

Identification of the Competitive Relationship between Aggressive Plant *Humulus japonicus* and Perennial Native Plants

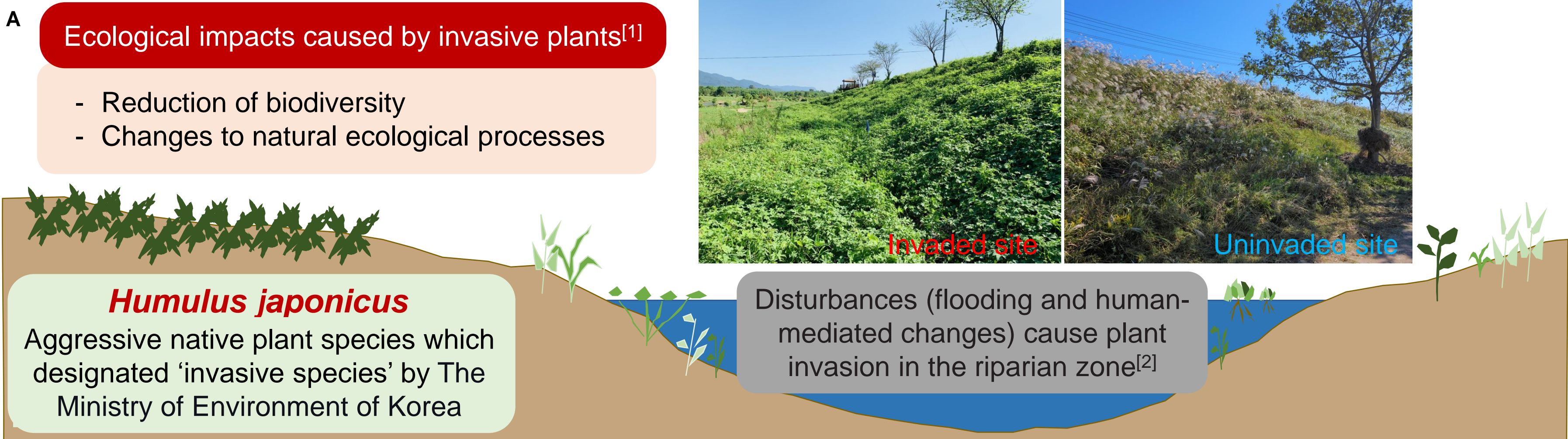
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Introduction



Research background – fundamental research

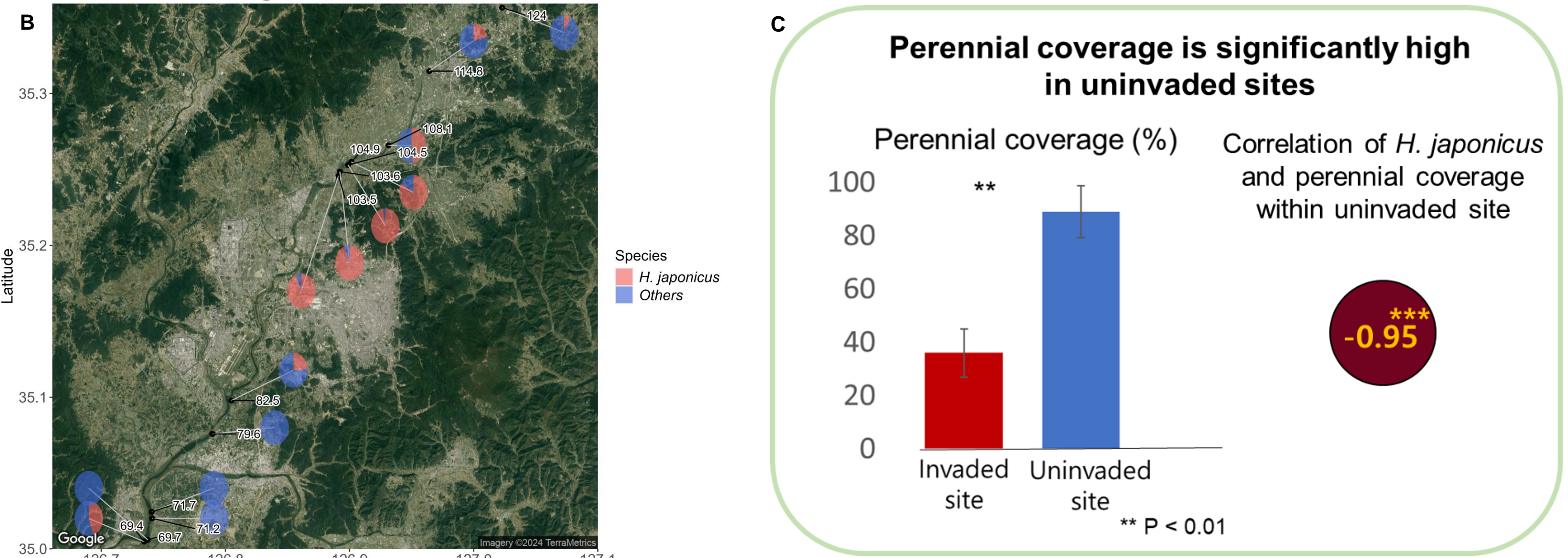


Figure 1 (A) Basic information of *H. japonicus* invasion in riparian zone. (B) The coverage of *H. japonicus* and other plant species in the Youngsan-gang River in Korea. (C) Results of perennial plant coverage between invaded and uninvaded sites.

Research hypothesis

Based on these results, it is expected that perennial native plants will be able to create an ecological barrier to the settlement of *H. japonicus*, so a competition experiment with perennial native plants was conducted.

- (1) Does the *H. japonicus* have a **competitive effect** on the competition with perennial native plants?
- (2) Does the *H. japonicus* have a **competitive response** to the competition with perennial native plants?
- (3) Is there a **priority effect** applied to the competition between *H. japonicus* and perennial native plants?

Keywords *Humulus japonicus*, Invasive plant, perennial native plants, plant competition and competitive ability

Conclusion

In this study, *H. japonicus* negatively affects the growth of perennial native plants. This result shows that *H. japonicus*, which appears widely after disturbances such as riverbank construction, can interrupt the growth of perennial native plants living around the invasive plant. The results of this study revealed the negative effect of *H. japonicus*, which are recently considered plants requiring management, and showed that some perennial native plants may interfere with the settlement of *H. japonicus*. For the sustainable stability of the river plant ecosystem, it is necessary to suggest an ecological control plan that can prevent the appearance of aggressive plant *H. japonicus* and our results can be used as basic information for the biological control of *H. japonicus*.

Acknowledgement

This work was supported by the National Research Foundation of Korea (NRF- 2021R111A2047635) and the GIST Research Project grant funded by the GIST in 2024 (K16840).

References

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- [3] The Ministry of Environment of Korea. (2011). Technical Guidelines for Ecological River Restoration. In Korean.

Materials and Methods

1. Experimental Species



Figure 2 Plant species used in the research. (A) *Humulus japonicus* and three riverside native perennial species were used. (B) *Miscanthus sacchariflorus* showed high coverage in areas where *H. japonicus* did not appear (in the fundamental research). (C) *Aster yomena* and (D) *Pennisetum alopecuroides* are riverside native perennial plants suggested in the technical guidelines for ecological river restoration^[3].

2. Experimental Methods

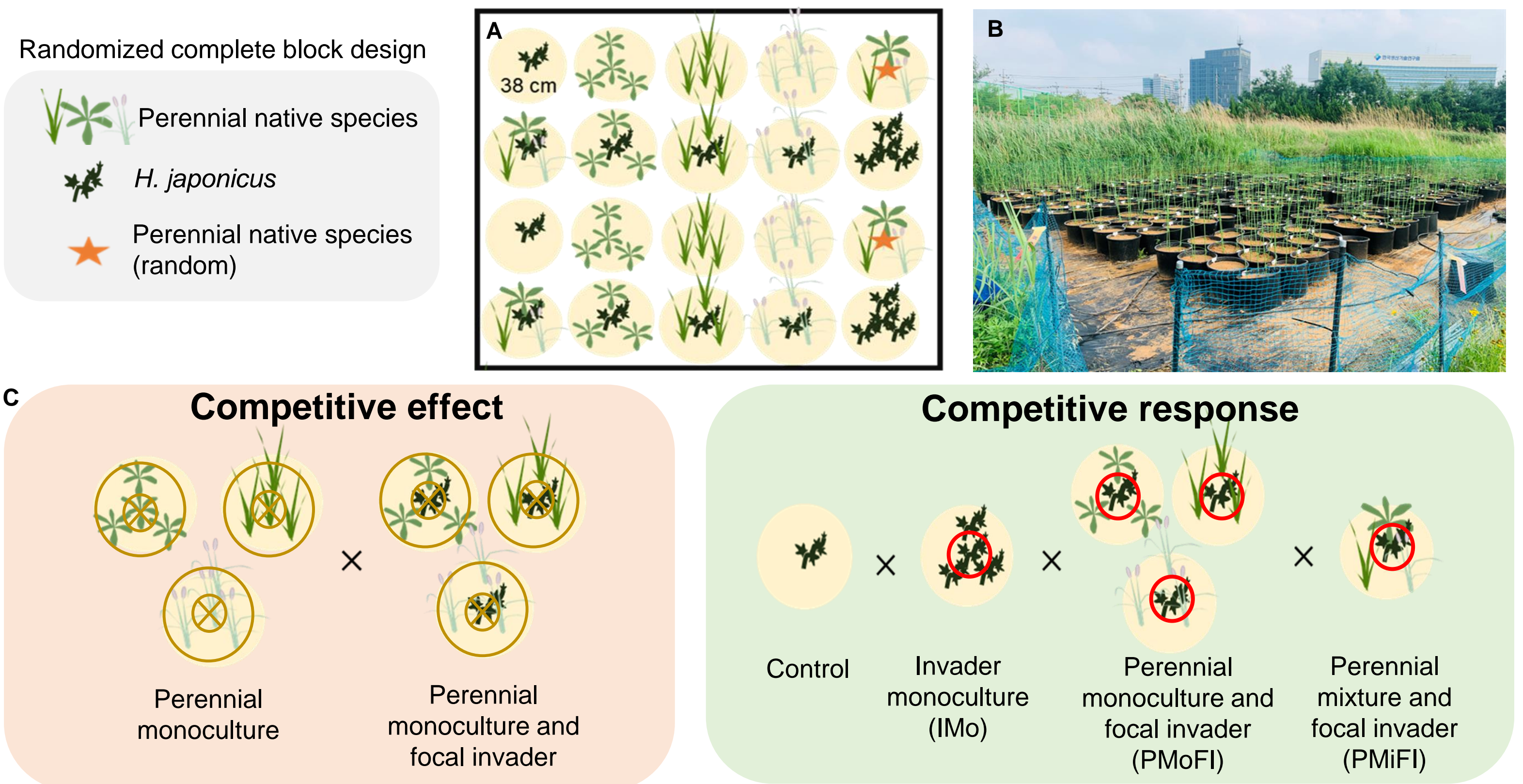


Figure 3 Experimental design. (A) A total of 15 replicate plots were used, in which one plot included two replicates. (B) The experimental site was constructed on an open field in GIST. The same grain size of soil as a natural riverbank was used. (C) The competition experiment was conducted based on hypothesis.

3. Collected data

- **Two-year common garden experiment**
 - In the first year, *H. japonicus* and perennial native plants were introduced and grown together.
 - The following year, *H. japonicus* was introduced after the perennial plants had already been established.
- **Measured functional traits**
 - Both *H. japonicus* and perennial native plants: leaf number, shoot length, specific leaf area, shoot drymass
 - Only *H. japonicus*: survival rate, root drymass, total biomass, R/S ratio

4. Statistical analysis

- Analysis of variance (ANOVA): the 'lme4' package and the 'car' package were utilized to analyze the functional traits between competitions
- Fisher test: the 'rstatix' package was utilized to analyze the survival between competitions
- All statistical analyses were performed using R 4.3.2 (R Foundation for Statistical Computing, Vienna, Austria)

Results and Discussion

◆ *H. japonicus* negatively affects perennial native plants.

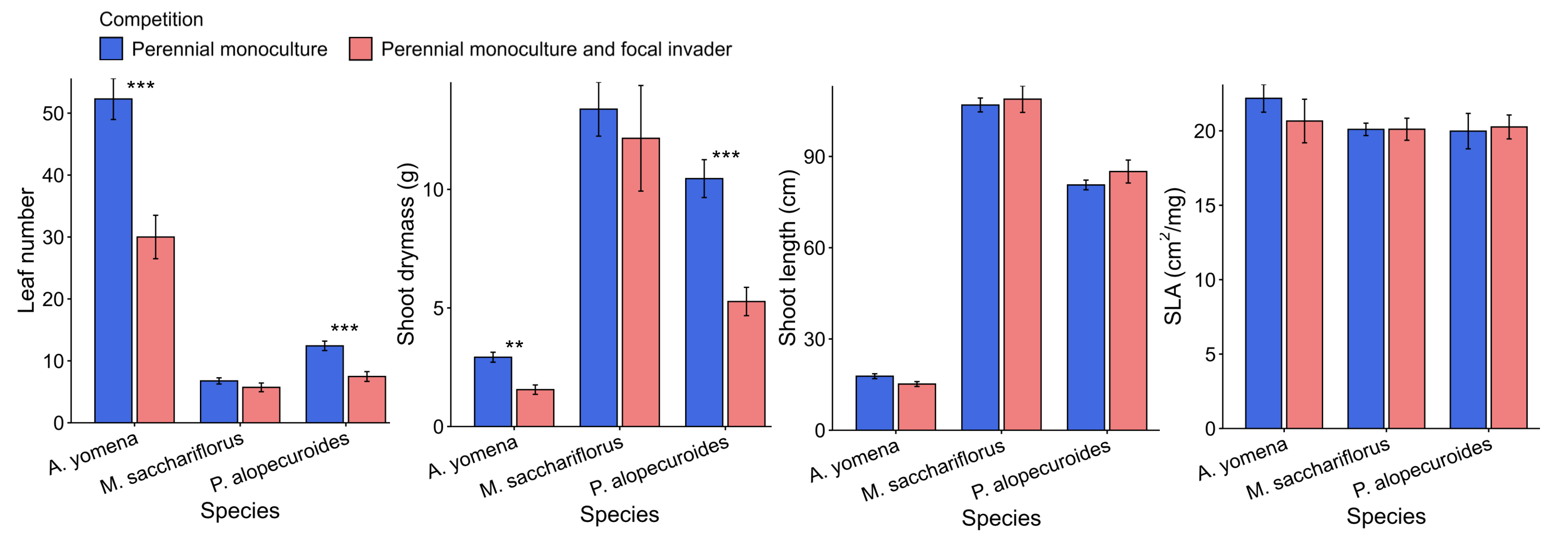


Figure 4 The competitive effects of *H. japonicus* on perennial native plants. *** $P < 0.001$, ** $P < 0.01$

◆ *H. japonicus* was influenced by intraspecific competition when competing with perennial native plants.

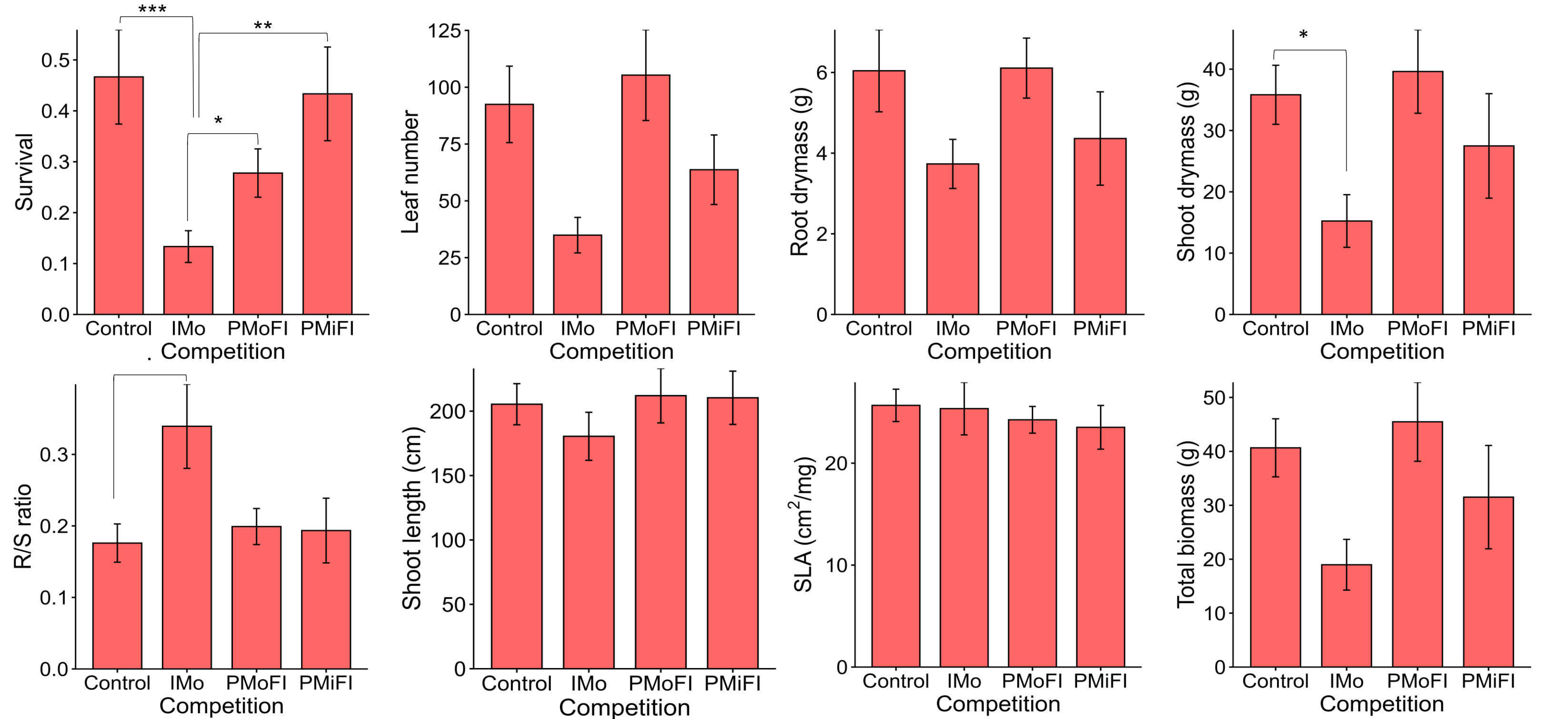


Figure 5 The competitive responses of *H. japonicus* to perennial native plants. * $P < 0.05$, . $P < 0.1$

◆ As a result of the priority effect, the survival rate of *H. japonicus* is reduced due to the influence of interspecific competition.

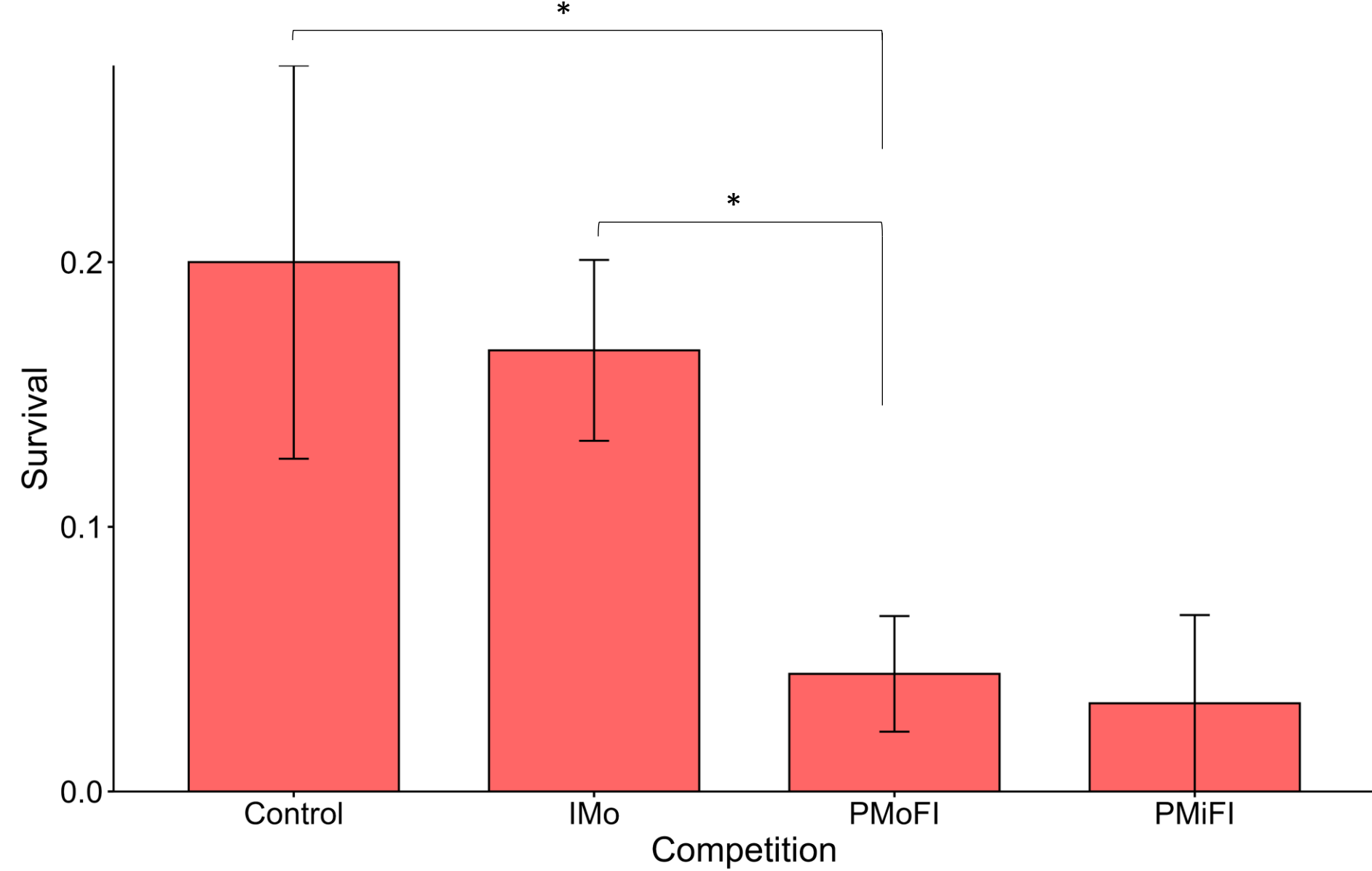


Figure 6 Priority effect on *H. japonicus* survival. * $P < 0.05$