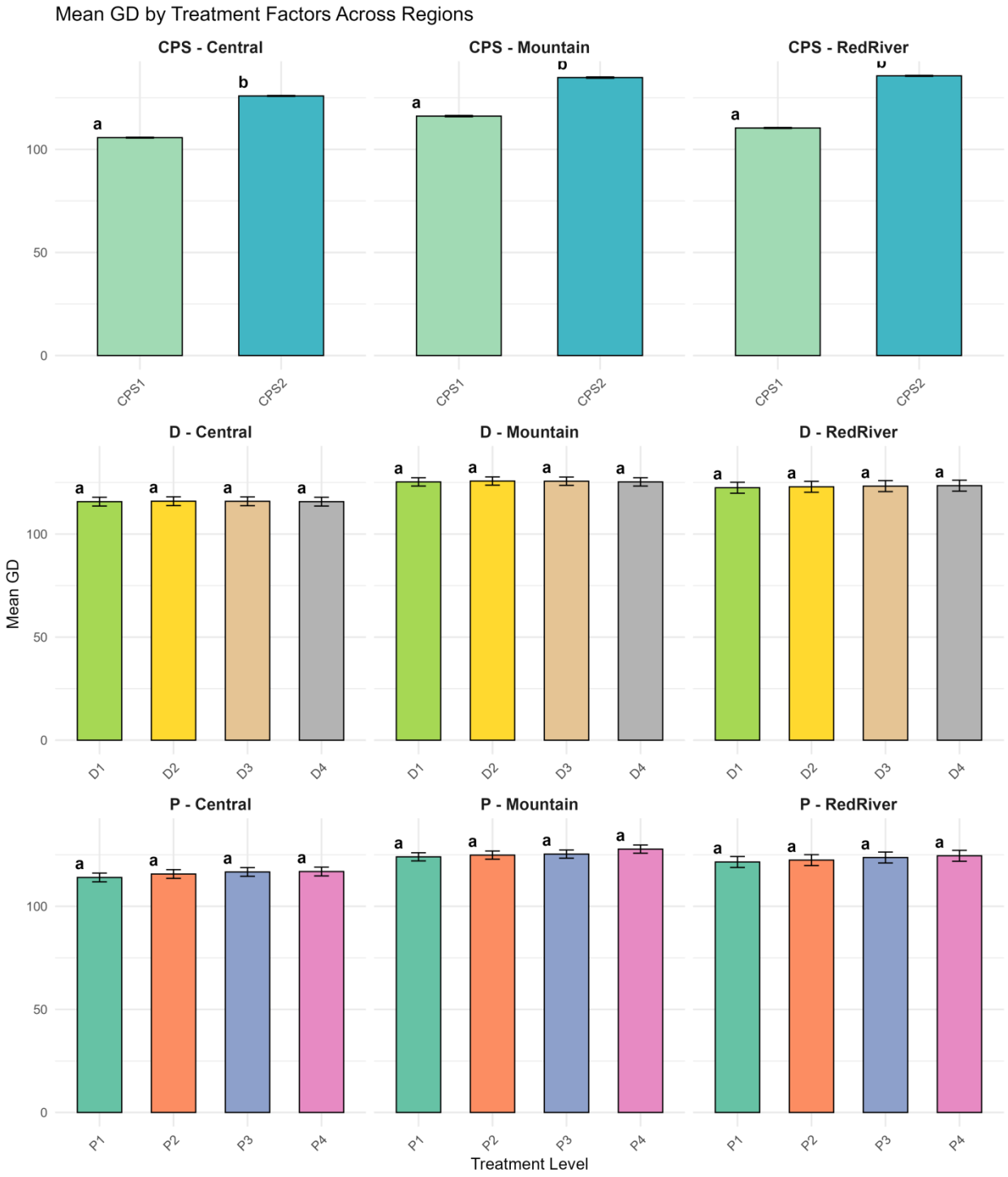

Fig. S1. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on growth duration (GD, days) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

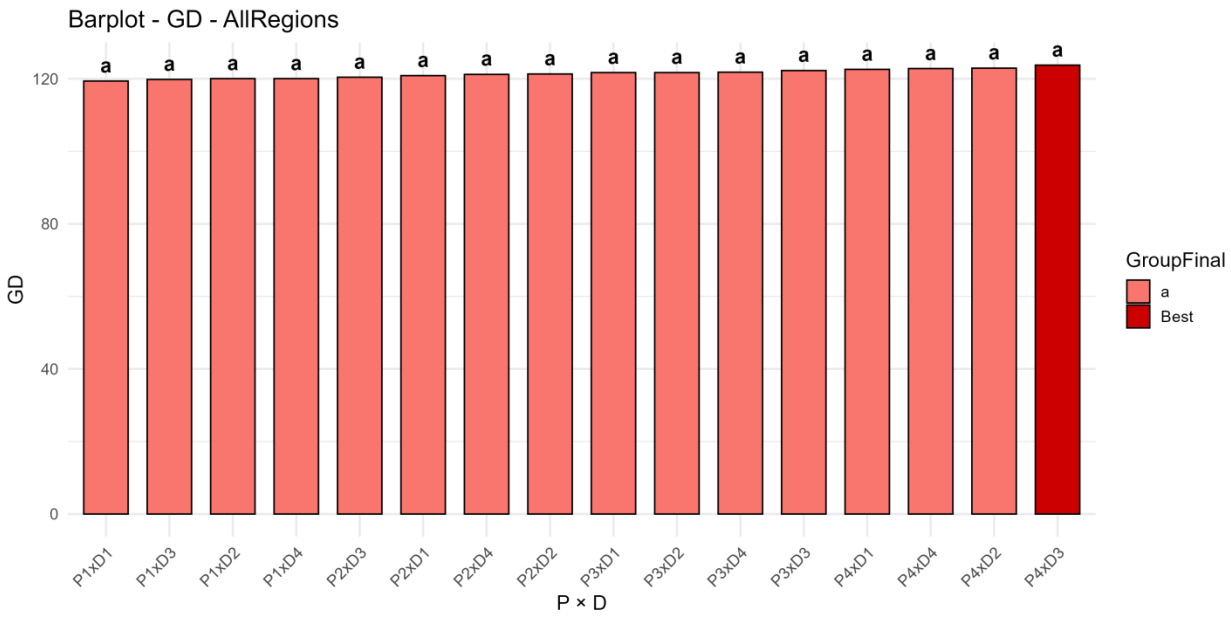

Fig. S2. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on the growth duration (GD, days) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

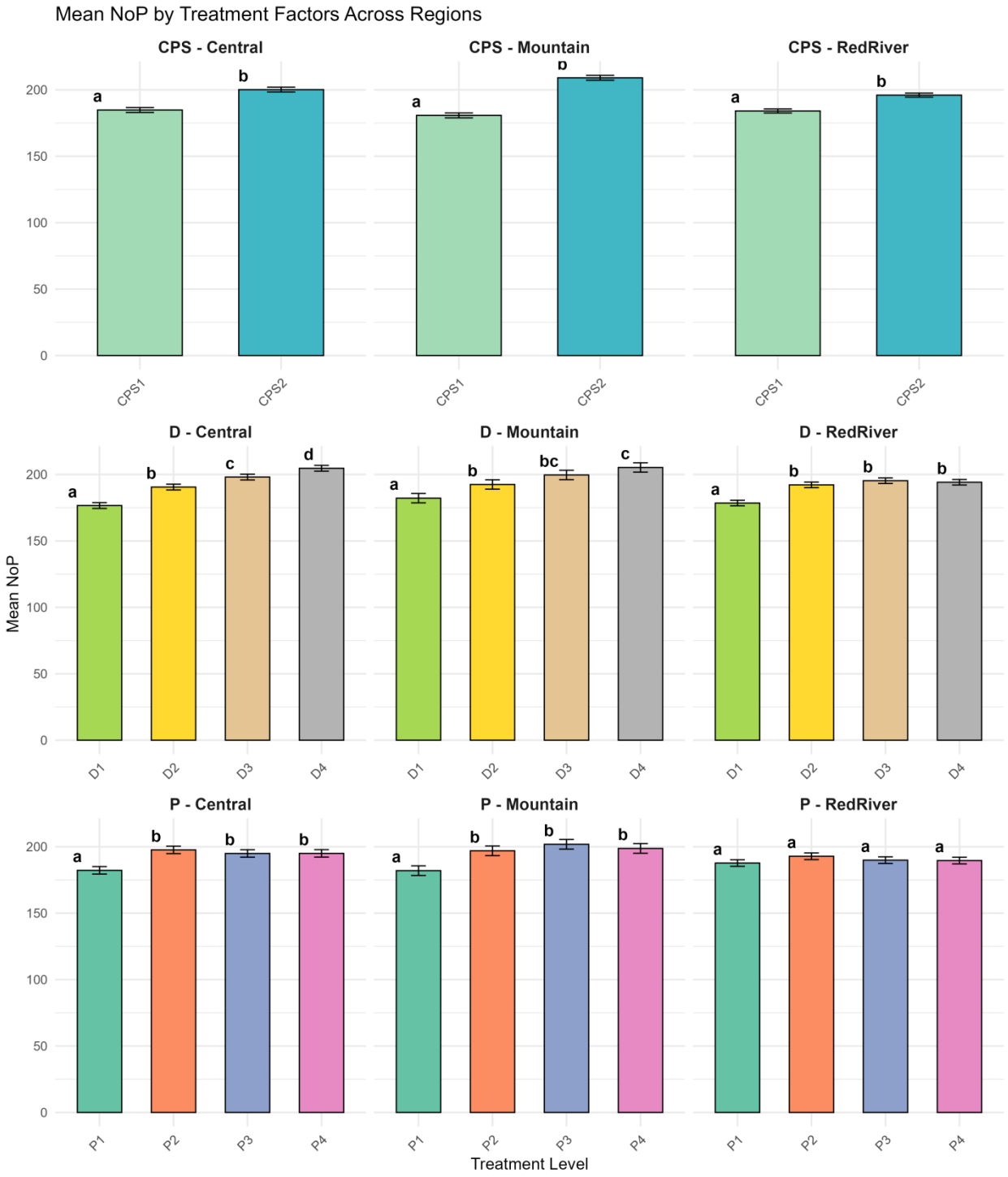

Fig. S3. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on number of panicles/m^2 (NoP, panicles/m^2) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

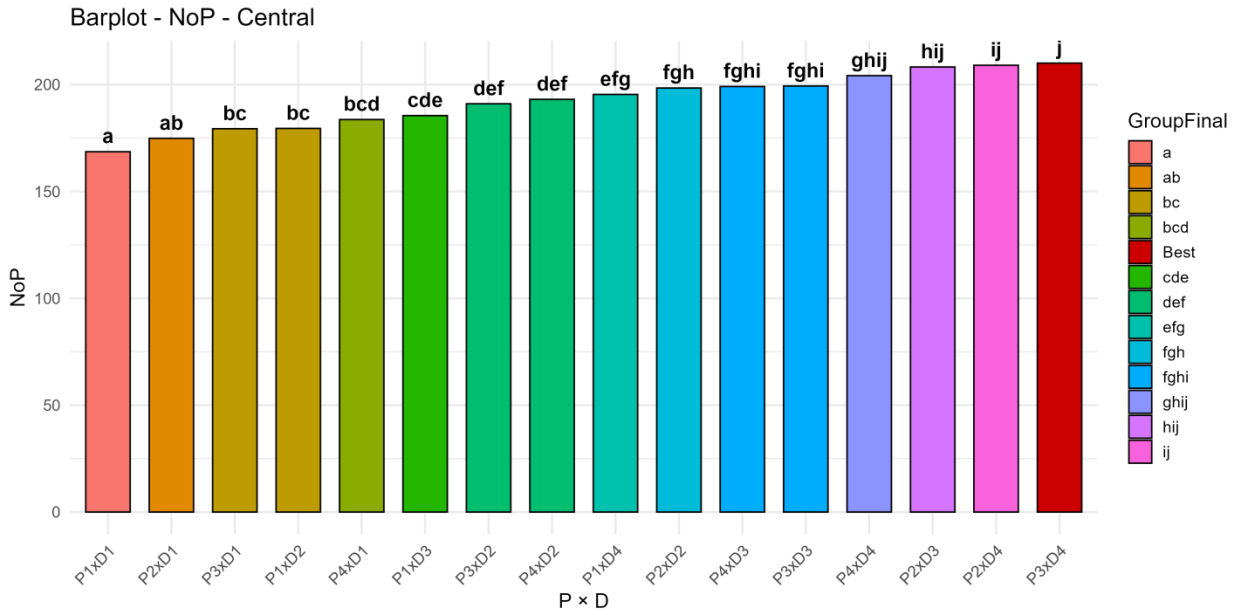

Fig. S4. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on number of $\text{panicles}/\text{m}^2$ (NoP, $\text{panicles}/\text{m}^2$) of black glutinous rice (ĐH8) in the North Central Region. Treatments with different letters are significantly different at $p < 0.05$.

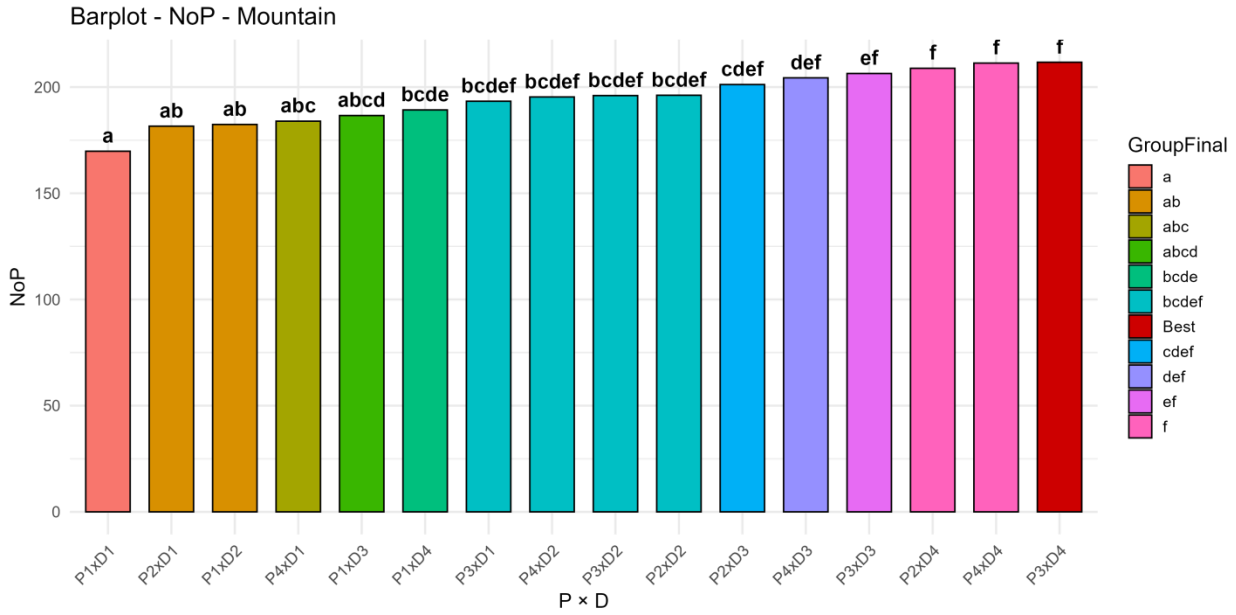

Fig. S5. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on number of $\text{panicles}/\text{m}^2$ (NoP, $\text{panicles}/\text{m}^2$) of black glutinous rice (ĐH8) in the Northern Mountainous Region. Treatments with different letters are significantly different at $p < 0.05$.

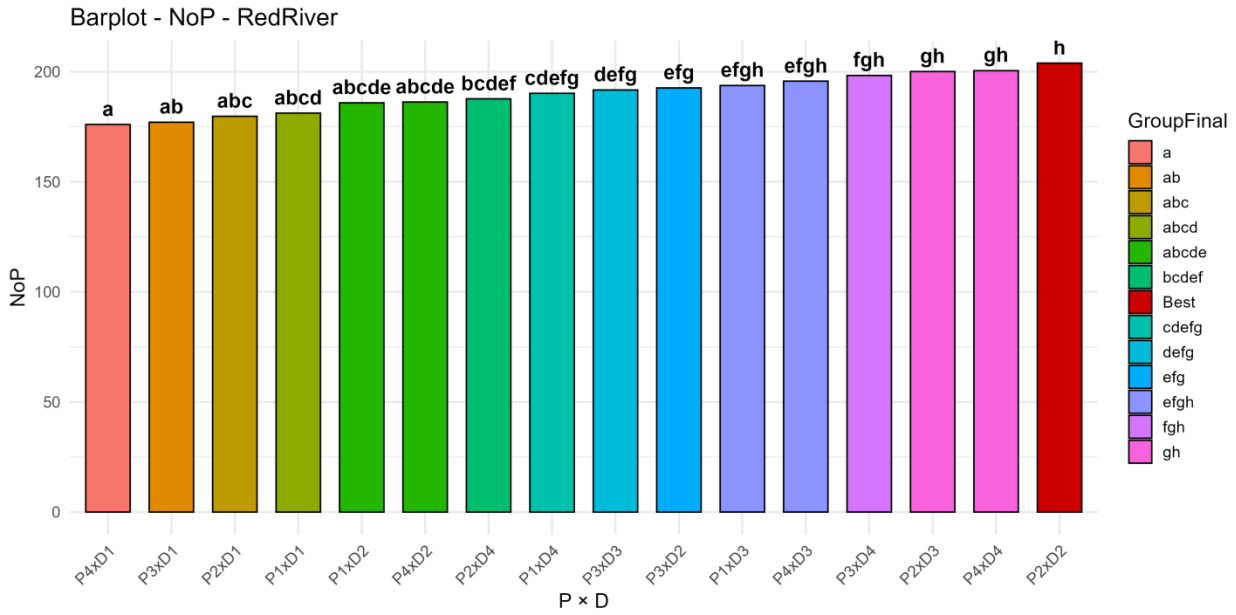

Fig. S6. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on number of panicles/m^2 (NoP, panicles/m^2) of black glutinous rice (ĐH8) in the Red River Delta Region. Treatments with different letters are significantly different at $p < 0.05$.

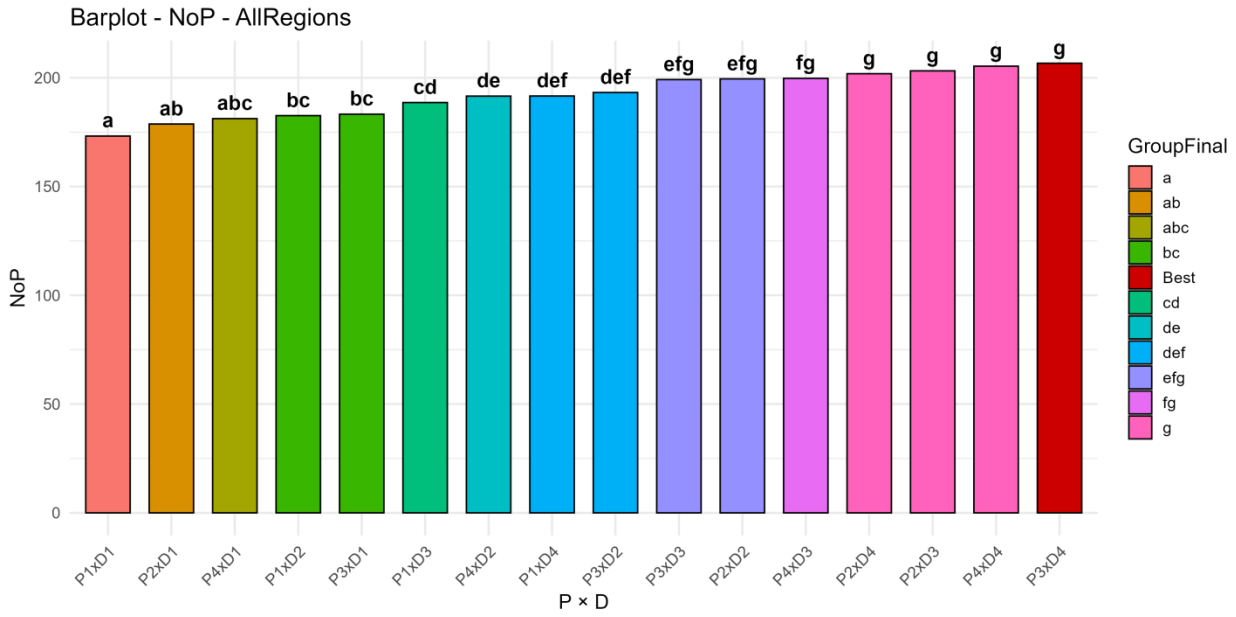

Fig. S7. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on number of panicles/m^2 (NoP, panicles/m^2) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

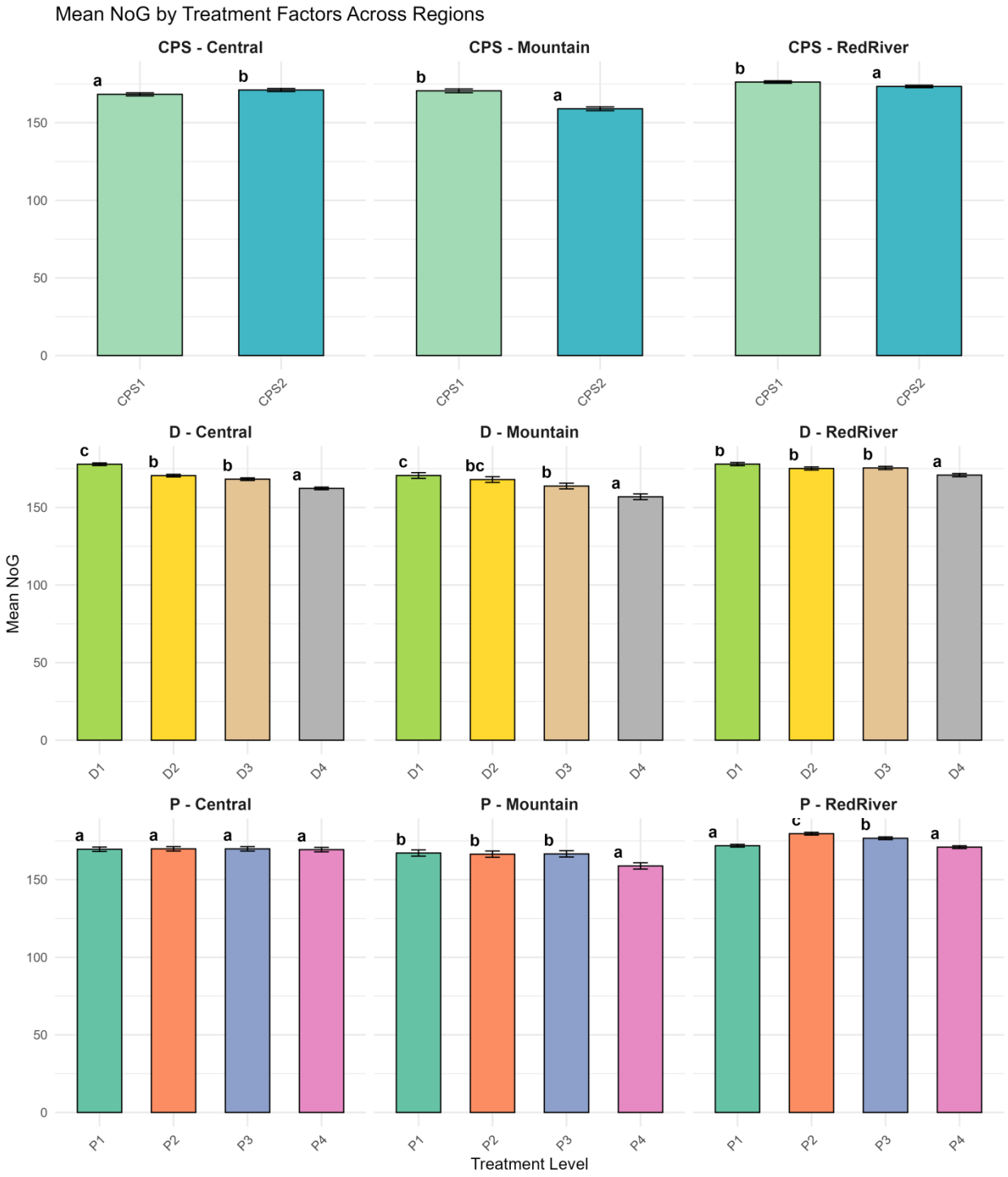

Fig. S8. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on number of grains/panicle (NoG) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

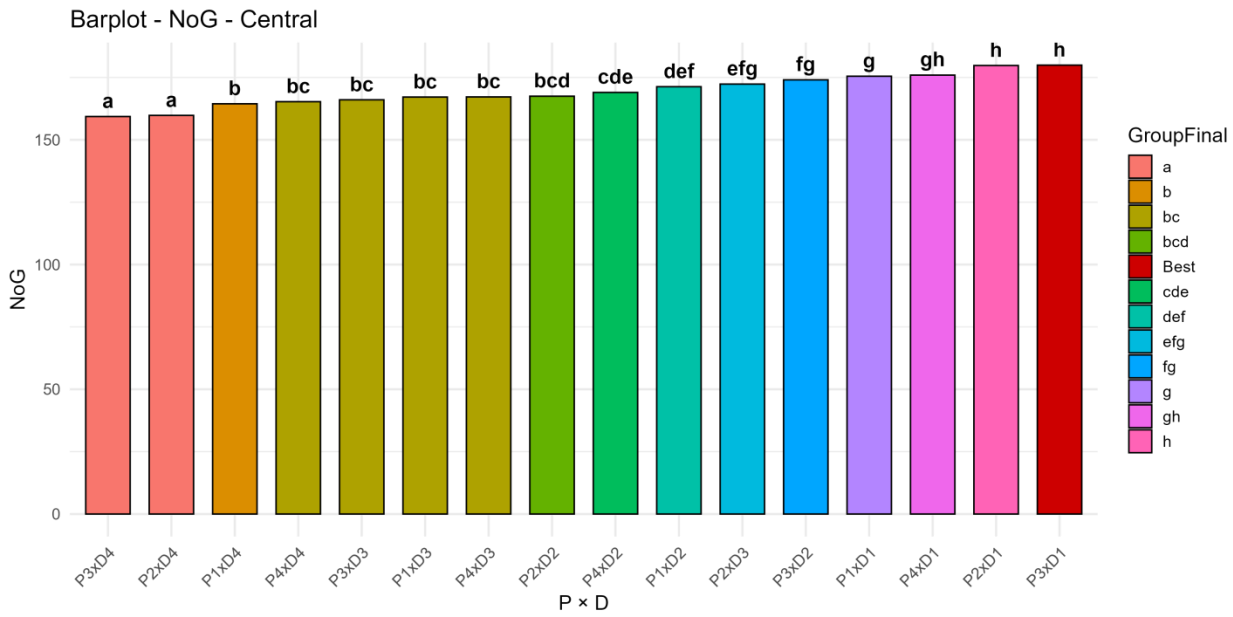

Fig. S9. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on on number of grains/panicle (NoG) of black glutinous rice (ĐH8) in the North Central Region. Treatments with different letters are significantly different at $p < 0.05$.

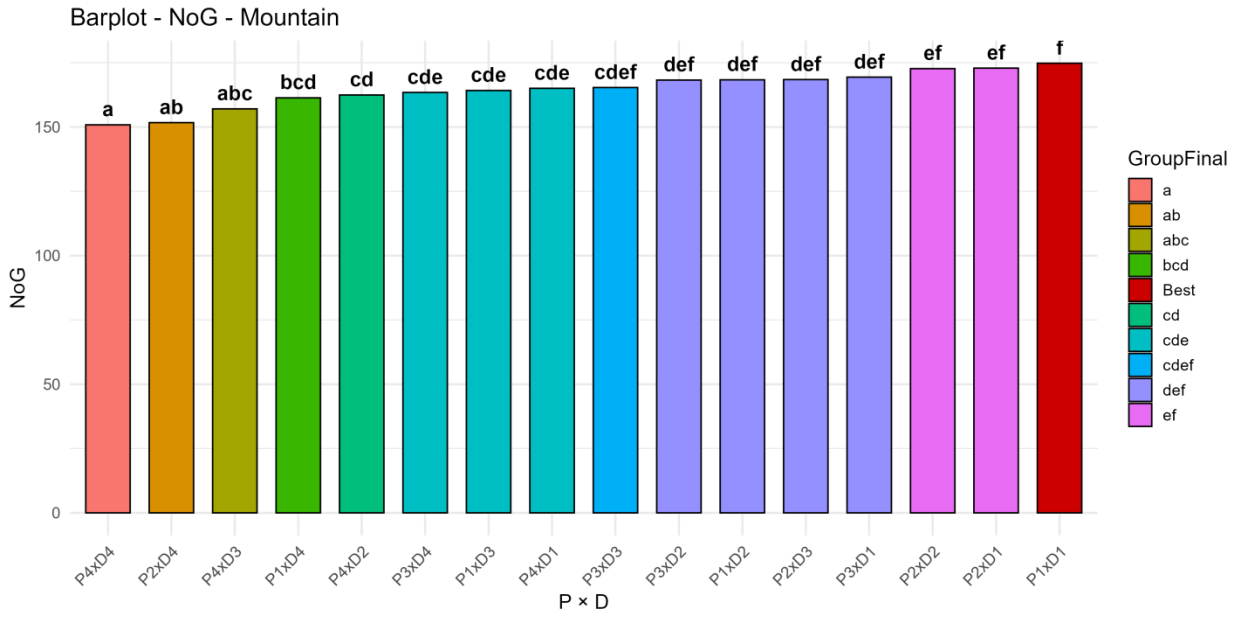

Fig. S10. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on number of grains/panicle (NoG) of black glutinous rice (ĐH8) in the Northern Mountainous Region. Treatments with different letters are significantly different at $p < 0.05$.

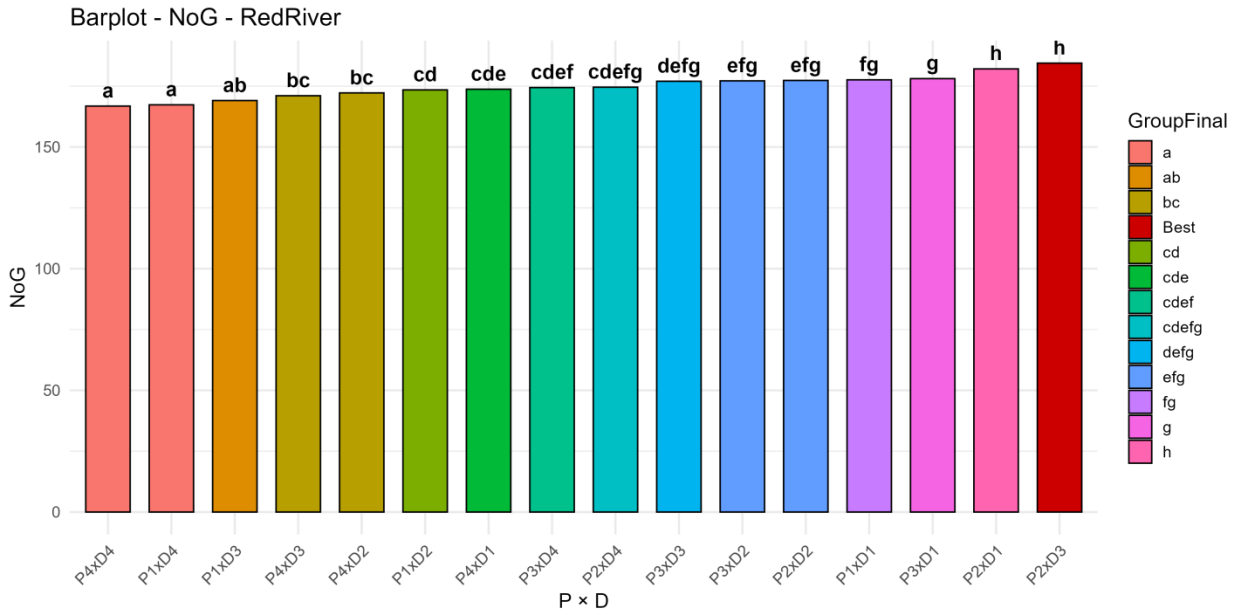

Fig. S11. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on on number of grains/panicle (NoG) of black glutinous rice (ĐH8) in the Red River Delta Region. Treatments with different letters are significantly different at $p < 0.05$.

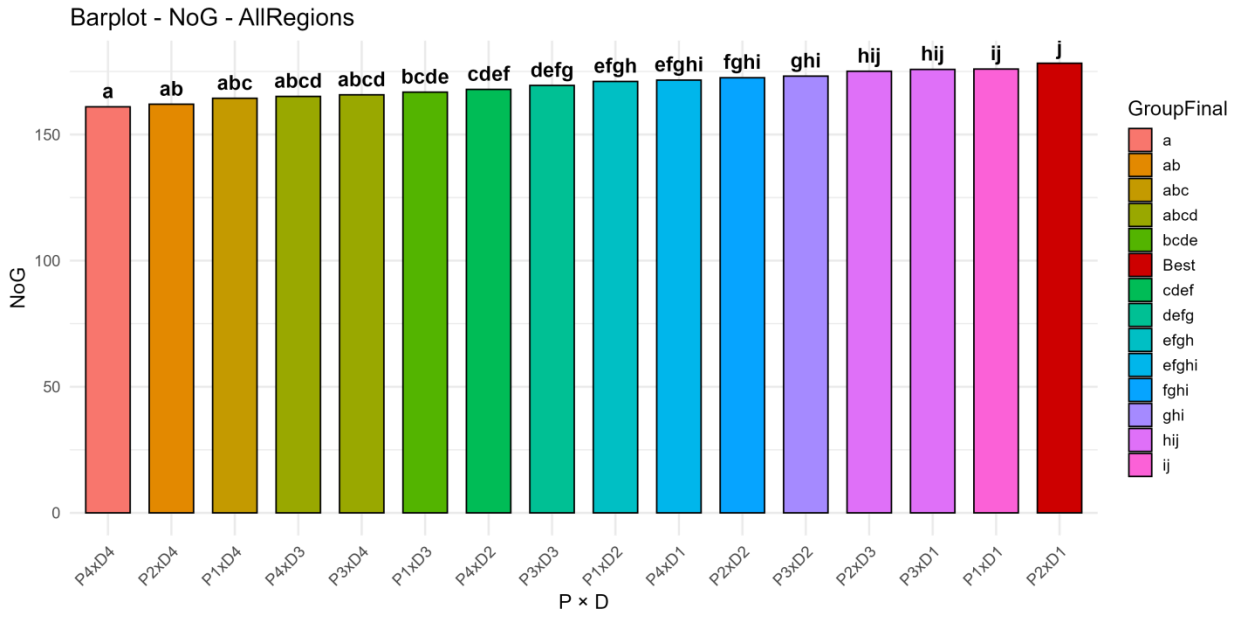

Fig. S12. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on number of grains/panicle (NoG) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

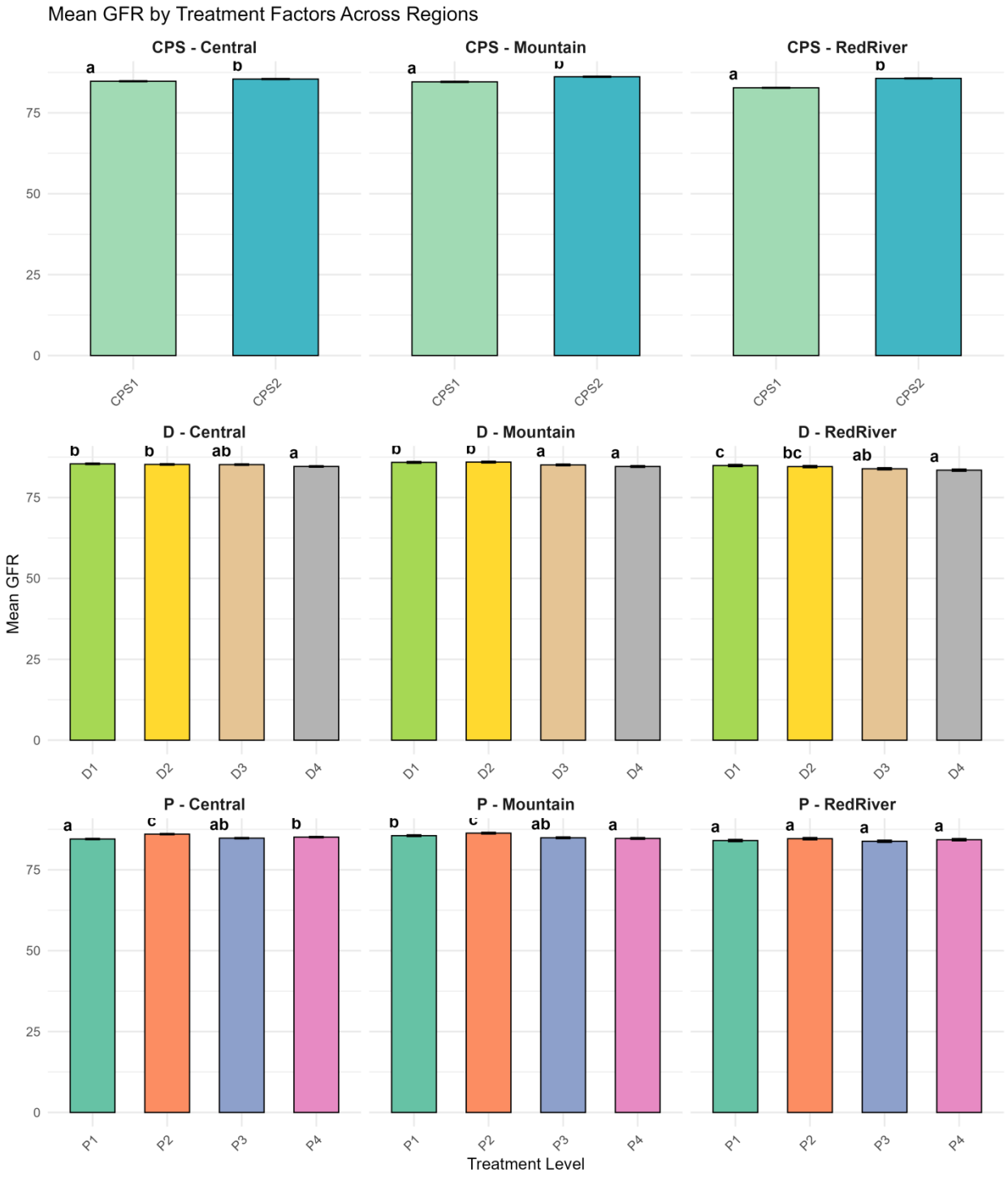

Fig. S13. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on grain filling rate (GFR, %) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

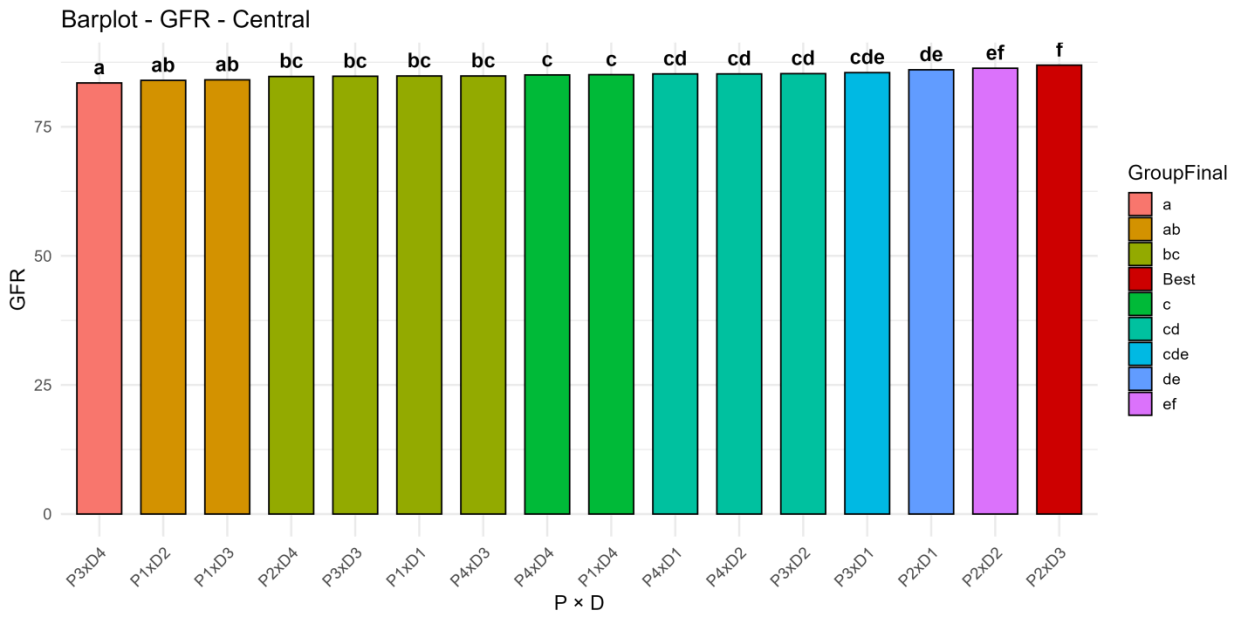

Fig. S14. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on grain filling rate (GFR, %) of black glutinous rice (ĐH8) in the North Central Region. Treatments with different letters are significantly different at $p < 0.05$.

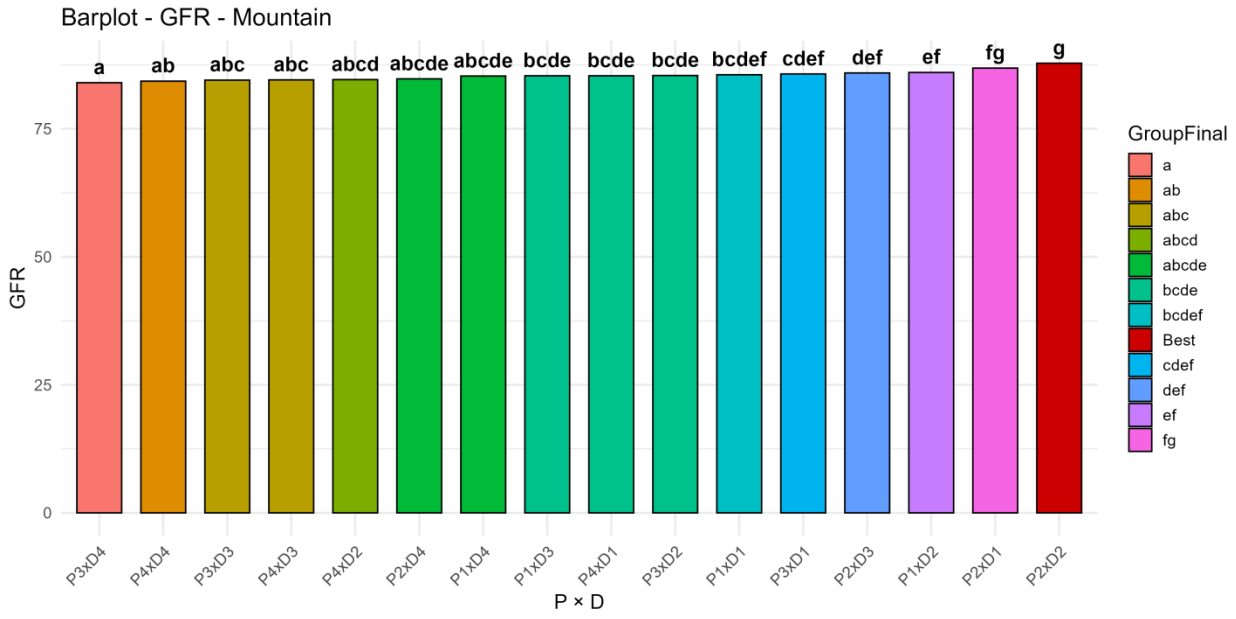

Fig. S15. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on grain filling rate (GFR, %) of black glutinous rice (ĐH8) in the Northern Mountainous Region. Treatments with different letters are significantly different at $p < 0.05$.

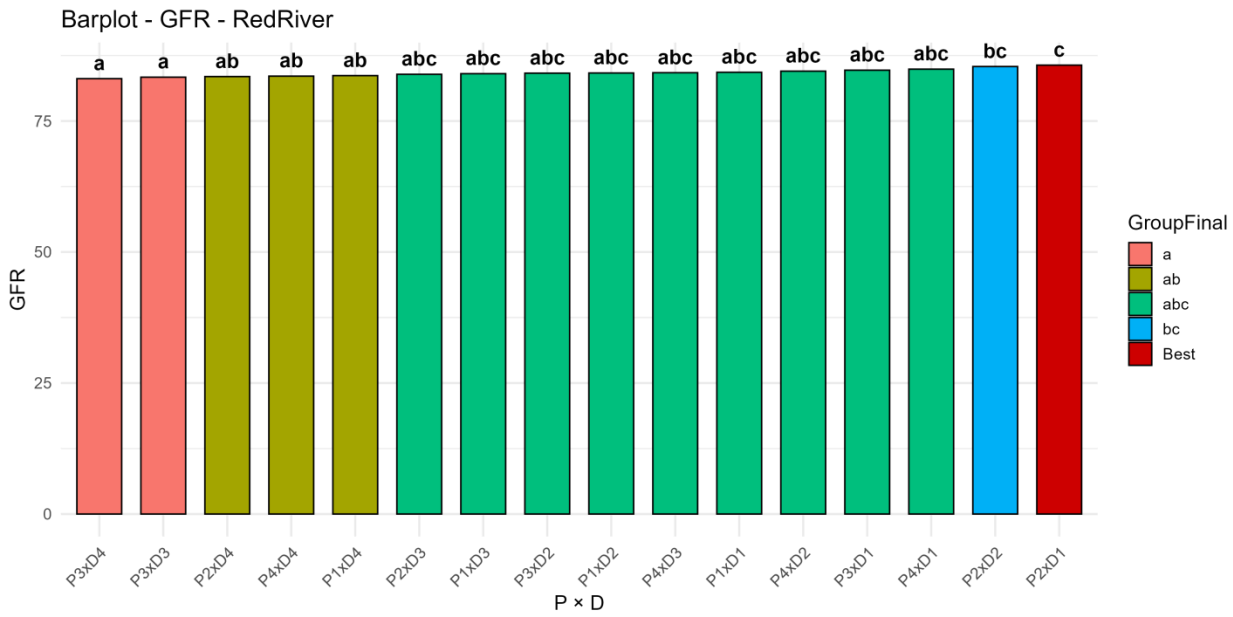

Fig. S16. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on grain filling rate (GFR, %) of black glutinous rice (ĐH8) in the Red River Delta Region. Treatments with different letters are significantly different at $p < 0.05$.

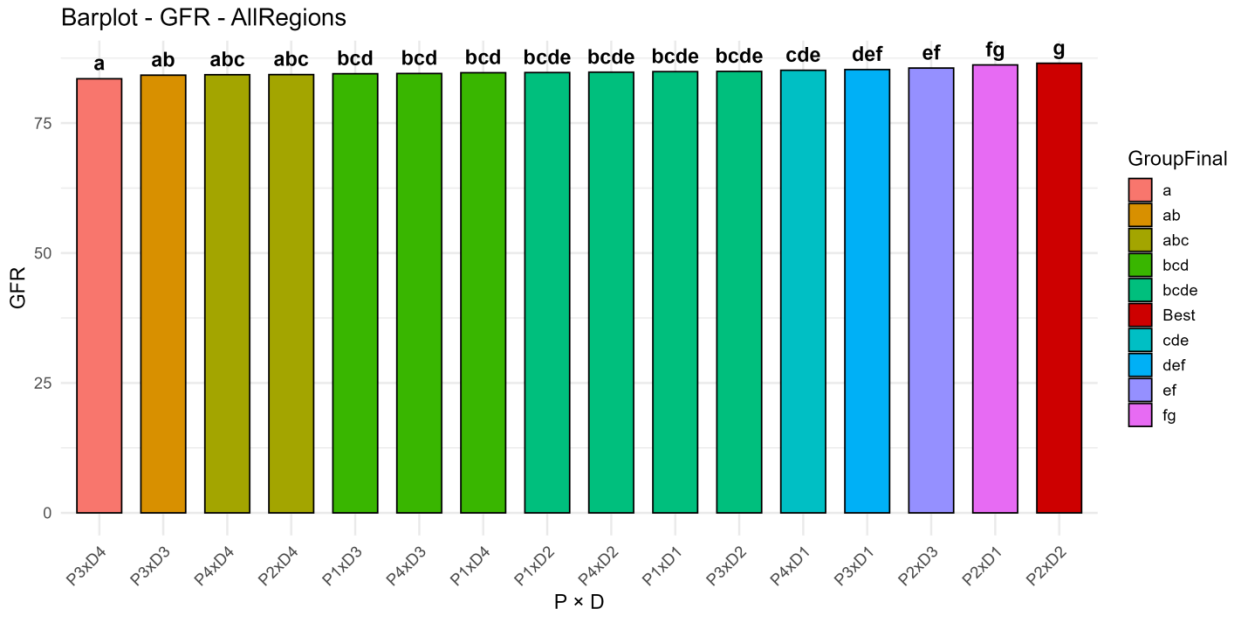

Fig. S17. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) grain filling rate (GFR, %) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

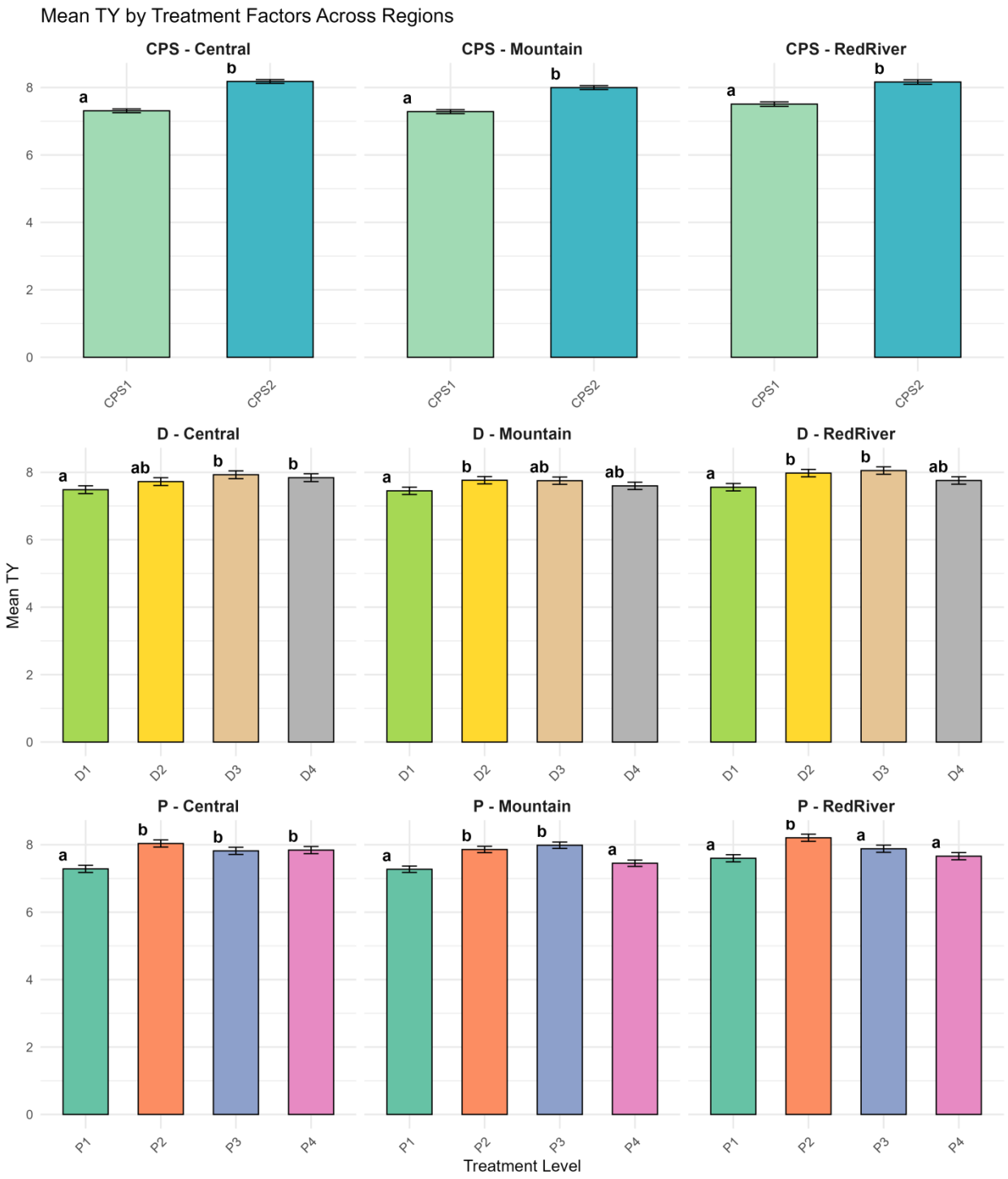

Fig. S18. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on the theoretical yield (TY, tons/ha) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

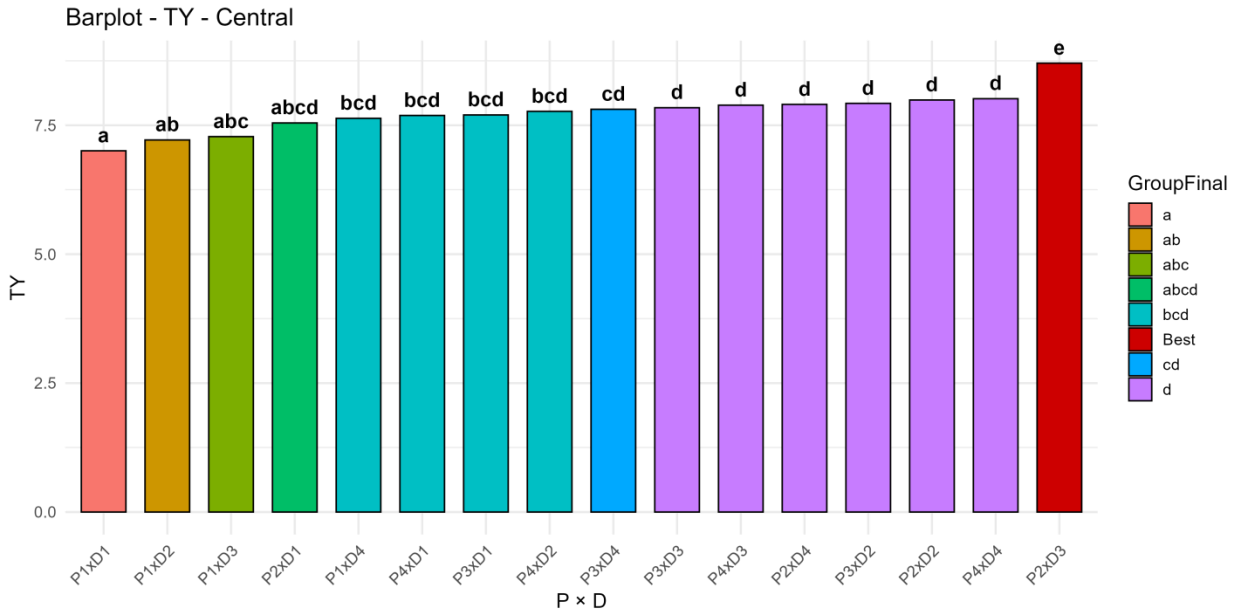

Fig. S19. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on the theoretical yield (TY, tons/ha) of black glutinous rice (ĐH8) in the North Central Region. Treatments with different letters are significantly different at $p < 0.05$.

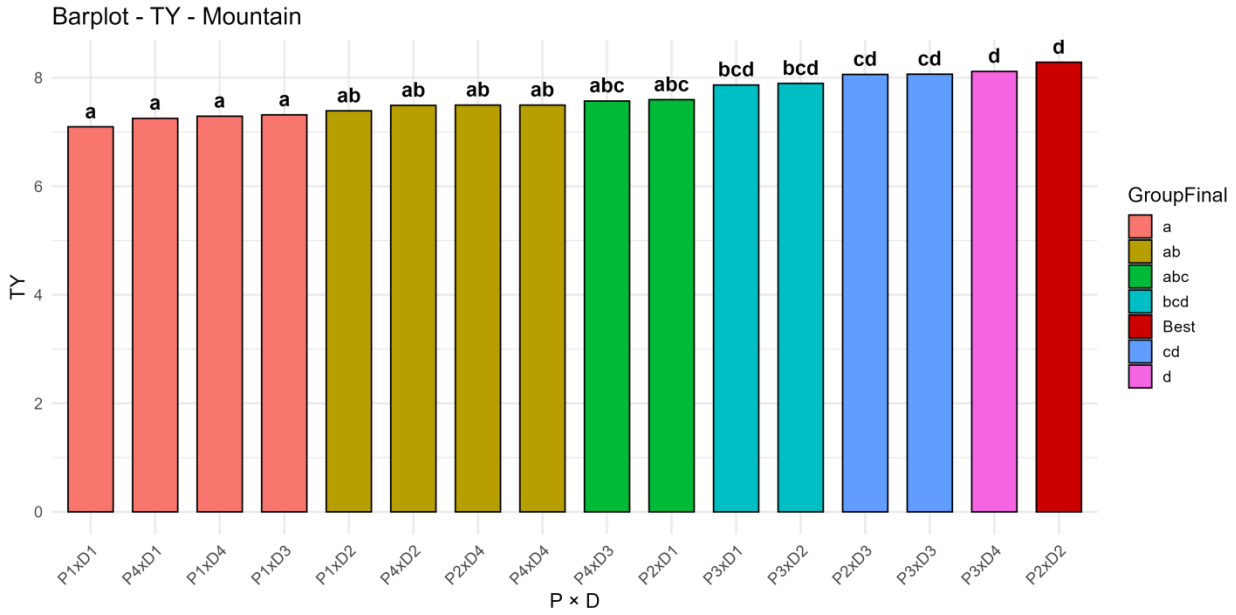

Fig. S20. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on the theoretical yield (TY, tons/ha)of black glutinous rice (ĐH8) in the Northern Mountainous Region. Treatments with different letters are significantly different at $p < 0.05$.

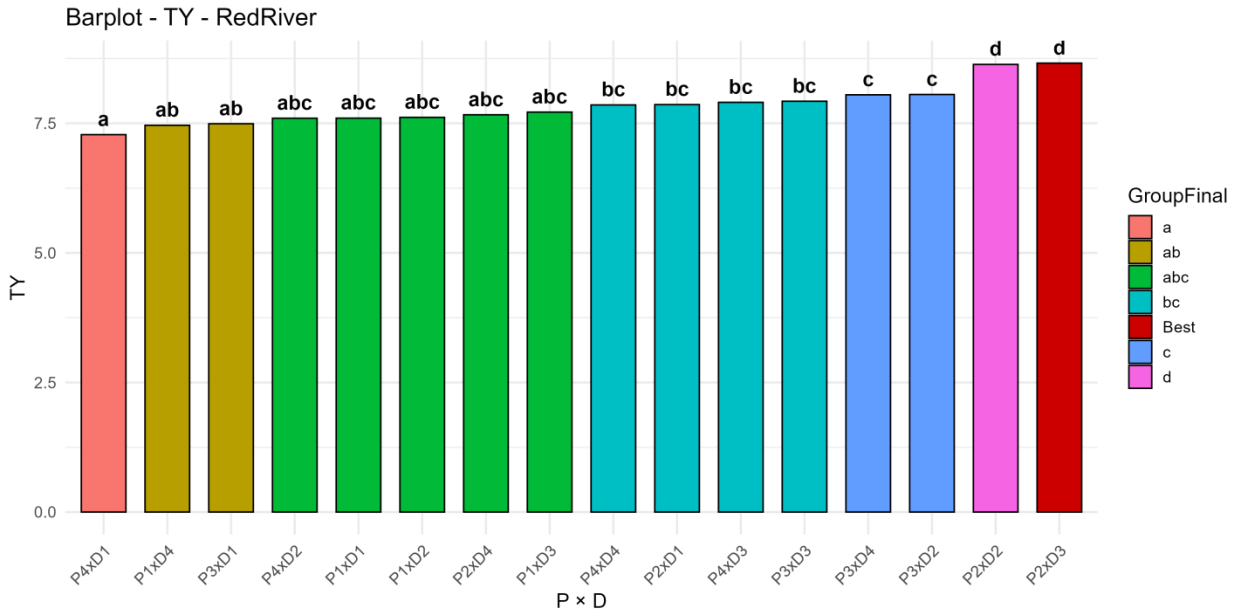

Fig. S21. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on the theoretical yield (TY, tons/ha) of black glutinous rice (ĐH8) in the Red River Delta Region. Treatments with different letters are significantly different at $p < 0.05$.

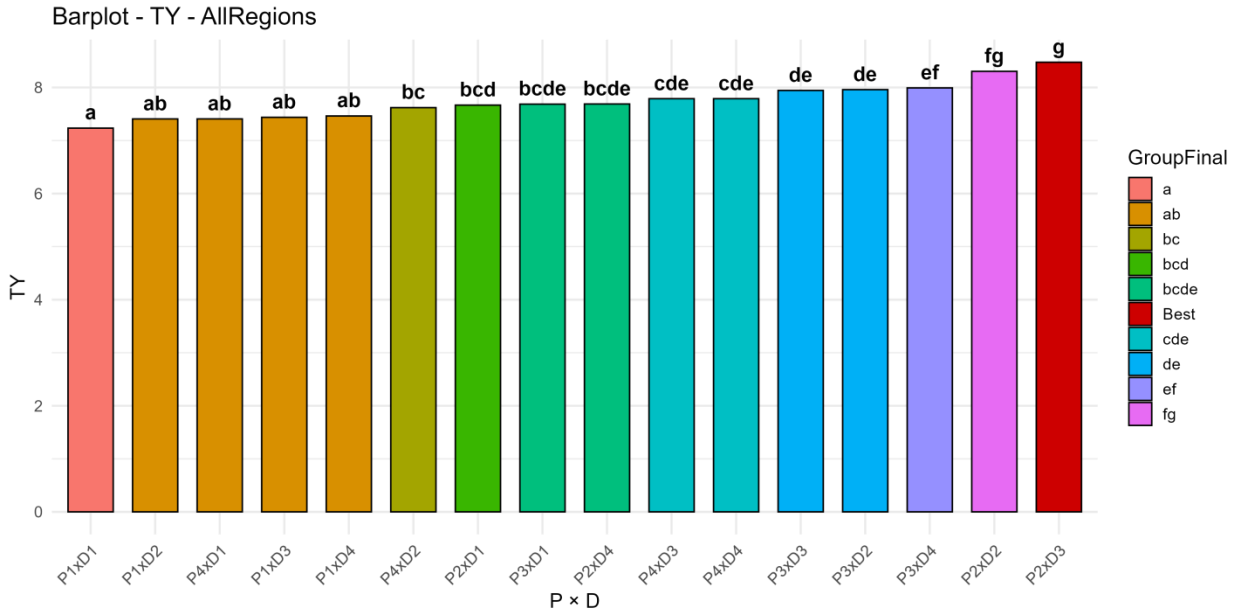

Fig. S22. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on the theoretical yield (TY, tons/ha) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

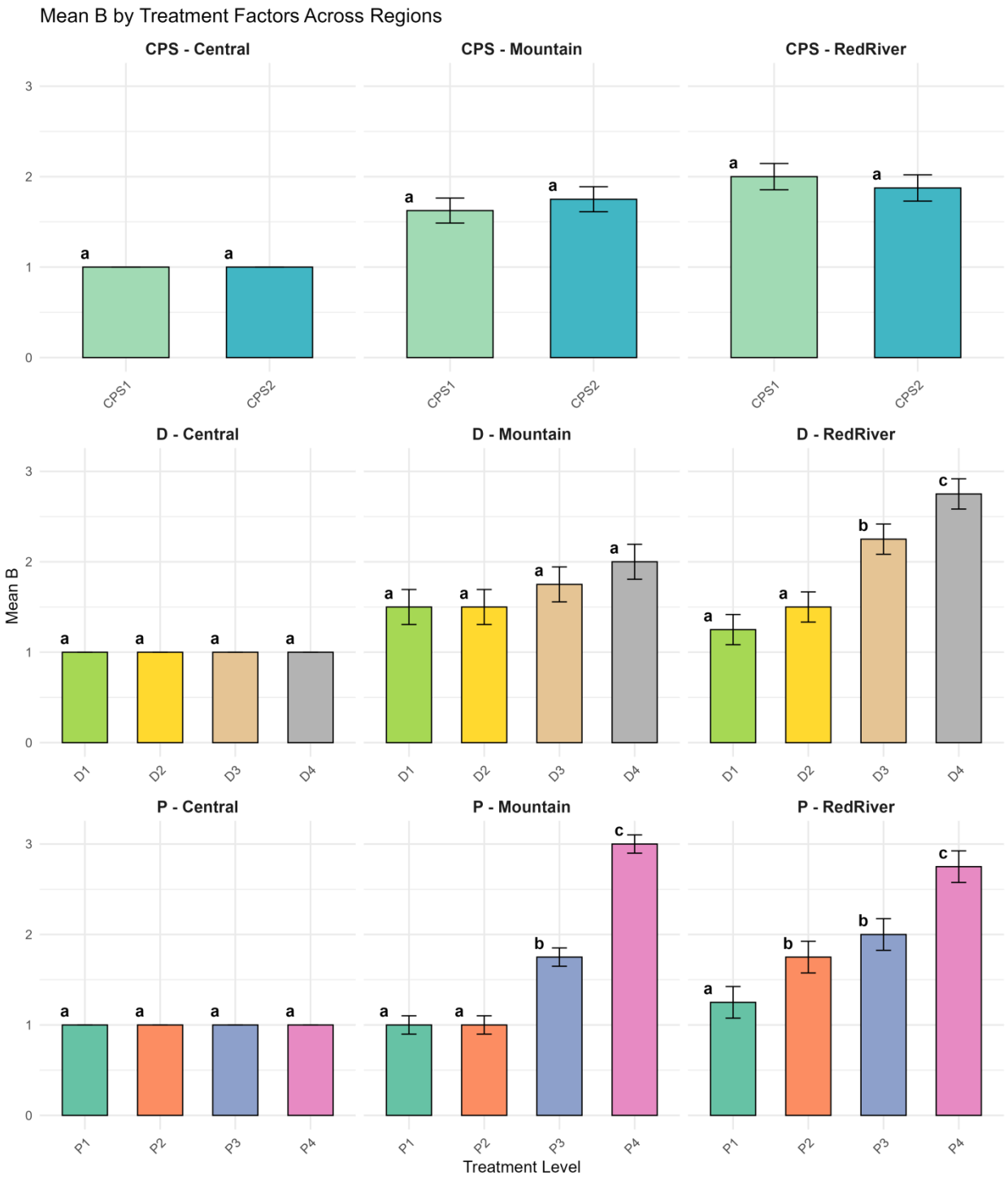

Fig.S 23. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on blast disease (B) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

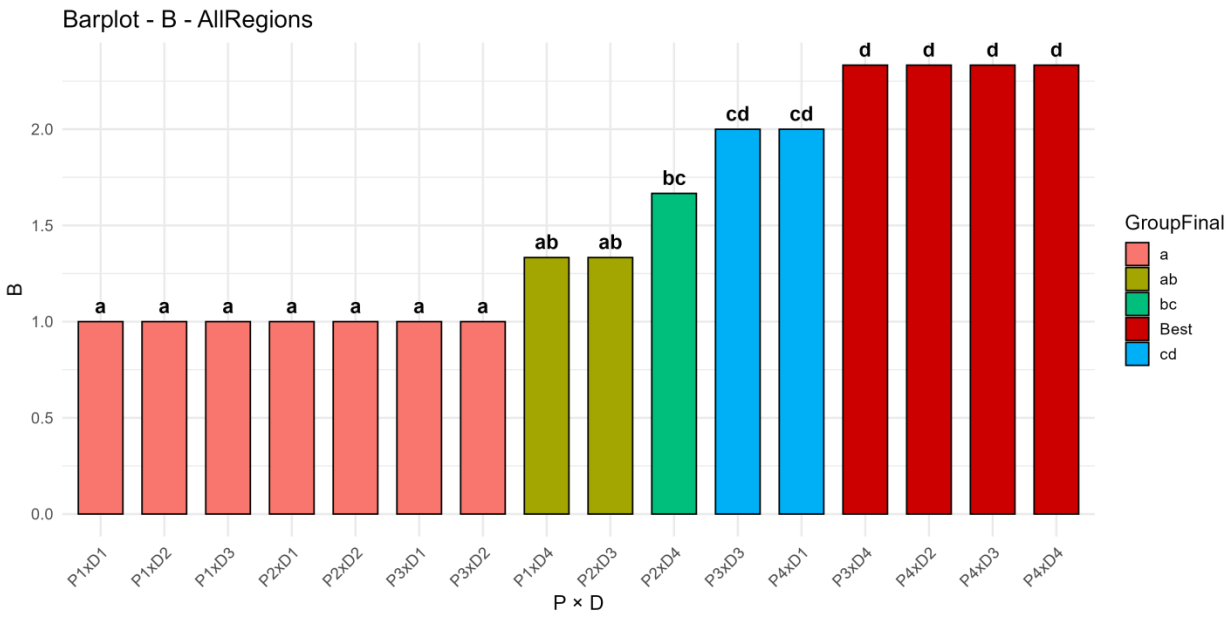

Fig. S24. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on the blast disease (B) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

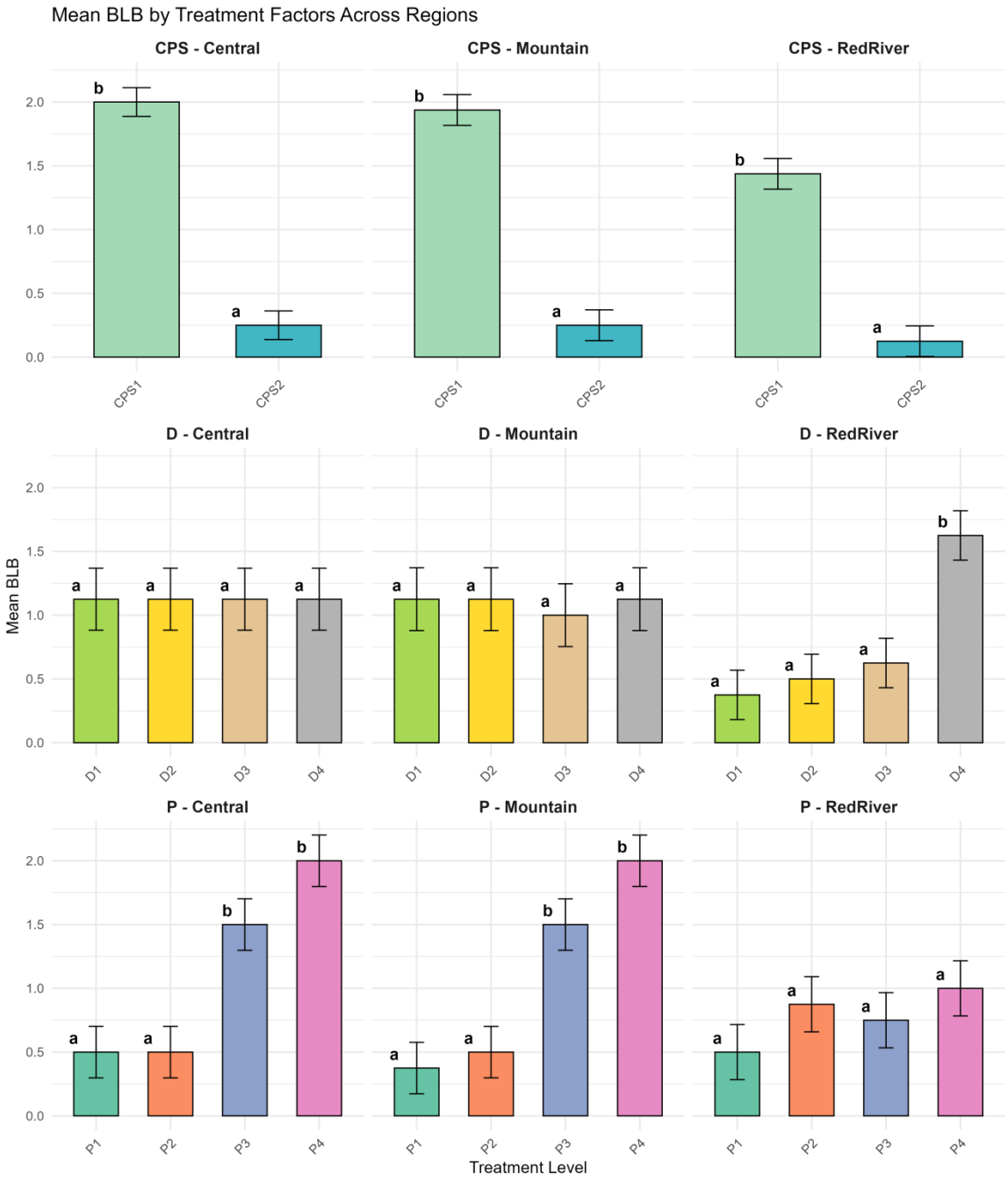

Fig. S25. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on bacterial leaf blight disease (BLB) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

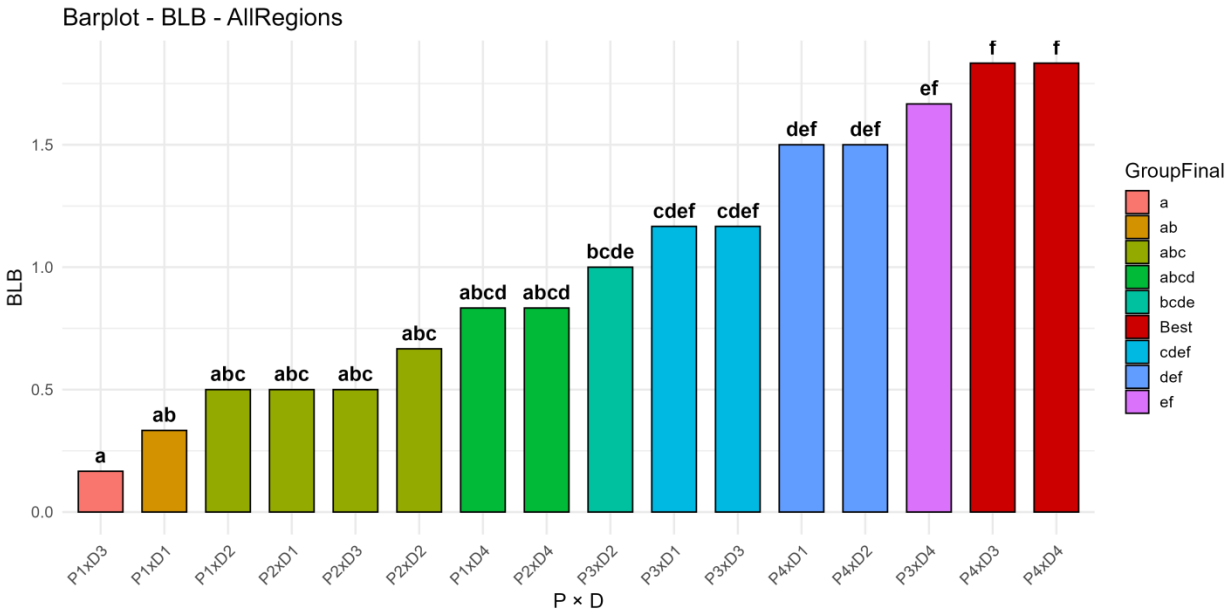

Fig. S26. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on bacterial leaf blight disease (BLB) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

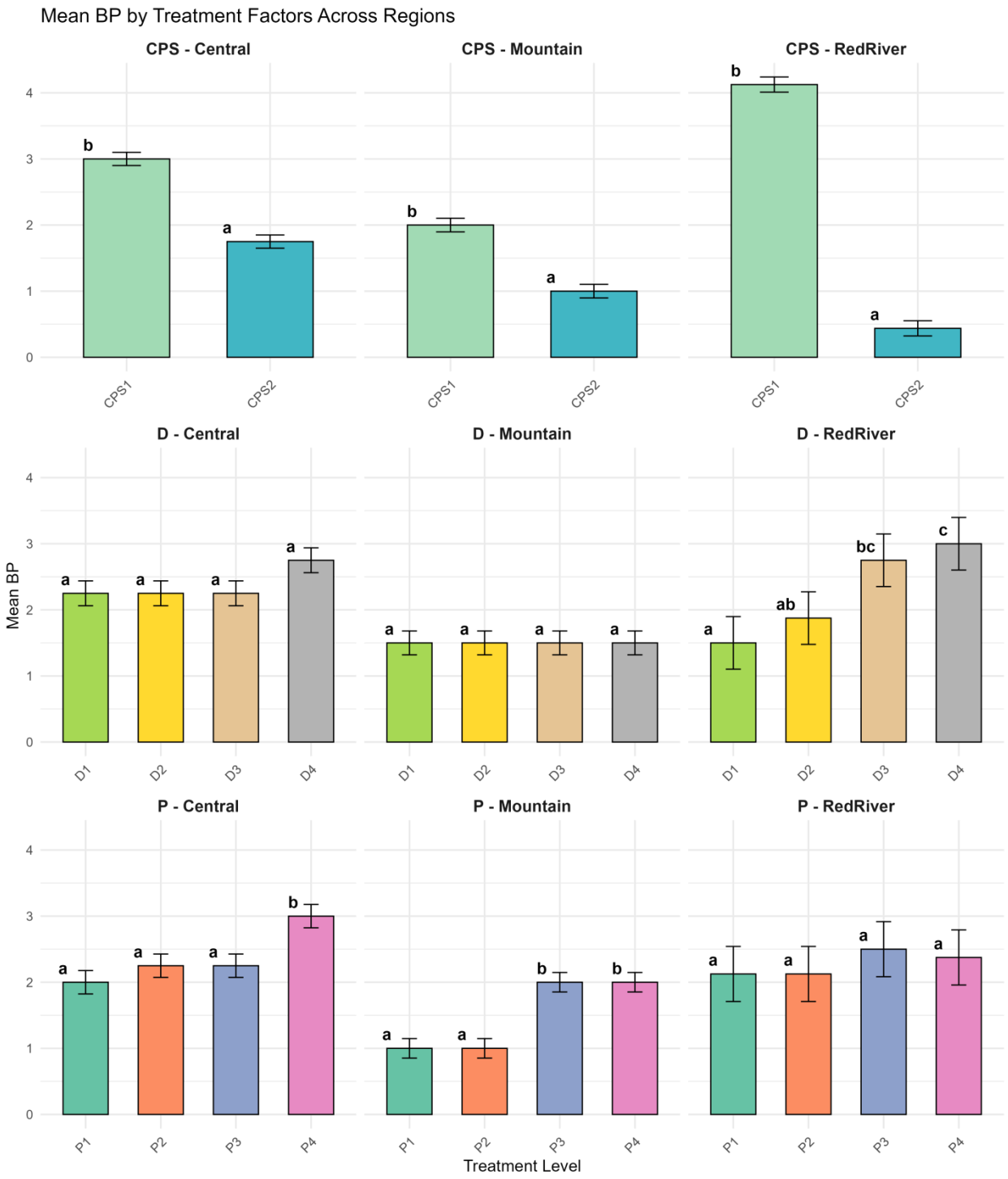

Fig. S27. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on brown plant hopper (BP) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

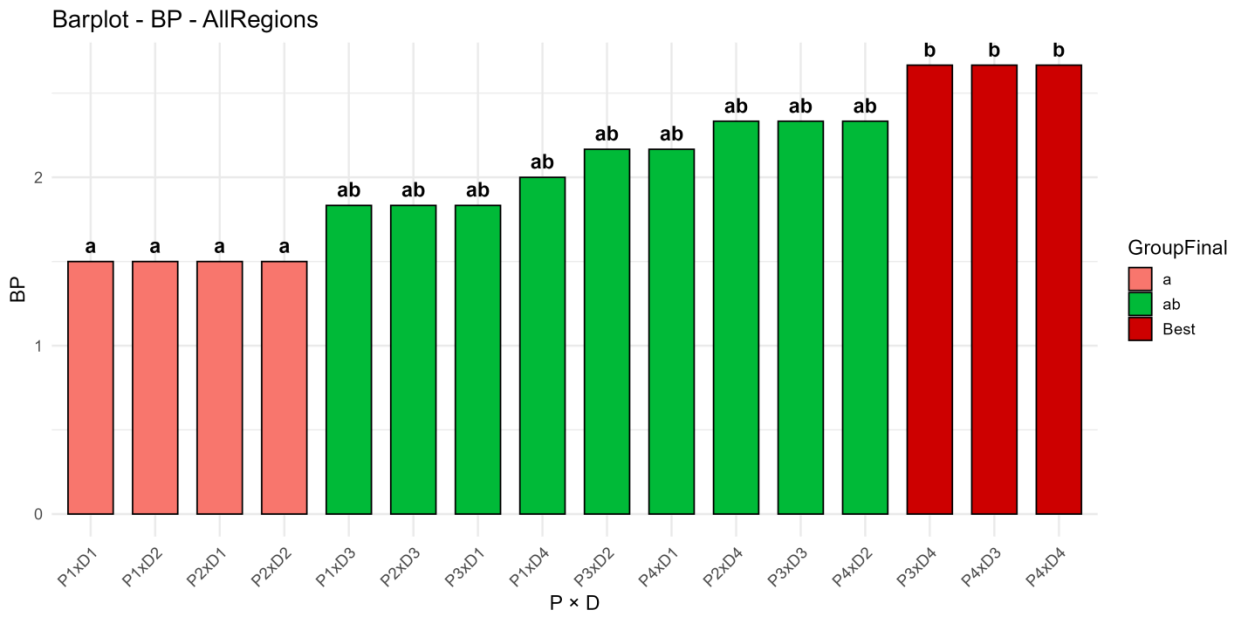

Fig. S28. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) brown plant hopper (BP) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

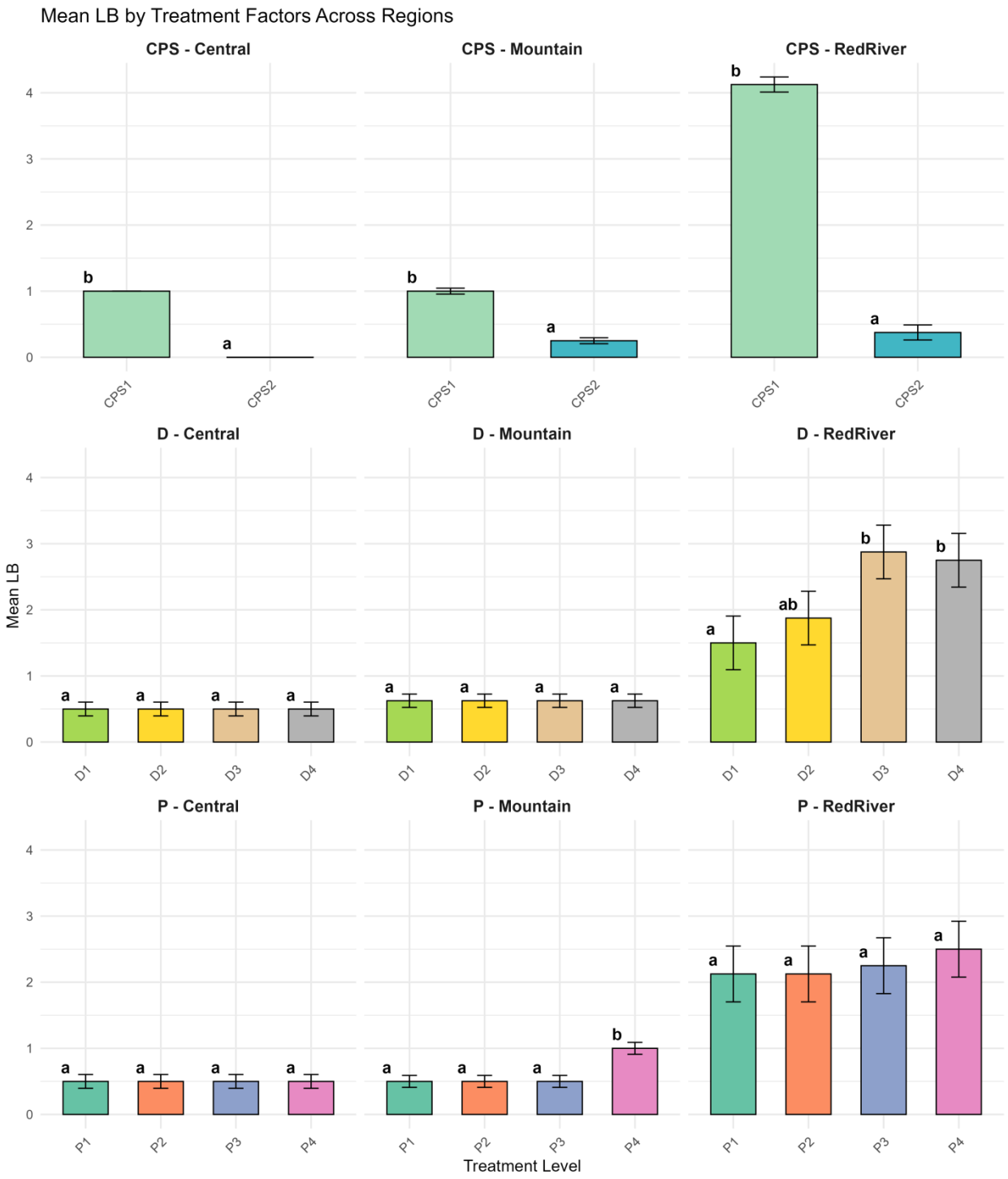

Fig. S29. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on leaf folder (LB) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

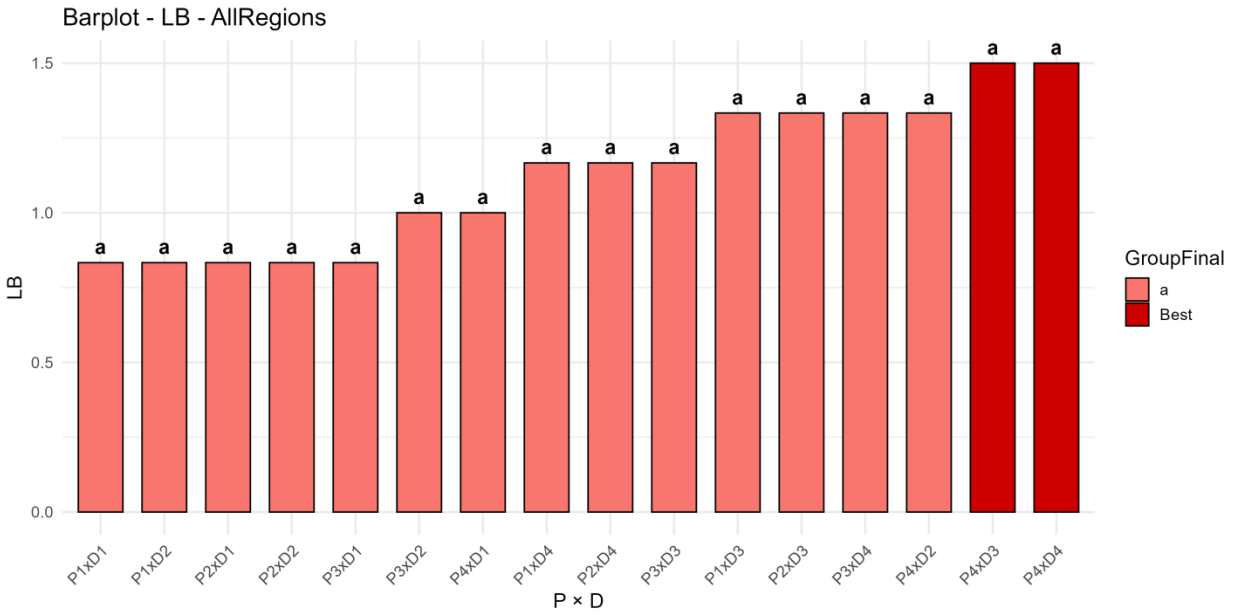

Fig. S30. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on the leaf folder (LB) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

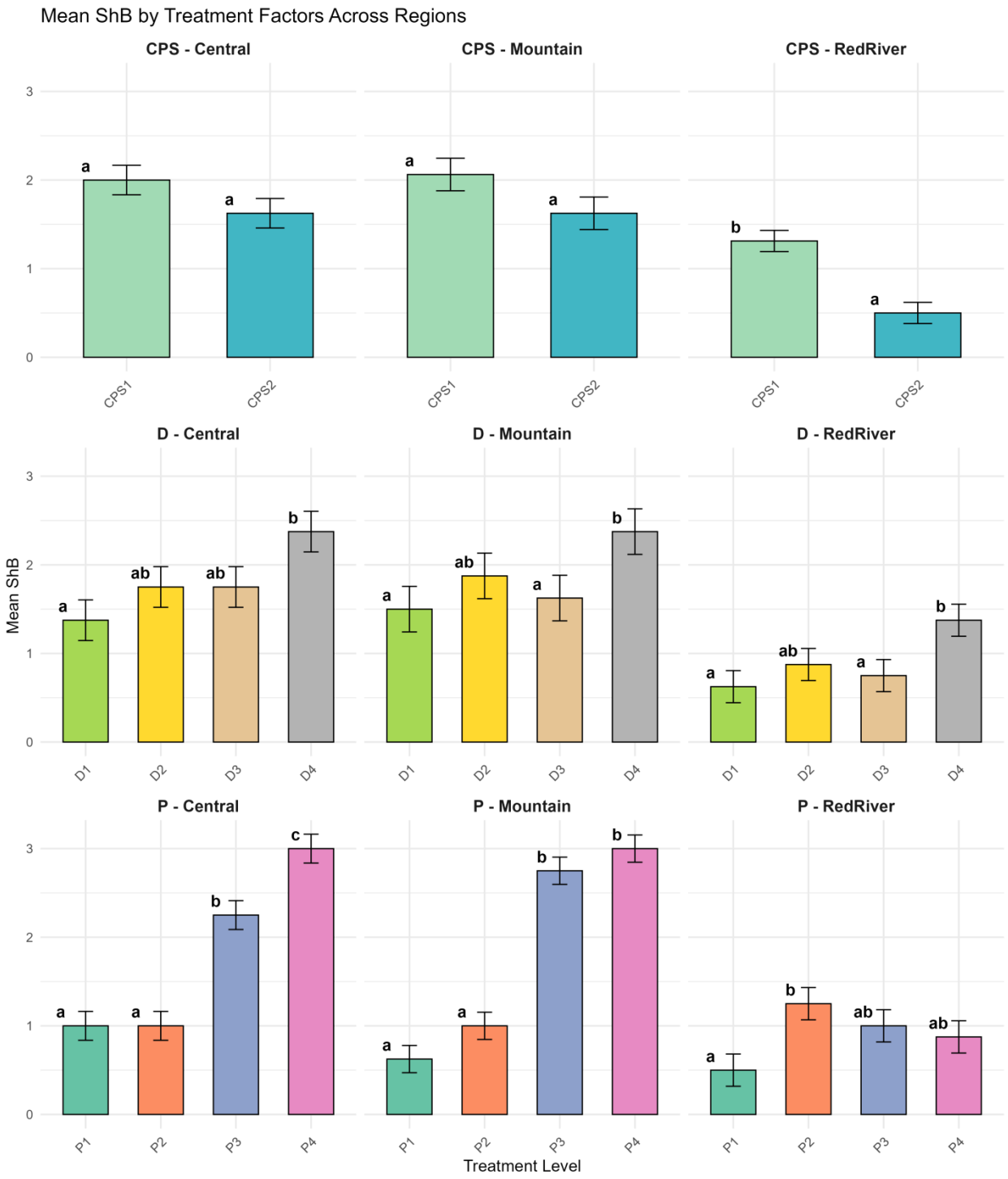

Fig. S31. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on the sheath blight disease (ShB) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

Sheath blight

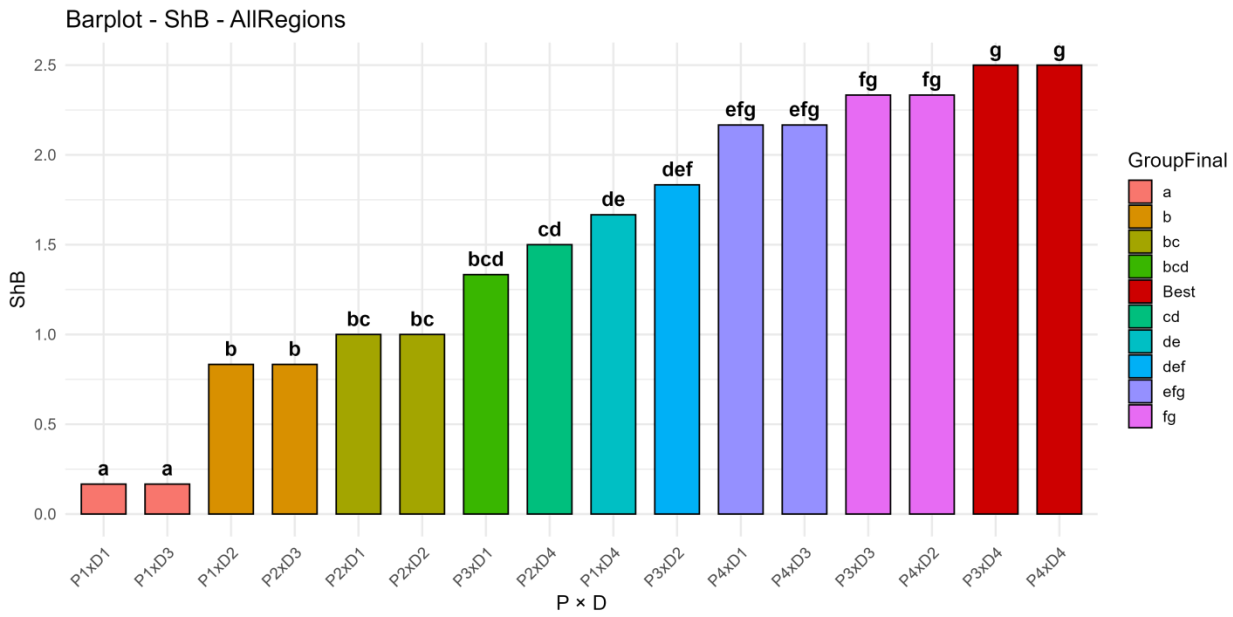

Fig. S32. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on the sheath blight disease (ShB)) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.

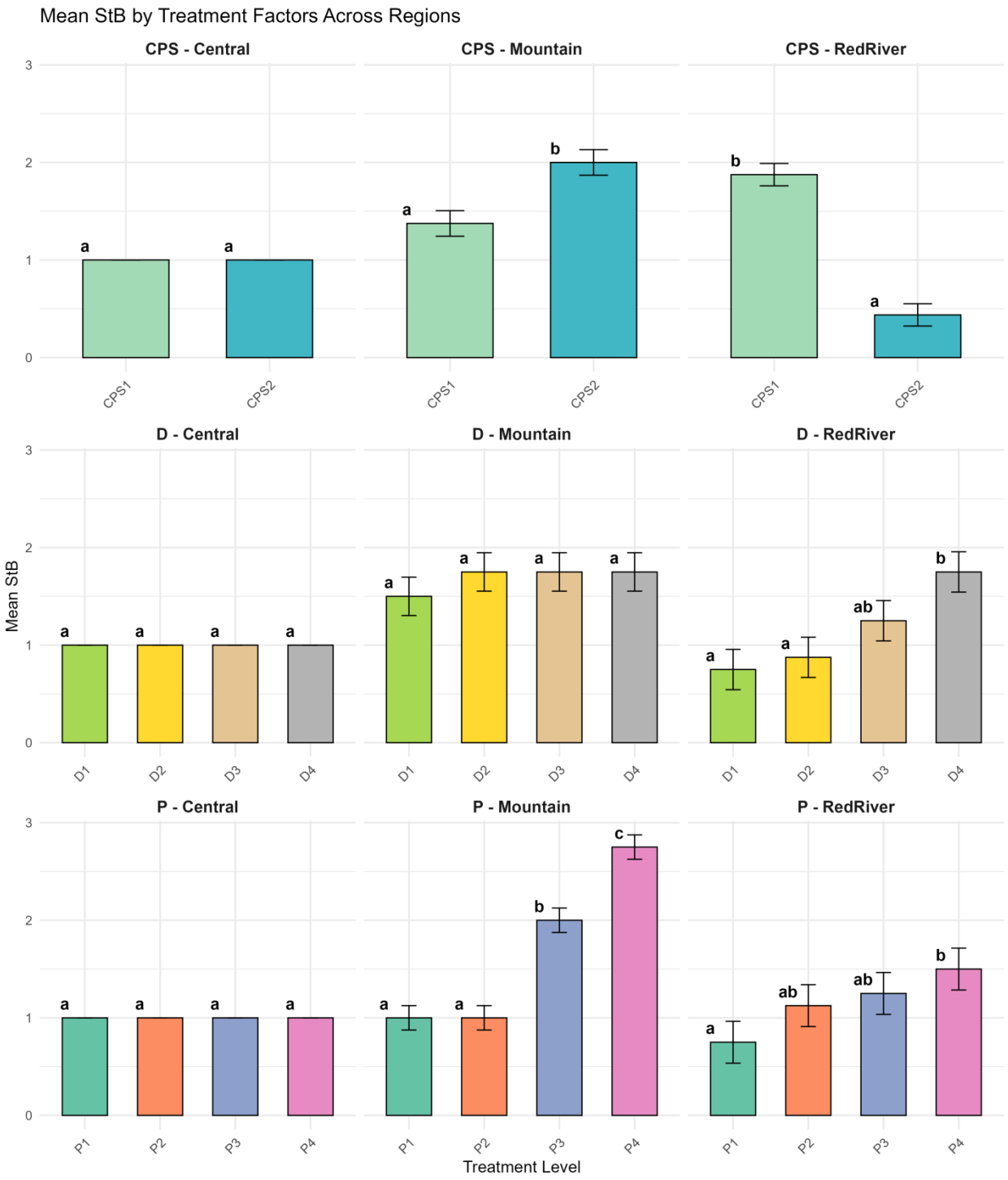

Fig. S33. Effects of cropping season (CS), plant density (D), and fertilizer dose (P) on the stem borer (StB) of black glutinous rice (ĐH8). Treatments with different letters are significantly different at $p < 0.05$.

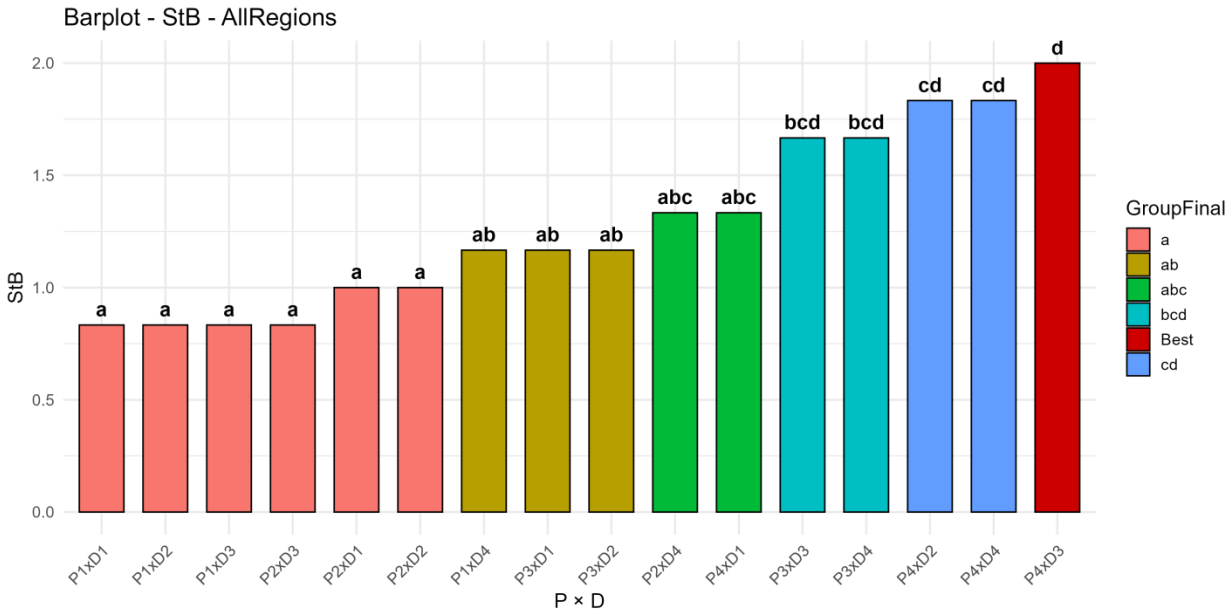

Fig. S34. Interaction effects of plant density (D) and fertilizer dose (P) (P × D) on the stem borer (StB) of black glutinous rice (ĐH8) across all regions. Treatments with different letters are significantly different at $p < 0.05$.