (2018) |
| 48 | - | 2B | 777.3 | Liu *et al.* (2018) |
| 49 | - | 2B | 777.5 | Liu *et al.* (2018) |
| 50 | QGns.sdau-2B | 2B | 9.0-182.4 | Deng *et al.* (2017) |
| 51 | - | 2B | 738.34 | Gerard *et al.* (2019) |
| 52 | - | 2D | 633.2–634.5 | Li *et al.* (2019) |
| 53 | QSns.crc-2D | 2D | 335 | Janice *et al.* (2008) |
| 54 | QGne.nfcri-2D | 2D | 48.2 | Lin *et al.* (2008) |
| 55 | QGnu.ipk-2D | 2D | undetermined | Börner *et al.* (2002) |
| 56 | - | 2D | 579.19 | Gerard *et al.* (2019) |
| 57 | - | 3A | 36.8–37.2 | Li *et al.* (2019) |
| 58 | - | 3A | 719.3–725.8 | Li *et al.* (2019) |
| 59 | QKns-3A.1 | 3A | 738.6–747.3 | Xu *et al.* (2017) |
| 60 | QKns-3A.2 | 3A | undetermined | Xu *et al.* (2017) |
| 61 | QGns.cau-3A.2 | 3A | 705.31–749.11 | Guan *et al.* (2018) |
| 62 | QGNS3A.3-2 | 3A | undetermined | Liu *et al.* (2018) |
| 63 | - | 3A | 549.9 | Jung *et al.* (2021) |
| 64 | QGns.cau-3A.1 | 3A | 639.1–650.4 | Zhai *et al.* (2018) |
| 65 | - | 3A | 727.4-729.9 | Pang *et al.* (2020) |
| 66 | QKNS.caas-3AL | 3A | 734.0-743.2 | Gao *et al.* (2015) |
| 67 | QSns.crc-3B | 3B | 101.8-354.9 | Janice *et al.* (2008) |
| 68 | QKns.sdau-3B.e1 | 3B | undetermined | Li *et al.* (2007) |
| 69 | - | 3B | 610.2 | Guo *et al.* (2018) |
| 70 | - | 3B | 630.2 | Guo *et al.* (2018) |
| 71 | - | 3B | 728.9 | Guo *et al.* (2018) |
| 72 | - | 3B | 708.9 | Guo *et al.* (2018) |
| 73 | - | 3B | 718.3 | Guo *et al.* (2018) |
| 74 | - | 3B | 715.9 | Guo *et al.* (2018) |
| 75 | - | 3B | 728.9 | Guo *et al.* (2018) |
| 76 | - | 3B | 728.9 | Guo *et al.* (2018) |
| 77 | - | 3B | 151.6-152.3 | Pang *et al.* (2020) |
| 78 | - | 3B | 483.5-483.6 | Pang *et al.* (2020) |
| 79 | - | 3B | 584.6-607.3 | Pang *et al.* (2020) |
| 80 | QKnps.hwwgr-3BS | 3B | 6.6-8.7 | Li *et al.* (2015) |
| 81 | QKNS.caas-3DL | 3D | undetermined | Li *et al.* (2018) |
| 82 | QGnps.cd-3D | 3D | 129.0-355.7 | Chen *et al.* (2017) |
| 83 | - | 3D | 84.8-116.3 | Pang *et al.* (2020) |
| 84 | qKnps-4A | 4A | 680.4–:683.6 | Cui *et al.* (2017) |
| 85 | QGns-4A | 4A | 18.2-87.3 | Liu *et al.* (2014) |
| 86 | QGns.cau-4A.3 | 4A | 622.2–685.0 | Guan *et al.* (2018) |
| 87 | QGns.cau-4A.4 | 4A | 622.2–685.0 | Guan *et al.* (2018) |
| 88 | - | 4A | 737.4 | Guo *et al.* (2018) |
| 89 | QKNS.caas-4AL.1 | 4A | 600.9 | Li *et al.* (2018) |
| 90 | QGnu.ipk-4A | 4A | 603.3-630.9 | Börner *et al.* (2002) |
| 91 | QGnps.cd-4A | 4A | 659.9-73.0 | Chen *et al.* (2017) |
| 92 | - | 4A | 631.9-665.7 | Pang *et al.* (2020) |
| 93 | QKNS.caas-4AL | 4A | 626.3-661.0 | Gao *et al.* (2015) |

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|---|---|---|---|---|
| 94 | QGn.nau-4B.1 | 4B | 358.5–390.7 | Jia *et al.* (2013) |
| 95 | QGn.nau-4B.2 | 4B | 17.1-641.5 | Jia *et al.* (2013) |
| 96 | QGns-4B | 4B | 75.7 | Liu *et al.* (2014) |
| 97 | QGNS4B.4-17 | 4B | undetermined | Liu *et al.* (2018) |
| 98 | - | 4B | 2.1 | Muhammad *et al.* (2020) |
| 99 | QKNS.caas-4BS.1 | 4B | 16.8 | Li *et al.* (2018) |
| 100 | QKNS.caas-4BS | 4B | 54.7 | Li *et al.* (2018) |
| 101 | QGnps.cd-4B.1 | 4B | 236.7-513.4 | Chen *et al.* (2017) |
| 102 | - | 4B | 28.7-44.2 | Pang *et al.* (2020) |
| 103 | QKNS.caas-4BS | 4B | 37.8 | Li *et al.* (2018) |
| 104 | QKnps.hwwgr-4BS | 4B | 75.7-98.7 | Li *et al* . (2015) |
| 105 | - | 4B | 22.8-317.0 | Li *et al* . (2015) |
| 106 | QGns-4D | 4D | 18.4–22.8 | Liu *et al* . (2014) |
| 107 | QSns.crc-5A | 5A | 130.1-661.1 | Janice *et al.* (2008) |
| 108 | QGns-5A | 5A | 524.2–531.3 | Liu *et al.* (2014) |
| 109 | Q.Gnu.uwa-5A-1 | 5A | 437.2–439.7 | Onyemaobi *et al.* (2018) |
| 110 | Q.Gnu.uwa-5A-2 | | 616.9–625.7 | Onyemaobi *et al.* (2018) |
| 111 | QGns.cau-5A.1 | 5A | 11.1–460.5 | Guan *et al.* (2018) |
| 112 | QGns.cau-5A.2 | 5A | 11.1–460.5 | Guan *et al.* (2018) |
| 113 | QGNS5A.6-14 | 5A | undetermined | Liu *et al.* (2018) |
| 114 | - | 5A | 2.2 | Muhammad *et al.* (2020) |
| 115 | - | 5A | 4.8 | Guo *et al.* (2018) |
| 116 | - | 5A | 555.5-575.4 | Pang *et al.* (2020) |
| 117 | QKnps.hwwgr-5AL | 5A | 694.9-697.7 | Li *et al.* (2015) |
| 118 | - | 5A | 697.7 | Li *et al.* (2015) |
| 119 | - | 5B | 416.4–418.0 | Li *et al.* (2019) |
| 120 | - | 5B | 489.3–492.9 | Li *et al.* (2019) |
| 121 | - | 5B | 386.4 | Guo *et al.* (2018) |
| 122 | - | 5B | 53.6 | Guo *et al.* (2018) |
| 123 | - | 5B | 55.2 | Guo *et al.* (2018) |
| 124 | QKNS.caas-5BL | 5B | undetermined | Li *et al.* (2018) |
| 125 | QGsp.czm-5B | 5B | 558.6 | Zhou *et al.* (2017) |
| 126 | QGne.nfcri-5D | 5D | 472.4 | Lin *et al.* (2008) |
| 127 | QGns-5D | 5D | 345.5 | Liu *et al.* (2014) |
| 128 | QKNS.caas-5DL | 5D | 177.2 | Li *et al.* (2018) |
| 129 | QGn.nau-6A | 6A | 428.7–448.2 | Jia *et al.* (2013) |
| 130 | QGns.cau-6A.2 | 6A | 38.4–596.6 | Guan *et al.* (2018) |
| 131 | QGns.cau-6A.2; | 6A | 52.4–585.4 | Zhai *et al.* (2018) |
| 132 | QGns.cau-6A.3 | 6A | 52.4–585.4 | Zhai *et al.* (2018) |
| 133 | QGns.cau-6A.4 | 6A | 52.4–585.4 | Zhai *et al.* (2018) |
| 134 | - | 6A | 604.9-609.5 | Guo *et al.* (2017) |
| 135 | QKnps.hwwgr-6AL | 6A | 73.7-88.1 | Li *et al.* (2015) |
| 136 | QGns-6B | 6B | 67.9 | Liu *et al.* (2014) |
| 137 | - | 6B | 3.4 | Muhammad *et al.* (2020) |
| 138 | QGns-6D | 6D | 13.9-36.8 | Liu *et al.* (2014) |
| 139 | Qtgns.iiwbr-6D | 6D | 59.7 | Bhusal *et al.* (2017) |
| 140 | QGnps.cd-6D | 6D | 1,7-14.2 | Chen *et al.* (2017) |
| 141 | - | 6D | 456.7-462.6 | Guo *et al.* (2017) |

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|---|---|---|---|---|
| 142 | - | 7A | 49.1–50.0 | Li *et al.* (2019) |
| 143 | QSns.crc-7A | 7A | 101.3 | Janice *et al.* (2008) |
| 144 | QGne.nfcri-7A | 7A | 681.4 | Lin *et al.* (2008) |
| 145 | QGns-7A | 7A | 286.9-484.4 | Liu *et al.* (2014) |
| 146 | QGns.cau-7A.3 | 7A | 7.1–612.4 | Guan *et al.* (2018) |
| 147 | QGns.cau-7A.2 | 7A | 7.1–612.4 | Guan *et al.* (2018) |
| 148 | QGns.cau-7A.4 | 7A | 7.1–612.4 | Guan *et al.* (2018) |
| 149 | QGns.cau-7A.5 | 7A | 672.0–719.6 | Guan *et al.* (2018) |
| 150 | QGns.cau-7A.6 | 7A | 672.0–719.6 | Guan *et al.* (2018) |
| 151 | - | 7A | 3.8 | Muhammad *et al.* (2020) |
| 152 | - | 7A | 3.8 | Muhammad *et al.* (2020) |
| 153 | QGns.cau-7A.2 | 7A | 76.9–275.9 | Zhai *et al.* (2018) |
| 154 | QGns.cau-7A.3 | 7A | 76.9–275.9 | Zhai *et al.* (2018) |
| 155 | QKNS.caas-7AL | 7A | undetermined | Li *et al.* (2018) |
| 156 | QKNS.caas-7AS | 7A | 118.1 | Li *et al.* (2018) |
| 157 | QKNS.caas-7AL | 7A | 675.4 | Li *et al.* (2018) |
| 158 | - | 7A | 670.2-670.8 | Guo *et al.* (2017) |
| 159 | - | 7A | 486.2-487.6 | Wang *et al.* (2017) |
| 160 | QNGS.cgb-7A | 7A | 605.8 | Wu *et al.* (2012 ) |
| 161 | QKnps.hwwgr-7AL | 7A | 675.3-679.9 | Li *et al.* (2015) |
| 162 | - | 7A | 675.2 | Li *et al.* (2015) |
| 163 | QGns-7B | 7B | 30.7-723.2 | Lin *et al.* (2014) |
| 164 | - | 7B | 457.4 | Guo *et al.* (2018) |
| 165 | QKNS.caas-7BL | 7B | 740 | Li *et al.* (2018) |
| 166 | QKNS.caas-7BS.1 | 7B | 11.9 | Li *et al.* (2018) |
| 167 | - | 7B | 716.6 | Liu *et al.* (2018) |
| 168 | - | 7B | 393.1-393.2 | Pang *et al.* (2020) |
| 169 | QGne.nfcri-7D | 7D | 614.5 | Lin *et al.* (2008) |
| 170 | QKNS.caas-7DS | 7D | 90.6 | Li *et al.* (2018) |

Note: No refer to the number of QTL. [a] Chromosome that GNS QTLs were detected. [b] The mapping interval range of GNS QTLs.