

Supplementary Table S1 Wheat landraces and cultivars used in this study

| Code | Wheat line name | Status   | Pedigree   |
|------|-----------------|----------|--|
| 1    | Orofen          | Cultivar | Newthatatch/Marroqui 588// Kenyaca 9908/Mentana/3/Frontana |
| 2    | Qianjiaomai     | Cultivar | Cheyenne/Early blackhull                                   |
| 3    | Triumph         | Cultivar | Black hull/Kanred/3/Black hull/Kanred//Florence            |
| 4    | Neixiang 5      | Cultivar | Mentana//Baihuomai/Quality/Baimangmai                      |
| 5    | Ganmai 8        | Cultivar | Wuyimai/Abbonodanza  |
| 6    | Huining 10      | Cultivar | Honglaomangmai/Abbonodanza                                 |
| 7    | Guinong 10      | Cultivar | Maris Termplar/Zongkangai 2                                |
| 8    | Fengmai 11      | Cultivar | Orofen/Yunnan778   |
| 9    | Shuiyuan 86     | Cultivar | Daruma/Fultz//Kanred                                       |
| 10   | Lovrin 10       | Cultivar | Abbondanza/Triumph//Bezostaja//Bezostaja 1                 |
| 11   | Youbao          | Cultivar | Youzimai/Baoda300pao                                       |
| 12   | Shuwan 8        | Cultivar | Hechang 5/Mentana  |
| 13   | Bimai26         | Cultivar | Yaana 2/Cajeime//7312                                      |
| 14   | Emai6           | Cultivar | Mentana F5 <sup>60</sup> Coy                               |
| 15   | Pingyang 27     | Cultivar | 79391/76262  |
| 16   | Beijing 8       | Cultivar | Bima 4/Early Premium                                       |
| 17   | Huadong 6       | Cultivar | Liyang 1/P225/Jiangdongmen                                 |
| 18   | Sumai 3         | Cultivar | Funo/Taiwanxiaomai   |
| 19   | Anhui 3         | Cultivar | Mentana/Triumph  |
| 20   | Taizhong 23     | Cultivar | Florence/Qiyu27  |
| 21   | Kashi 1         | Cultivar | Bakepuke/Heine Hvede                                       |
| 22   | Kashibaipi      | Cultivar | Line selection of Baichunmai                               |
| 23   | Dongfanghong 3  | Cultivar | Eguan 186/Nongda 17//Early Premium                         |
| 24   | Xinshuguang 1   | Cultivar | Abbondanza/Orofen F0 <sup>60</sup> Coy                     |
| 25   | Xinshuguang 6   | Cultivar | Hezuo 2/Lanyanmai//Kefeng                                  |
| 26   | Mentana         | Cultivar | Rieti/Wilhelmine//Akagomughi                               |
| 27   | Early Premium   | Cultivar | Introduced from American                                   |
| 28   | Yannong 15      | Cultivar | Youbao/Fanxiu 4  |
| 29   | Yanzhan 1       | Cultivar | C39/78(6)9-2//Jimai5418/3/781-4                            |
| 30   | Fengkang 2      | Cultivar | Youmangbai 4/Lovrin 10                                     |
| 31   | Bima 1          | Cultivar | Mazhamei/Quality   |
| 32   | Bima 4          | Cultivar | Mazhamei/Quality   |
| 33   | Fengchan 3      | Cultivar | Danmark 1/Xinong 6028                                      |
| 34   | Xinong 6028     | Cultivar | Jingyang 60/Zhongnong 28                                   |
| 35   | Xiaoyan 6       | Cultivar | St2422/464//Xiaoyan 96                                     |
| 36   | Aifeng 3        | Cultivar | Bima 6/Jiyuanxiaofoshou//Fengchan 3                        |
| 37   | Huzhuhong       | Cultivar | Breeding from introduced cultivar                          |
| 38   | Changzhi 6406   | Cultivar | Shanqianmai/Changzhi 620                                   |
| 39   | Yanan 11        | Cultivar | Bulgarian 10/Taigu 49                                      |
| 40   | Mingxian 169    | Cultivar | Breeding from landrace                                     |
| 41   | Yangmai 158     | Cultivar | Yangmai 4//St1472/506                                      |

|    |                  |          |  |
|----|------------------|----------|--|
| 42 | Zhemai 1         | Cultivar | Zhenong 939/Ailiduo//Miluo   |
| 43 | Xinkehan 9       | Cultivar | Kefeng 2/Ke74F4-249-3  |
| 44 | Kefeng 3         | Cultivar | Ke71F4-307-7/Nadadoles   |
| 45 | Funo             | Cultivar | Dueceutodieci/Mentana  |
| 46 | Gaojiasuo        | Cultivar | Introduced from Soviet Union   |
| 47 | Zhengyin 4       | Cultivar | Introduced from Italy  |
| 48 | Gansu 96         | Cultivar | Merit/Thatcher   |
| 49 | Shijiazhuang 54  | Cultivar | Bima 4/Early Premium   |
| 50 | Taishan 1        | Cultivar | Bima 4/ Скороспелка-Л11//Orofen  |
| 51 | Jinan 2          | Cultivar | Bima 4/Early Premium   |
| 52 | Bainong 3217     | Cultivar | Funo/Neixiang 5//Xiannong 39/3/Xinong64(4)43-2/Yanda 24                                      |
| 53 | Shijiazhuang 407 | Cultivar | Triumph/1817   |
| 54 | Jimai 2          | Cultivar | Weimai 8/05-38   |
| 55 | Zhengzhou 6      | Cultivar | Neixiang 5/Huixianhong//heimai   |
| 56 | Shannong 7859    | Cultivar | 7576/327/6811(2)-2   |
| 57 | Aimengniu        | Cultivar | Aifeng 3//Mengxian 201/Niuzhute  |
| 58 | Yumai 49         | Cultivar | 394A/Yumai 2   |
| 59 | Zhengzhou 741    | Cultivar | St2422/464//Zhengzhou 17   |
| 60 | Ningchun 4       | Cultivar | Sonora 64/Hongtu   |
| 61 | Jinmai 4         | Cultivar | Huimai 2/Canada  |
| 62 | Fan 6            | Cultivar | IBO1828/N.P.824/3/Wuyimai//Chengduguangtou/Zhong483/4/<br>Zhongnong28B/IBO1828//N.P.824/Funo |
| 63 | Yunmai 34        | Cultivar | Gaojiasuo/IRN68-77   |
| 64 | Pingyuan 50      | Landrace |  |
| 65 | Meiqianwu        | Landrace |  |
| 66 | Laoqimai         | Landrace |  |
| 67 | Hanzhongbai      | Landrace |  |
| 68 | Huangguaxian     | Landrace |  |
| 69 | Youmangsaogudan  | Landrace |  |
| 70 | Shengen          | Landrace |  |
| 71 | Youzimai         | Landrace |  |
| 72 | Chushanbao       | Landrace |  |
| 73 | Wumangchunmai    | Landrace |  |
| 74 | Huoliaomai       | Landrace |  |
| 75 | Jiangdongmen     | Landrace |  |
| 76 | Daqingmang       | Landrace |  |
| 77 | Dabaimai         | Landrace |  |
| 78 | Naolaohan        | Landrace |  |
| 79 | Shanmai          | Landrace |  |
| 80 | Baiqitou         | Landrace |  |
| 81 | Yangmai          | Landrace |  |
| 82 | Chejianzi        | Landrace |  |
| 83 | Rumai            | Landrace |  |
| 84 | Sankechun        | Landrace |  |
| 85 | Tumangmai        | Landrace |  |

|    |                |          |
|----|----------------|----------|
| 86 | Hongmangzi     | Landrace |
| 87 | Geerhongmai    | Landrace |
| 88 | Hongheshangtou | Landrace |
| 89 | Baimaizi       | Landrace |
| 90 | Jiangmai       | Landrace |
| 91 | Hongxumai      | Landrace |

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Supplementary Table S2 All the measured grain zinc and iron concentrations for each wheat genotype during 2017-2018 season

| Code | Wheat line name | Grain Zn in wheat (mg kg <sup>-1</sup> ) | Grain Fe in wheat (mg kg <sup>-1</sup> ) |
|------|-----------------|--|--|
| 1    | Orofen          | 29.48                                    | 32.25                                    |
| 2    | Qianjiaomai     | 27.46                                    | 27.29                                    |
| 3    | Triumph         | 30.52                                    | 30.85                                    |
| 4    | Neixiang 5      | 31.56                                    | 34.17                                    |
| 5    | Ganmai 8        | 25.78                                    | 32.67                                    |
| 6    | Huining 10      | 30.26                                    | 28.84                                    |
| 7    | Guinong 10      | 30.05                                    | 32.77                                    |
| 8    | Fengmai 11      | 29.97                                    | 34.22                                    |
| 9    | Shuiyuan 86     | 28.50                                    | 36.50                                    |
| 10   | Lovrin 10       | 31.49                                    | 36.61                                    |
| 11   | Youbao          | 31.92                                    | 36.86                                    |
| 12   | Shuwan 8        | 27.96                                    | 37.75                                    |
| 13   | Bimai26         | 28.44                                    | 35.83                                    |
| 14   | Emai6           | 46.77                                    | 46.75                                    |
| 15   | Pingyang 27     | 54.42                                    | 51.06                                    |
| 16   | Beijing 8       | 45.90                                    | 40.50                                    |
| 17   | Huadong 6       | 55.07                                    | 37.33                                    |
| 18   | Sumai 3         | 54.16                                    | 39.23                                    |
| 19   | Anhui 3         | 44.40                                    | 41.88                                    |
| 20   | Taizhong 23     | 44.67                                    | 43.53                                    |
| 21   | Kashi 1         | 44.83                                    | 43.70                                    |
| 22   | Kashibaipi      | 44.68                                    | 43.77                                    |
| 23   | Dongfanghong 3  | 32.51                                    | 32.64                                    |
| 24   | Xinshuguang 1   | 43.68                                    | 34.56                                    |
| 25   | Xinshuguang 6   | 40.63                                    | 32.45                                    |
| 26   | Mentana         | 36.24                                    | 33.68                                    |
| 27   | Early Premium   | 36.35                                    | 33.59                                    |
| 28   | Yannong 15      | 32.23                                    | 34.21                                    |
| 29   | Yanzhan 1       | 35.63                                    | 34.38                                    |
| 30   | Fengkang 2      | 38.18                                    | 48.08                                    |
| 31   | Bima 1          | 35.55                                    | 45.05                                    |
| 32   | Bima 4          | 33.10                                    | 45.72                                    |
| 33   | Fengchan 3      | 35.88                                    | 45.64                                    |
| 34   | Xinong 6028     | 35.54                                    | 46.63                                    |
| 35   | Xiaoyan 6       | 38.42                                    | 49.30                                    |
| 36   | Aifeng 3        | 39.68                                    | 45.57                                    |
| 37   | Huzhuhong       | 35.75                                    | 49.05                                    |
| 38   | Changzhi 6406   | 39.41                                    | 41.69                                    |
| 39   | Yanan 11        | 40.08                                    | 38.58                                    |
| 40   | Mingxian 169    | 36.70                                    | 38.11                                    |
| 41   | Yangmai 158     | 43.21                                    | 43.25                                    |

|    |                  |       |       |
|----|------------------|-------|-------|
| 42 | Zhemai 1         | 41.61 | 40.76 |
| 43 | Xinkehan 9       | 36.86 | 35.57 |
| 44 | Kefeng 3         | 43.44 | 35.64 |
| 45 | Funo             | 36.76 | 42.45 |
| 46 | Gaojiasuo        | 35.19 | 37.53 |
| 47 | Zhengyin 4       | 35.50 | 38.54 |
| 48 | Gansu 96         | 38.53 | 36.14 |
| 49 | Shijiazhuang 54  | 34.10 | 42.75 |
| 50 | Taishan 1        | 38.06 | 36.72 |
| 51 | Jinan 2          | 36.15 | 44.72 |
| 52 | Bainong 3217     | 42.56 | 42.11 |
| 53 | Shijiazhuang 407 | 32.04 | 38.45 |
| 54 | Jimai 2          | 35.61 | 35.74 |
| 55 | Zhengzhou 6      | 32.14 | 36.53 |
| 56 | Shannong 7859    | 36.13 | 44.09 |
| 57 | Aimengniu        | 40.78 | 42.27 |
| 58 | Yumai 49         | 39.08 | 38.23 |
| 59 | Zhengzhou 741    | 37.22 | 41.55 |
| 60 | Ningchun 4       | 37.52 | 36.62 |
| 61 | Jinmai 4         | 43.91 | 40.35 |
| 62 | Fan 6            | 32.87 | 41.88 |
| 63 | Yunmai 34        | 35.57 | 35.35 |
| 64 | Pingyuan 50      | 31.33 | 33.52 |
| 65 | Meiqianwu        | 25.22 | 34.18 |
| 66 | Laoqimai         | 29.70 | 34.81 |
| 67 | Hanzhongbai      | 31.12 | 31.77 |
| 68 | Huangguaxian     | 31.06 | 51.18 |
| 69 | Youmangsaogudan  | 31.80 | 50.22 |
| 70 | Shengen          | 30.45 | 38.99 |
| 71 | Youzimai         | 31.15 | 37.56 |
| 72 | Chushanbao       | 31.64 | 41.93 |
| 73 | Wumangchunmai    | 61.79 | 32.37 |
| 74 | Huoliaomai       | 54.89 | 48.84 |
| 75 | Jiangdongmen     | 60.95 | 51.49 |
| 76 | Daqingmang       | 53.17 | 57.10 |
| 77 | Dabaimai         | 54.52 | 54.41 |
| 78 | Naolaohan        | 52.67 | 58.20 |
| 79 | Shanmai          | 52.73 | 54.99 |
| 80 | Baiqitou         | 51.86 | 53.04 |
| 81 | Yangmai          | 67.25 | 52.03 |
| 82 | Chejianzi        | 54.62 | 44.20 |
| 83 | Rumai            | 44.92 | 36.44 |
| 84 | Sankechun        | 54.41 | 41.66 |
| 85 | Tumangmai        | 32.49 | 30.71 |
| 86 | Hongmangzi       | 36.49 | 33.77 |

|    |                |       |       |
|----|----------------|-------|-------|
| 87 | Geerhongmai    | 42.79 | 45.56 |
| 88 | Hongheshangtou | 41.58 | 39.62 |
| 89 | Baimaizi       | 37.77 | 43.88 |
| 90 | Jiangmai       | 32.37 | 38.12 |
| 91 | Hongxumai      | 42.08 | 44.89 |

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Supplementary Table S3 All the measured grain zinc and iron concentrations for each wheat genotype during 2018-2019 season

| Code | Wheat line name | Grain Zn in wheat (mg kg <sup>-1</sup> ) |                      | Grain Fe in wheat (mg kg <sup>-1</sup> ) |                      |
|------|-----------------|--|----------------------|--|----------------------|
|      |                 | No zinc fertilizer                       | With zinc fertilizer | No iron fertilizer                       | With iron fertilizer |
| 1    | Orofen          | 37.26                                    | 38.78                | 41.09                                    | 38.10                |
| 2    | Qianjiaomai     | 32.60                                    | 43.61                | 35.13                                    | 33.53                |
| 3    | Triumph         | 54.26                                    | 53.08                | 40.82                                    | 36.45                |
| 4    | Neixiang 5      | 41.19                                    | 44.63                | 26.90                                    | 26.76                |
| 5    | Ganmai 8        | 41.35                                    | 42.51                | 40.78                                    | 46.69                |
| 6    | Huining 10      | 34.83                                    | 37.10                | 42.24                                    | 30.80                |
| 7    | Guinong 10      | 46.99                                    | 44.18                | 47.33                                    | 55.33                |
| 8    | Fengmai 11      | 37.84                                    | 55.39                | 29.86                                    | 40.40                |
| 9    | Shuiyuan 86     | 33.71                                    | 27.57                | 31.92                                    | 29.03                |
| 10   | Lovrin 10       | 38.97                                    | 42.31                | 36.14                                    | 39.83                |
| 11   | Youbao          | 41.44                                    | 40.52                | 40.12                                    | 28.84                |
| 12   | Shuwan 8        | 37.49                                    | 39.30                | 45.75                                    | 36.44                |
| 13   | Bimai26         | 29.48                                    | 45.54                | 46.16                                    | 59.11                |
| 14   | Emai6           | 37.49                                    | 45.92                | 40.05                                    | 42.13                |
| 15   | Pingyang 27     | 70.15                                    | 51.53                | 37.57                                    | 42.49                |
| 16   | Beijing 8       | 53.20                                    | 64.81                | 62.85                                    | 64.12                |
| 17   | Huadong 6       | 47.68                                    | 62.52                | 41.51                                    | 48.94                |
| 18   | Sumai 3         | 40.39                                    | 52.20                | 38.24                                    | 32.04                |
| 19   | Anhui 3         | 43.99                                    | 39.17                | 42.29                                    | 42.47                |
| 20   | Taizhong 23     | 74.12                                    | 49.51                | 60.96                                    | 39.45                |
| 21   | Kashi 1         | 38.71                                    | 53.89                | 33.56                                    | 43.38                |
| 22   | Kashibaipi      | 31.16                                    | 55.02                | 26.20                                    | 43.42                |
| 23   | Dongfanghong 3  | 79.26                                    | 67.80                | 57.41                                    | 82.82                |
| 24   | Xinshuguang 1   | 40.66                                    | 43.28                | 32.04                                    | 31.01                |
| 25   | Xinshuguang 6   | 32.05                                    | 43.19                | 24.97                                    | 23.61                |
| 26   | Mentana         | 37.35                                    | 39.04                | 25.89                                    | 28.33                |
| 27   | Early Premium   | 49.98                                    | 49.41                | 43.18                                    | 32.72                |
| 28   | Yannong 15      | 35.04                                    | 53.67                | 21.50                                    | 29.96                |
| 29   | Yanzhan 1       | 38.05                                    | 43.99                | 30.43                                    | 30.27                |
| 30   | Fengkang 2      | 38.71                                    | 62.13                | 60.04                                    | 67.63                |
| 31   | Bima 1          | 52.24                                    | 60.66                | 38.45                                    | 40.20                |
| 32   | Bima 4          | 47.89                                    | 53.79                | 42.16                                    | 35.53                |
| 33   | Fengchan 3      | 51.97                                    | 62.78                | 37.00                                    | 41.75                |
| 34   | Xinong 6028     | 51.08                                    | 52.04                | 36.08                                    | 33.00                |
| 35   | Xiaoyan 6       | 44.92                                    | 61.88                | 37.49                                    | 37.21                |
| 36   | Aifeng 3        | 39.29                                    | 46.66                | 29.53                                    | 29.38                |
| 37   | Huzhuhong       | 30.89                                    | 49.77                | 36.44                                    | 39.14                |
| 38   | Changzhi 6406   | 40.51                                    | 60.05                | 83.18                                    | 66.67                |
| 39   | Yanan 11        | 46.70                                    | 71.05                | 78.81                                    | 70.60                |

|    |                  |       |       |       |       |
|----|------------------|-------|-------|-------|-------|
| 40 | Mingxian 169     | 51.29 | 68.92 | 52.21 | 60.71 |
| 41 | Yangmai 158      | 28.34 | 44.63 | 35.03 | 46.48 |
| 42 | Zhemai 1         | 57.38 | 59.76 | 57.97 | 53.95 |
| 43 | Xinkehan 9       | 49.18 | 44.31 | 46.98 | 34.11 |
| 44 | Kefeng 3         | 43.43 | 51.79 | 32.87 | 34.57 |
| 45 | Funuo            | 41.66 | 38.24 | 30.17 | 34.11 |
| 46 | Gaojiasuo        | 37.44 | 39.64 | 31.94 | 29.50 |
| 47 | Zhengyin 4       | 39.24 | 39.92 | 31.73 | 29.72 |
| 48 | Gansu 96         | 49.31 | 65.37 | 36.98 | 36.22 |
| 49 | Shijiazhuang 54  | 38.52 | 49.71 | 33.80 | 35.89 |
| 50 | Taishan 1        | 35.21 | 41.81 | 23.05 | 28.40 |
| 51 | Jinan 2          | 35.54 | 39.81 | 26.75 | 26.31 |
| 52 | Bainong 3217     | 49.14 | 52.07 | 31.51 | 30.07 |
| 53 | Shijiazhuang 407 | 47.04 | 54.13 | 31.52 | 34.81 |
| 54 | Jimai 2          | 46.17 | 50.31 | 28.32 | 28.86 |
| 55 | Zhengzhou 6      | 50.14 | 42.06 | 44.38 | 31.48 |
| 56 | Shannong 7859    | 46.98 | 65.31 | 34.23 | 37.19 |
| 57 | Aimengniu        | 42.96 | 46.41 | 32.36 | 52.22 |
| 58 | Yumai 49         | 36.77 | 46.31 | 30.08 | 32.27 |
| 59 | Zhengzhou 741    | 43.29 | 64.86 | 35.00 | 40.31 |
| 60 | Ningchun 4       | 39.41 | 45.78 | 37.10 | 43.49 |
| 61 | Jinmai 4         | 42.13 | 50.92 | 37.82 | 44.61 |
| 62 | Fan 6            | 42.86 | 45.57 | 50.32 | 48.71 |
| 63 | Yunmai 34        | 45.47 | 46.33 | 37.34 | 54.37 |
| 64 | Pingyuan 50      | 38.08 | 49.47 | 29.65 | 29.89 |
| 65 | Meiqianwu        | 33.50 | 59.25 | 47.15 | 33.39 |
| 66 | Laoqimai         | 37.80 | 47.34 | 23.35 | 27.07 |
| 67 | Hanzhongbai      | 44.03 | 49.36 | 32.66 | 35.11 |
| 68 | Huangguaxian     | 45.97 | 71.07 | 34.16 | 44.90 |
| 69 | Youmangsaogudan  | 50.54 | 74.10 | 47.14 | 39.97 |
| 70 | Shengen          | 51.86 | 50.19 | 33.65 | 36.70 |
| 71 | Youzimai         | 43.23 | 58.89 | 25.94 | 35.21 |
| 72 | Chushanbao       | 46.67 | 51.37 | 39.84 | 32.92 |
| 73 | Wumangchunmai    | 44.38 | 57.47 | 34.85 | 39.11 |
| 74 | Huoliaomai       | 71.61 | 76.32 | 85.12 | 71.11 |
| 75 | Jiangdongmen     | 56.09 | 76.56 | 47.78 | 55.41 |
| 76 | Daqingmang       | 48.93 | 63.27 | 51.14 | 52.74 |
| 77 | Dabaimai         | 42.29 | 53.77 | 36.42 | 34.76 |
| 78 | Naolaohan        | 41.68 | 48.74 | 30.75 | 36.01 |
| 79 | Shanmai          | 59.59 | 58.97 | 38.78 | 40.42 |
| 80 | Baiqitou         | 44.00 | 71.09 | 33.44 | 41.09 |
| 81 | Yangmai          | 52.50 | 57.83 | 41.56 | 51.94 |
| 82 | Chejianzi        | 50.00 | 72.33 | 40.23 | 50.92 |
| 83 | Rumai            | 42.34 | 51.63 | 41.38 | 37.87 |
| 84 | Sankechun        | 39.72 | 65.05 | 44.59 | 54.78 |

|    |                |       |       |       |       |
|----|----------------|-------|-------|-------|-------|
| 85 | Tumangmai      | 37.63 | 49.96 | 30.05 | 38.17 |
| 86 | Hongmangzi     | 40.90 | 58.10 | 27.83 | 38.94 |
| 87 | Geerhongmai    | 43.39 | 45.74 | 37.98 | 36.43 |
| 88 | Hongheshangtou | 49.30 | 65.58 | 30.74 | 37.63 |
| 89 | Baimaizi       | 48.04 | 56.08 | 34.15 | 34.98 |
| 90 | Jiangmai       | 54.83 | 60.48 | 40.50 | 40.44 |
| 91 | Hongxumai      | 48.78 | 59.06 | 39.93 | 68.82 |

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