Preliminary Study on the Optimization of the Heavy-ion Dose for Mutation Breeding in Three *Lilium* Species

Jinrong Bai[1,2], Ying Kong[1,2] , Lixin Lang[1,2], Fang Bao[1,2], and Xiaoying Dou[1,2]

[1]Beijing Radiation Center, Beijing, China, 100015

[2]Key Lab of Beam Technology and Material Modification of Ministry of Education, College of Nuclear Science and Technology, Beijing Normal University, Beijing, China,100875

bjr301@126.com

Introduction

Compared with traditional radiation such as X-rays and gamma rays, heavy-ion beam provides a higher linear energy transfer and stronger relative biological effectiveness. Heavy-ion beam technology is an excellent tool in mutation breeding. This approach has been applied in more than 20 ornamental plants including chrysanthemums, carnations, verbena, and torenia. Many novel mutations and varieties have thus been obtained.

Objectives

To optimize the heavy-ion dose for seeds of three *Lilium* species.

Meterials and Methods

- Dry seeds from three *Lilium* species (*L. cernuum*, *L. amabile*, *L. leichtlinii* var. *maximowiczii* were used for this study. The seeds were laid flat in cell culture dishes (35mm×10mm, Corning, NY, USA), were irradiated with $^{12}C^{6+}$ heavy-ions at doses of 0 (control), 10, 20, 30, 40, 50 and 100 Gy at the Heavy Ion Research Facility in Lanzhou (HIRFL), Institute of Modern Physics, Chinese Academy of Sciences.
- The irradiated and control seeds were soaked in water 24h, had the wings of the seed cut off and then inoculated on the germination medium (MS + 20 g/L sugar + 9 g/L agar). Germination rates and survival data (initiate after 30 days) were recorded every 10 days for 3 months after treatment.

Species	CK	10Gy	20Gy	30Gy	40Gy	50Gy	100Gy
L. leichtlinii var. *maximowiczii*	80	4×20	4×20	4×20	4×20	4×20	2×20
L. cernuum	60	2×30	2×30	2×30	2×30	2×30	/
L. amabile	40	2×20	2×20	2×20	2×20	2×20	/

Table 1. Number of dry seeds of the *Lilium* species used for study

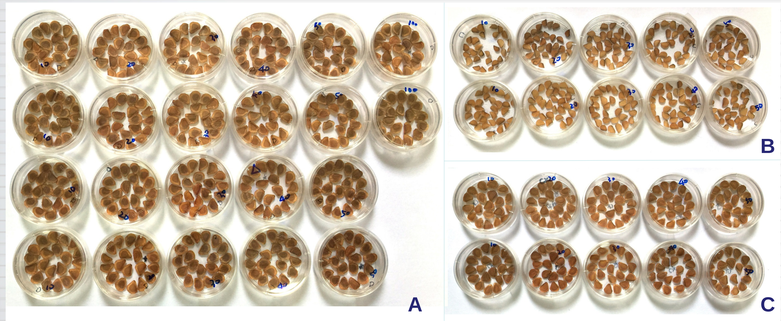


Figure 1. Dry seeds of three *Lilium* species used for this study. (A: *L. leichtlinii* var. *maximowiczii*, B: *L. cernuum*, C: *L. amabile*.)

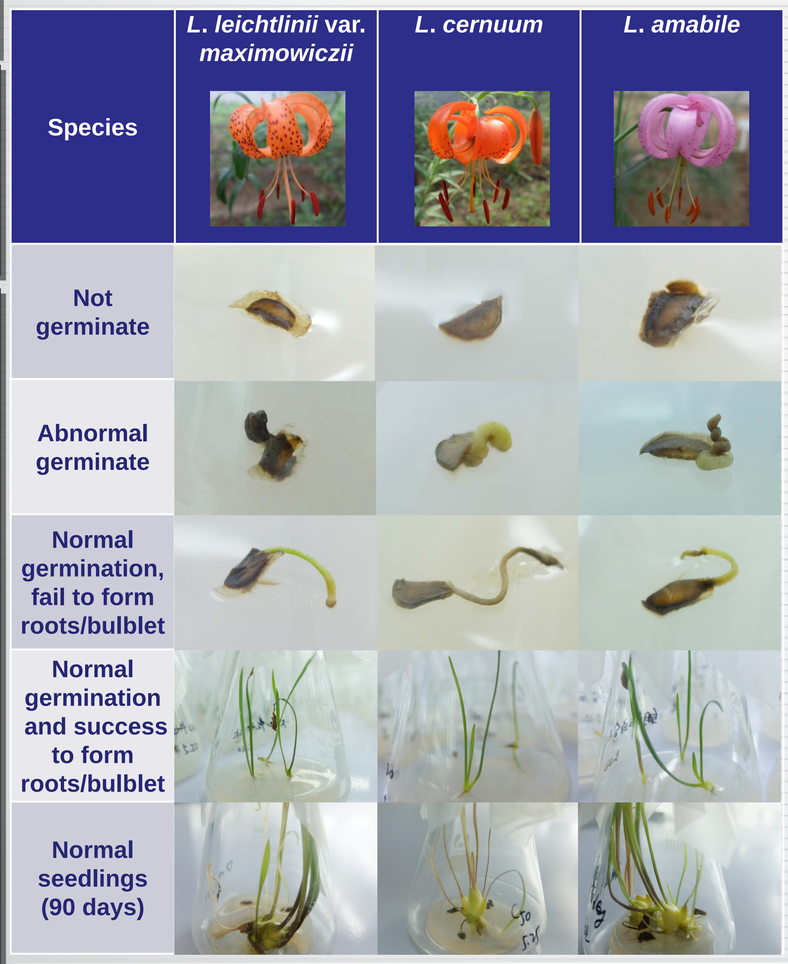
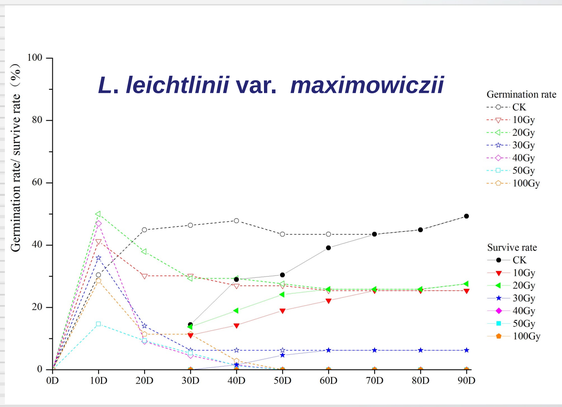
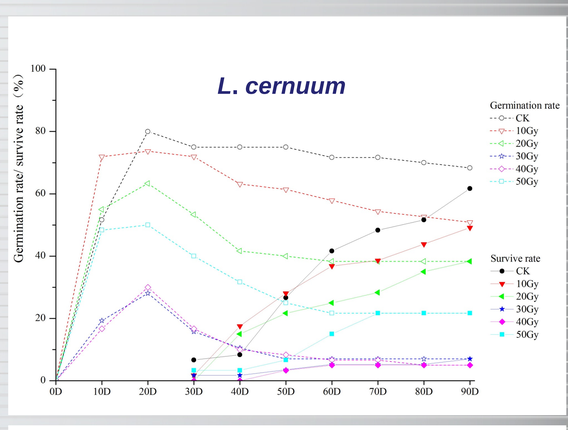
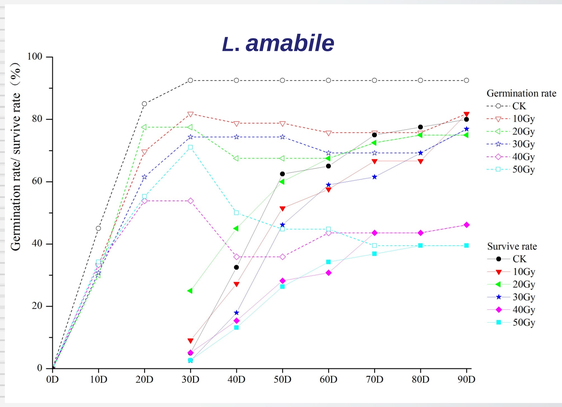


Figure 2. Four responses in the growth of irradiated seeds of three *Lilium* species as compared to normal seedlings.







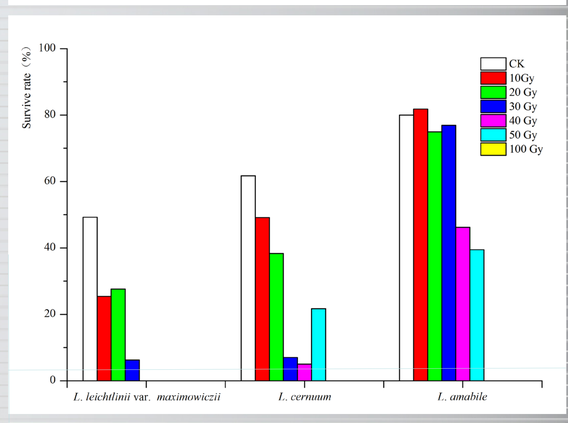


Figure 3. Germination rates and survival rates of irradiated seeds of three *Lilium* species.

Figure 4. Comparison of survival rates of three *Lilium* species after 90 days growth.

Results

- There were four responses in the growth of irradiated seeds: no germination, abnormal germination, normal germination without root/bulblet formation, and normal germination with successful formation of roots/bulblets.
- The germination rates of all irradiated seeds first rose but then fell because some irradiated seeds did not form roots.
- Generally speaking, the germination rates and survival rates decreased with increased radiation dose in *L. leichtlinii* var. *maximowiczii* and *L. amabile*. However, a saddle-shaped curve was observed in the *L. cernuum*.
- The species differed substantially in seed growth with the same radiation dose, which was likely caused by the differences in the thickness of the testa.

Conclusion

- It is suggested that the appropriate doses for mutation breeding are 10-20 Gy for *L. leichtlinii* var. *maximowiczii*, 20 and 50 Gy for *L. cernuum*, and 40-50 Gy for *L. amabile*.

Acknowledgments

- This work was supported by the Special Fund for Forestry Scientific Research in the Public Interest (201204609), the Program for Innovative Research Team in BJAST (IG201404N) and the BJAST Young Researcher Training Plan (201416).
- Thanks for attending the ASHS meeting supported by the Chinese Scholarship Council during I visit to Texas A&M University.
- I thank Professor David H Byrne and Ph D student Jeekin Lau in Department of Horticultural Sciences of Texas A&M University for reviewing the abstract.