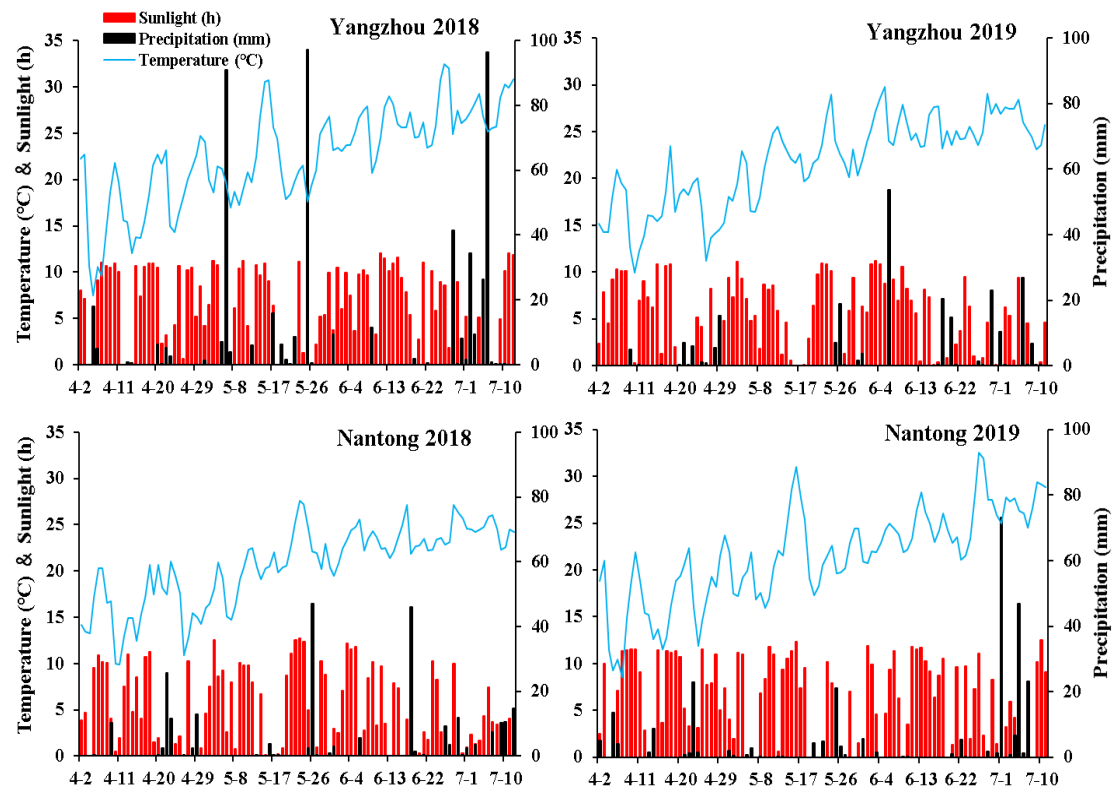
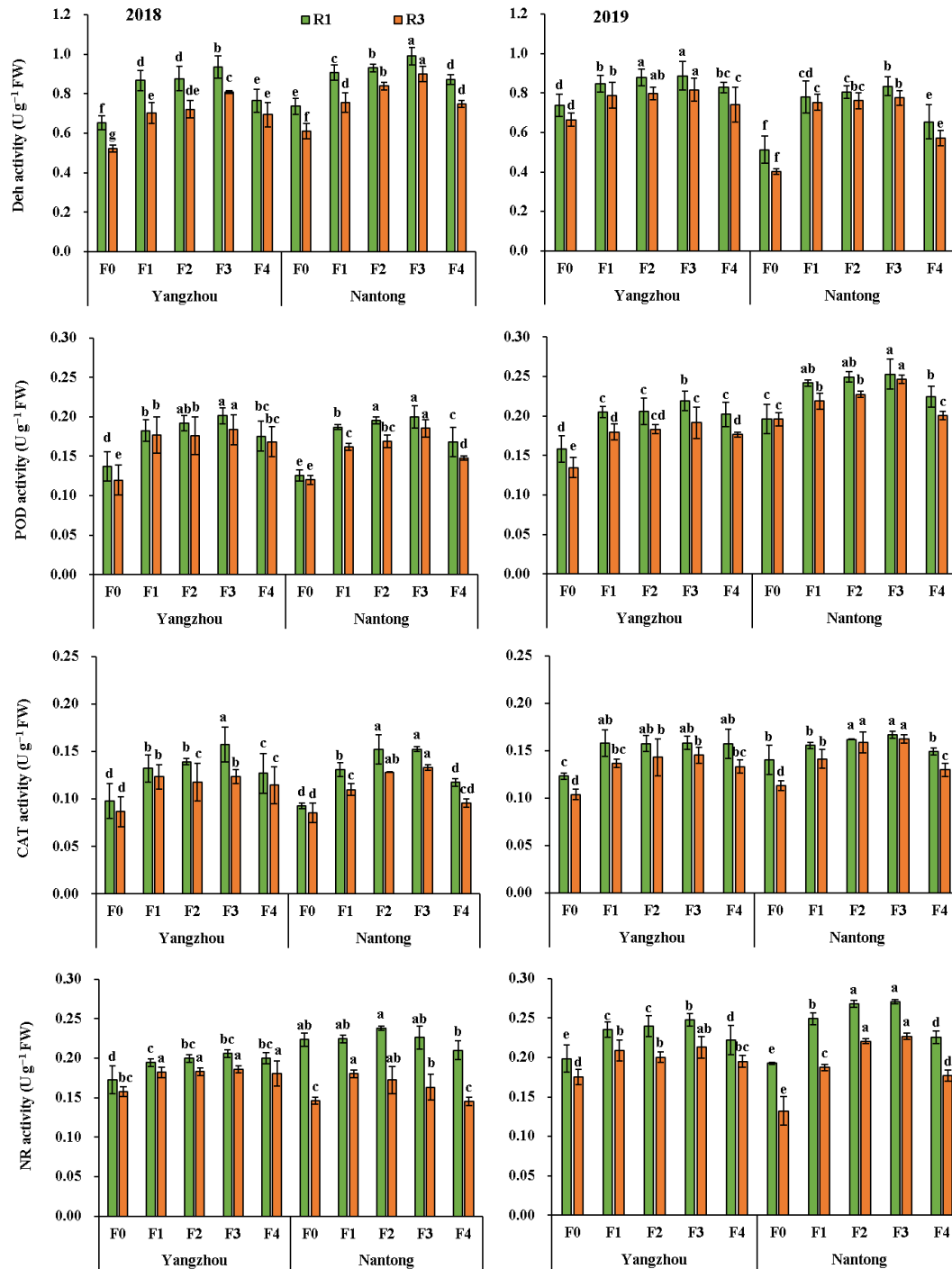


**Table S1.** The soil properties of experimental field prior to sowing at 0–20 cm soil depth.

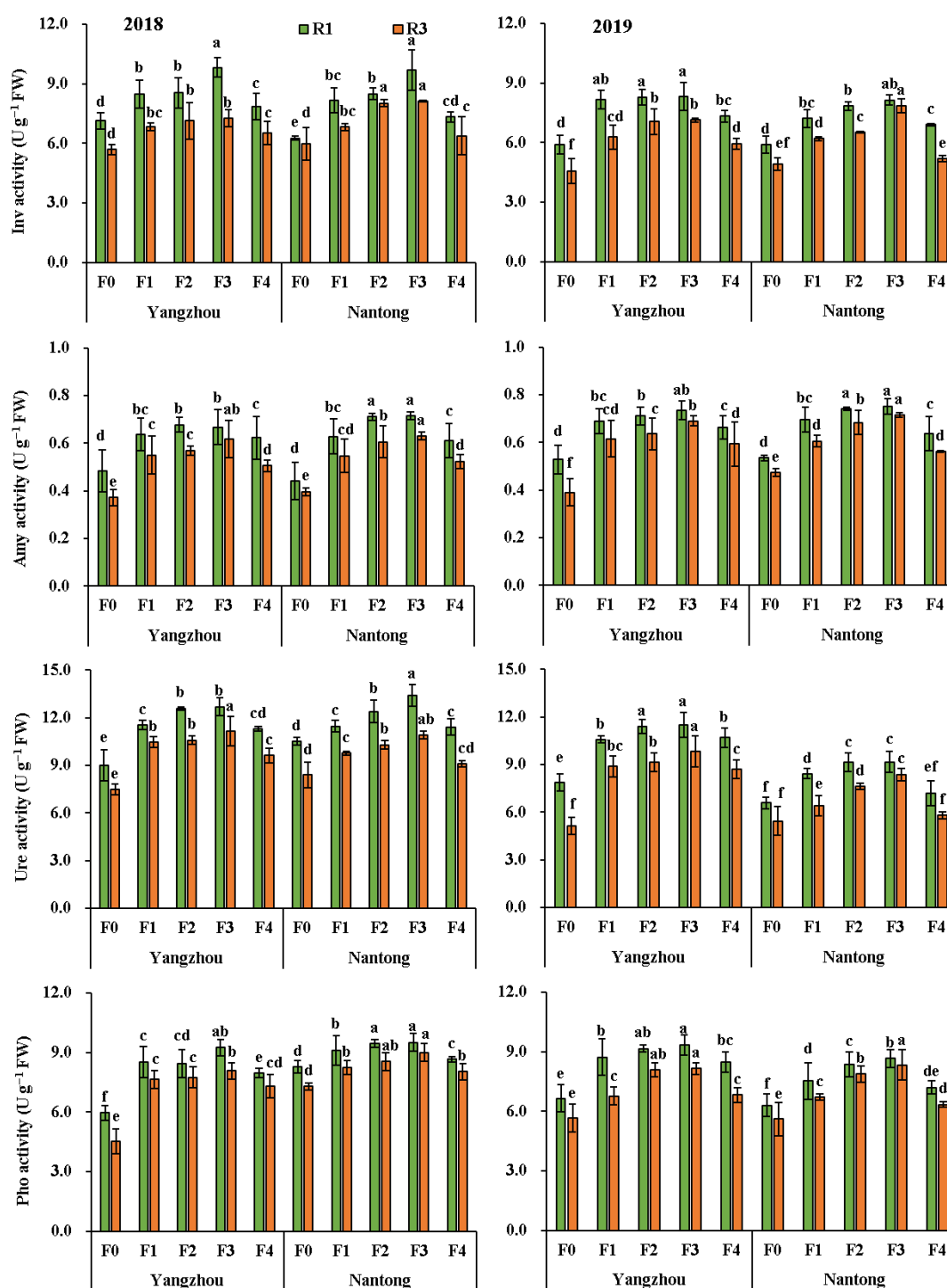
| Experimental site | Year | Organic matter<br>(g kg <sup>-1</sup> ) | Total N<br>(g kg <sup>-1</sup> ) | Available N<br>(mg kg <sup>-1</sup> ) | Available P<br>(mg kg <sup>-1</sup> ) | Available K<br>(mg kg <sup>-1</sup> ) |
|-------------------|------|---|----------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| Yangzhou          | 2018 | 13.95±1.06                              | 1.06±0.20                        | 73.82±2.12                            | 8.00±0.46                             | 63.10±1.27                            |
|                   | 2019 | 12.68±1.30                              | 0.95±0.61                        | 68.19±1.37                            | 6.83±0.42                             | 68.53±1.63                            |
| Nantong           | 2018 | 11.80±0.63                              | 0.97±0.09                        | 32.12±0.52                            | 5.95±0.27                             | 61.01±2.47                            |
|                   | 2019 | 9.16±0.05                               | 1.12±0.10                        | 29.16±0.95                            | 7.36±0.42                             | 72.16±3.55                            |



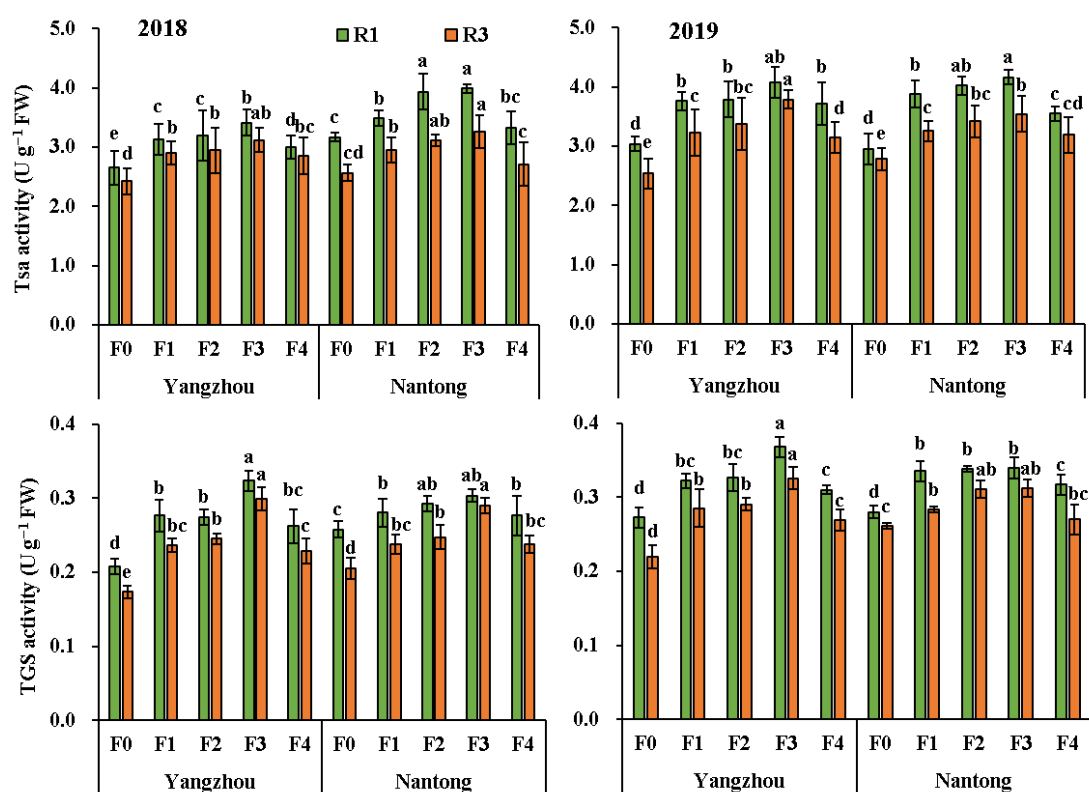
**Figure S1.** Daily precipitation, average temperature and sunlight during maize growth seasons in 2018 and 2019.



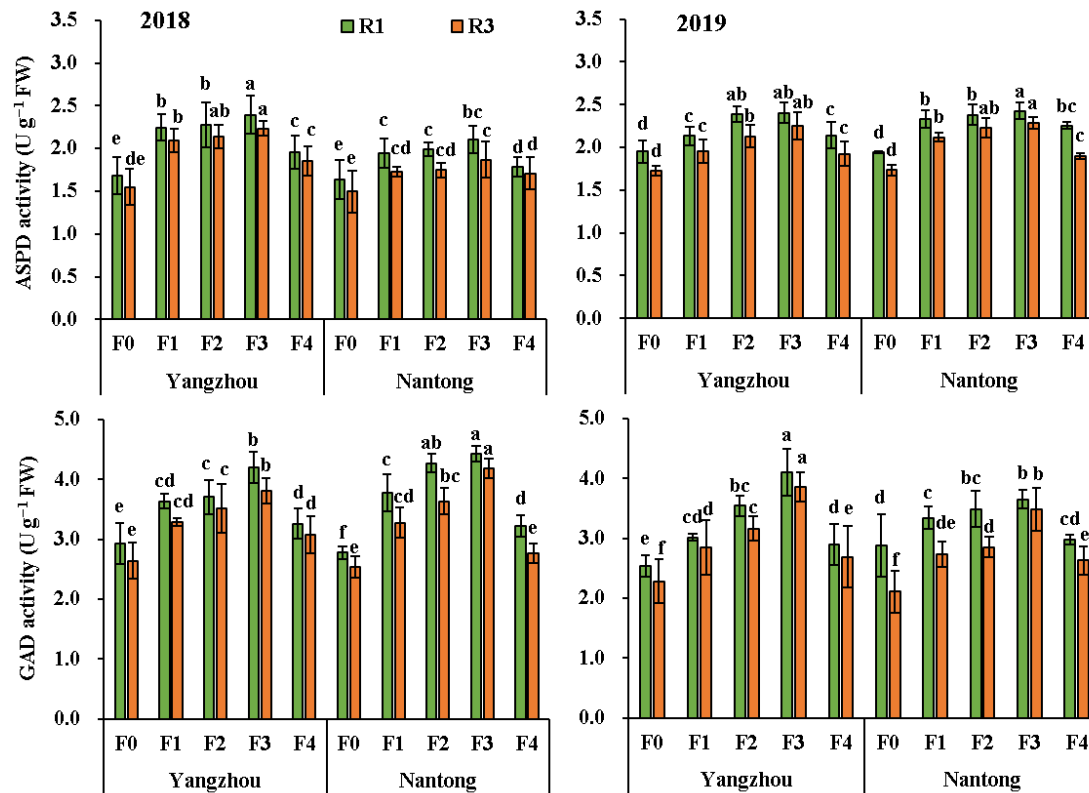
**Figure S2.** Effects of optimized fertilization practices on oxidoreductases activities of rhizosphere soil. Vertical bars are means  $\pm$  standard deviation ( $n = 9$ , from 3 independent plots). Different letters above the bars represent significant differences at  $P < 0.05$  at same stage. Note: F0: no fertilizer; F1, F2 and F3 represent new compound fertilizer applied  $225 \text{ kg N ha}^{-1}$  at sowing, V3 and V6 stages, respectively; F4: applied  $75 \text{ kg N ha}^{-1}$  traditional compound fertilizer at sowing stage, and  $150 \text{ kg N ha}^{-1}$  urea at V6 stage. R1 and R3 represent silking and milking stages. Deh, POD, CAT and NR represent dehydrogenase, peroxidase, catalase and nitrate reductase in rhizosphere soil, respectively.



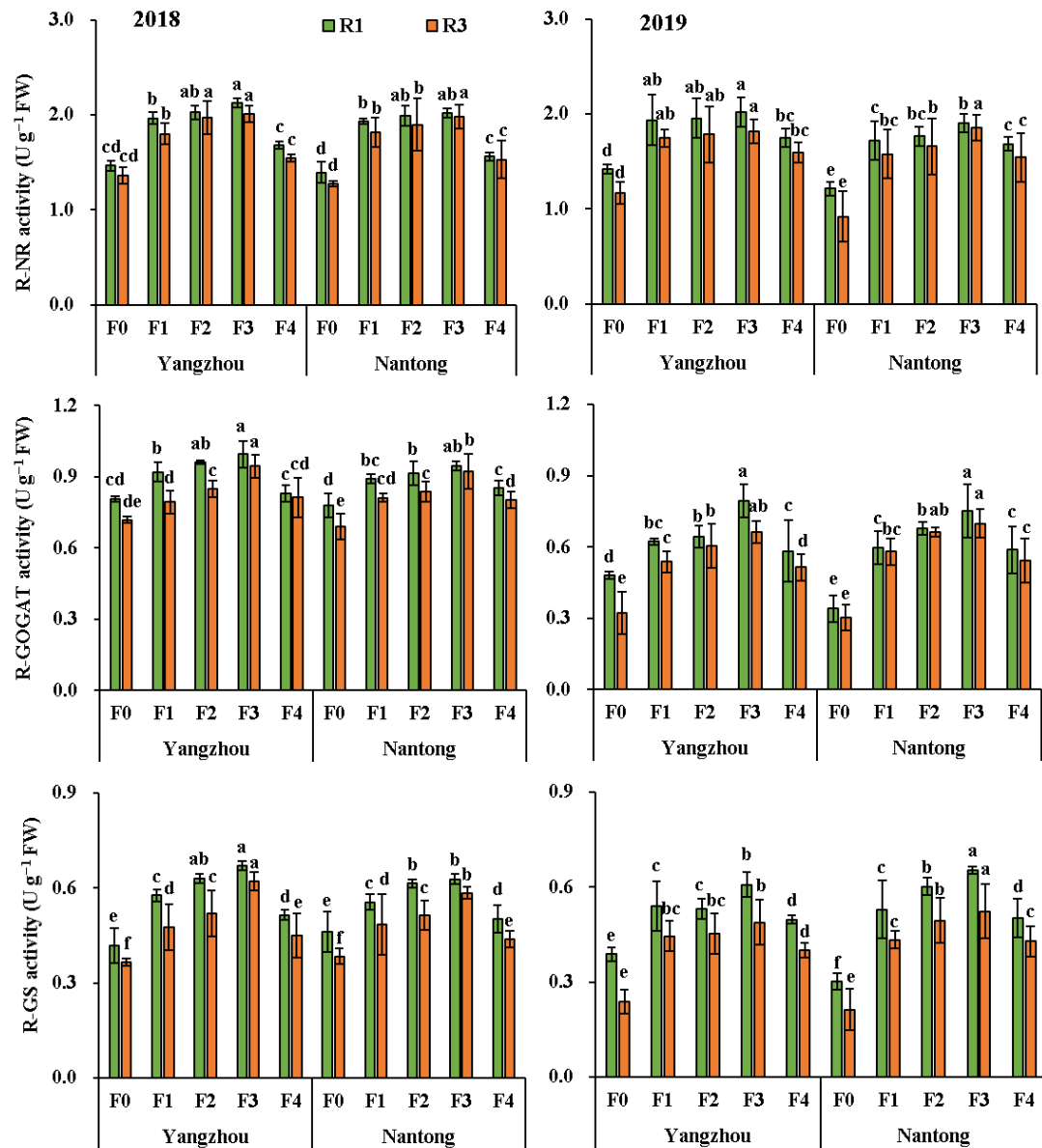
**Figure S3.** Effects of optimized fertilization practices on hydrolases activities of rhizosphere soil. Vertical bars are means  $\pm$  standard deviation ( $n = 9$ , from 3 independent plots). Different letters above the bars represent significant differences at  $P < 0.05$  at same stage. Note: F0: no fertilizer; F1, F2 and F3 represent new compound fertilizer applied  $225 \text{ kg N ha}^{-1}$  at sowing, V3 and V6 stages, respectively; F4: applied  $75 \text{ kg N ha}^{-1}$  traditional compound fertilizer at sowing stage, and  $150 \text{ kg N ha}^{-1}$  urea at V6 stage. R1 and R3 represent silking and milking stages. Inv, Amy, Ure and Pho represent invertase, amylase, urease and phosphatase in rhizosphere soil, respectively.



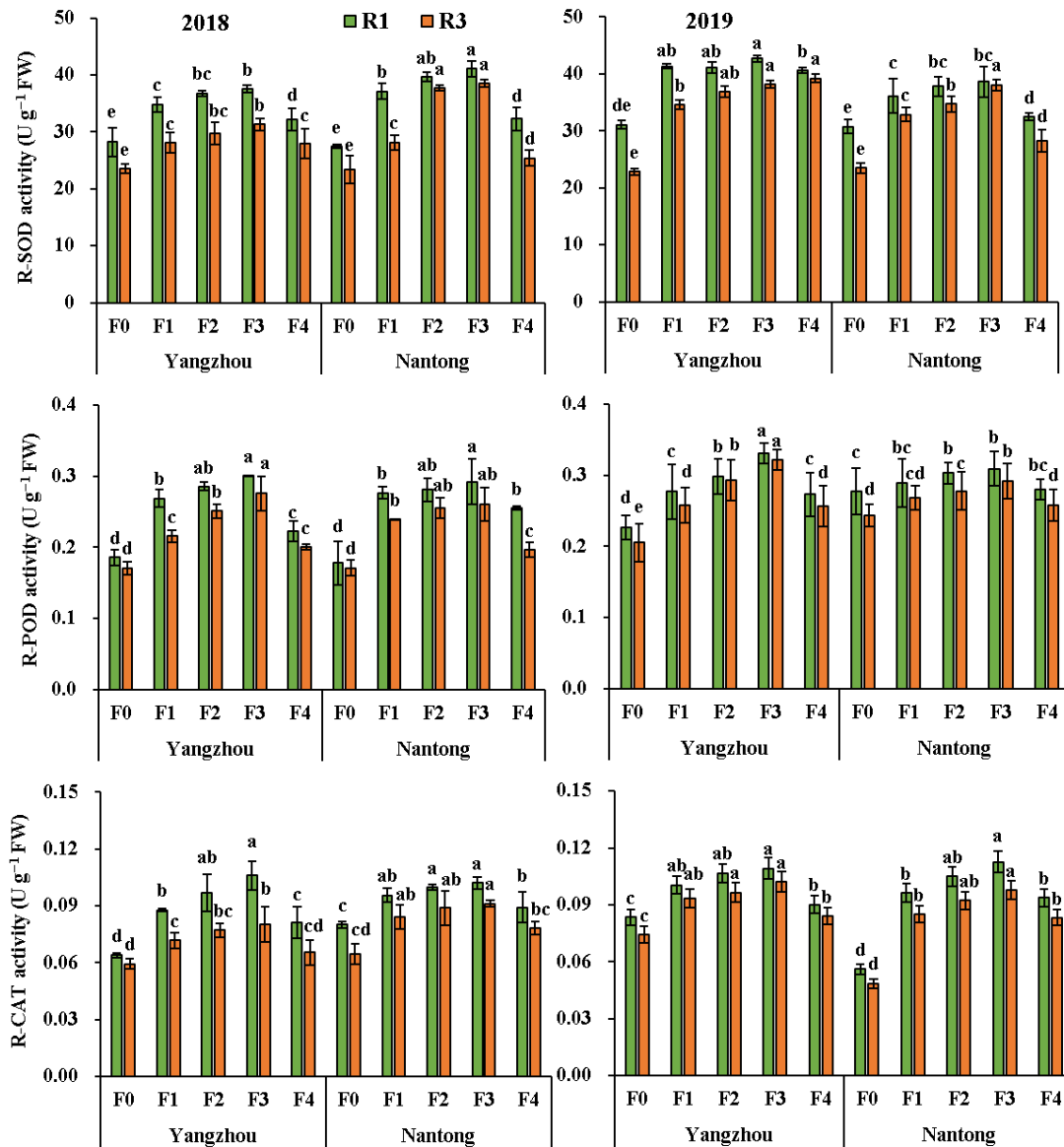
**Figure S4.** Effects of optimized fertilization practices on transferases activities of rhizosphere soil. Vertical bars are means  $\pm$  standard deviation ( $n = 9$ , from 3 independent plots). Different letters above the bars represent significant differences at  $P < 0.05$  at same stage. Note: F0: no fertilizer; F1, F2 and F3 represent new compound fertilizer applied 225 kg N ha<sup>-1</sup> at sowing, V3 and V6 stages, respectively; F4: applied 75 kg N ha<sup>-1</sup> traditional compound fertilizer at sowing stage, and 150 kg N ha<sup>-1</sup> urea at V6 stage. R1 and R3 represent silking and milking stages. Tsa and TGS represent transaminase and transglycosidase in rhizosphere soil.



**Figure S5.** Effects of optimized fertilization practices on lyases activities of rhizosphere soil. Vertical bars are means  $\pm$  standard deviation ( $n = 9$ , from 3 independent plots). Different letters above the bars represent significant differences at  $P < 0.05$  at same stage. Note: F0: no fertilizer; F1, F2 and F3 represent new compound fertilizer applied 225 kg N ha<sup>-1</sup> at sowing, V3 and V6 stages, respectively; F4: applied 75 kg N ha<sup>-1</sup> traditional compound fertilizer at sowing stage, and 150 kg N ha<sup>-1</sup> urea at V6 stage. R1 and R3 represent silking and milking stages. ASPD and GAD represent aspartate decarboxylase and glutamate decarboxylase in rhizosphere soil.



**Figure S6.** Effects of optimized fertilization practices on activities of N metabolism enzymes in root of fresh waxy maize. Vertical bars are means  $\pm$  standard deviation ( $n=9$ , from 3 independent plots). Different letters above the bars represent significant differences at  $P < 0.05$  at same stage. Note: F0: no fertilizer; F1, F2 and F3 represent new compound fertilizer applied 225 kg N ha<sup>-1</sup> at sowing, V3 and V6 stages, respectively; F4: applied 75 kg N ha<sup>-1</sup> traditional compound fertilizer at sowing stage, and 150 kg N ha<sup>-1</sup> urea at V6 stage. R1 and R3 represent silking and milking stages. R-NR, R-GOGAT and R-GS represent nitrate reductase, glutamate synthase and glutamine synthetase in root, respectively.



**Figure S7.** Effects of optimized fertilization practices on antioxidant enzymes activity in root of fresh waxy maize. Vertical bars are means  $\pm$  standard deviation ( $n = 9$ , from 3 independent plots). Different letters above the bars represent significant differences at  $P < 0.05$  at same stage. Note: F0: no fertilizer; F1, F2 and F3 represent new compound fertilizer applied 225 kg N ha<sup>-1</sup> at sowing, V3 and V6 stages, respectively; F4: applied 75 kg N ha<sup>-1</sup> traditional compound fertilizer at sowing stage, and 150 kg N ha<sup>-1</sup> urea at V6 stage. R1 and R3 represent silking and milking stages. R-SOD, R-POD and R-CAT represent superoxide dismutase, peroxidase and catalase in root, respectively.