

PA-96

The Effects of Water Level and Temperature on Seed Germination and Early Seedling Development of Rice (*Oryza sativa* L.)

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[Abstract]

The application of direct seeding cultivation reduces time, labor, and cost. However, this application often has poor seedling establishment and leads to lower yield as compared to transplanting system. The tolerance to anaerobic and low temperature germination is important to improve seedling establishment and the wide-spread application of direct seeding method. This study was carried out to evaluate the responses of three japonica cultivars to different temperatures (15°C, 18°C, 21°C, 24°C, and 27°C) and different flooding levels (1 cm, 4 cm, 7 cm, 10 cm) during germination and seedling development. The mean survival percentage significantly increased ($P < 0.05$) when the flooding level decreased and when temperature increased. There were significant effects of the interaction between temperature and water depth on survival percentage and seedling height. When temperature decreased from 27°C to 15°C, the germination duration significantly increased from 6.4 days to 16.3 days while the germination speed, survival percentage, and seedling height decreased from 5.3 seeds day⁻¹, 61.9% and 190.6 cm to 2.2 seeds day⁻¹, 33.2%, and 47 cm, respectively. The increase in temperature under submergence condition was associated with the increased expression of *Amy3D* and *ALDH2a* but the decreased expression of *ADH1* and *PDC1*. The results of this research would be used for further studies and breeding programs to improve rice seedling establishment and the application of direct seeding cultivation.

[Acknowledgement]

This work was supported by a grant (project number: PJ01488603) New agricultural climate change response system establishment project and “2022 KoRAA Long-term Training Program” of Rural Development Administration, Rural Development Administration (RDA), Republic of Korea.

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