学位論文の要旨
Abstract of Thesis

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学位論文題目 Title of Thesis（学位論文題目が英語の場合は和訳を付記）

Studies on flowering control of *Eustoma grandiflorum* seedling raised under high temperatures by using re–drying storage of cold imbibed seed and intermittent low temperature storage
湿潤低温処理種子の再乾燥貯蔵と間欠冷蔵処理による高温下で育苗したトルコギキョウの開花制御に関する研究

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Eustoma grandiflorum seedling easily forms rosette and semi–rosette following exposure to high temperatures. This physiological trait leads to the failure of the subsequent production of cut *Eustoma* flower in the winter and the following spring. Cold imbibition of *Eustoma* seed for 4 to 5 weeks before sowing has been widely used to prevent rosetting of seedling raised in the summer. In order to facilitate the handling of cold imbibed seeds, re–drying treatment is an essential technique. Moreover, in the southwestern region in Japan, seedlings are raised using air conditioner systems during high temperatures because cold imbibition of seed in high–rosetting cultivars cannot prevent completely rosettes and semi–rosettes. Growers require cheaper methods alternative to air conditioning systems. In the present study, re–drying storage of cold imbibed seed and intermittent low temperature storage were investigated to improve the growth and flowering of seedling raised under high temperatures.

In the first study, the conditions of re–drying and storage for cold imbibed *Eustoma* seeds which has been raised under high temperatures were investigated. ‘Exe Lavender’ seed was imbibed at 10°C for 21, 28, 35, or 42 days in the dark, and then was re–dried and stored at 10°C for 30 days. The germination rate decreased significantly after 42–day of cold imbibition and following storage. This result could relate to the increasing of radicle protrusion that was observed 1–19% after respective 28–42 days of cold imbibition. To investigate effect of storage temperature, ‘Exe Lavender’ seed was imbibed at 10°C for 35 days in the dark, re–dried and stored at 2, 10, 20, 30 and 40°C for 30 days. Storage temperatures did not affect germination rate, bolting rate and flowering rate. It is therefore suggested that high storage temperatures did not influence the growth improvement of ‘Exe Lavender’ achieved from cold–imbibition treatment. Besides, ‘Exe Lavender’ seed viability did not lose after 35 days of cold imbibition and 180 days of cold storage, however, days until 50% germination was longer than those stored for the shorter periods. Cold effect obtained from cold–imbibition treatment was maintained after 180 days of storage to improve percentages of bolting and flowering of ‘Exe Lavender’ raised under high temperatures. Investigation the responses of other *Eustoma* cultivars to cold–imbibition treatment and following 30–day of cold storage resulted that cultivars ‘Exe Lavender’, ‘Orb Snow’, ‘Dure Lavender’ and ‘Philia Lavender’ could retain their seed longevity but ‘Exe Light Pink’ showed negative

result. The bolting rate of ‘Exe Light Pink’, ‘Philia Lavender’ and the flowering rate of ‘Philia Lavender’ decreased when 30–day storage treatment was applied.

In the second study, the relationship between water potential of cold treatment and seed radicle protrusion for ‘Exe Lavender’ seed was investigated. The further objective was to investigate the germination and growth responses to high temperatures of cold–imbibed seed at different water potential by PEG–6000 (Polyethylene glycol 6000) and following a long storage period. Whereas in water (0 MPa) treatment, germination rate of ‘Exe Lavender’ seed after re–drying decreased by 13%, it was not influenced by PEG treatments at –0.75 MPa and –1.5 MPa. Different water potential did not affect the bolting rate, bolting node, flowering rate and the number of nodes to the first flower of re–dried ‘Exe Lavender’ seed. To investigate effect of imbibed duration, ‘Exe Lavender’ seed was imbibed at 10°C with 0 MPa and –1.5 MPa in the dark for 28, 35, 42, 49 and 56 days. A close–up view of the seed after the end of 0 MPa resulted when the duration increased from 28 to 56 days, the percentage of radicle protrusion increased and the re–dried seed germination rate decreased. However, in PEG–treatment, there was no seed protruding radicle and the re–dried seed germination rate was maintained. Moreover, cold PEG–treatment enhanced the seed longevity after 360–day of following storage at 10°C. A reduction of seed germination was found from 30–day to 360–day of storage in water treatment. Rosetting of ‘Exe Lavender’ seedling could be prevented under high temperatures even after a long term of storage in both water and PEG treatments.

In the third study, intermittent low temperature storage (ILTS), in which plants are repeatedly transferred between a refrigerator (low temperature) and ambient conditions (high temperature) was investigated its cold–storage duration and length of ILTS cycles. Seeds were subjected to imbibition at 10°C for 35 days before were entered to ILTS. Only half of the plants of ‘Exe Lavender’ and ‘Nancy’ grown from cold–imbibed seeds without ILTS treatment flowered up to December 20. For those who desire to harvest cut high–rosetting cultivars for the demand of New year holidays, the seedlings should have ILTS treatment with 24 days or longer cold exposure duration. Starting cold exposure of ILTS after 3 days of sowing showed that using ILTS cycle 15D/15D × 2 not only improved bolting and flowering for *Eustoma* but also saved labors than using other ILTS cycles, 6D/6D × 5 and 3D/3D × 10.

In the fourth study, to improve the growth quality and cut flower quality of stored seed in ‘Exe Lavender’, ILTS was investigated with the cycle 15D/15D × 2. After 35 days of cold imbibition, ‘Exe Lavender’ seed was re–dried and stored for 0, 30 and 180 days at 10°C. The stored seed subjected to ILTS was exposed to low temperatures for 30 days and to high temperatures for 33 days. Without using ILTS, plant grown from 180–day stored seed delayed time to bolting, flowering and also decreased flowering rate compared with that grown from non–stored seed. Applying ILTS for 180–day stored seed improved the bolting rate, flowering rate and cut flower length of ‘Exe Lavender’.

In conclusion, *Eustoma* seeds were able to be re-dried and stored after several weeks of cold imbibition. The germination rate, bolting rate and flowering rate of some cultivars did not change after re–drying storage and growing under high temperatures. ‘Exe Lavender’ seed could retain the seed longevity for one year when PEG–treatment was applied instead of water–treatment during the seed cold–imbibition. Moreover, ILTS is recommended for cultivating re–dried and stored *Eustoma* seeds to achieve early harvesting.