**Table 3 Effect of $^{12}C^{6+}$ ion to the length of hypocotyl of lavender 701 and 702 ($n=3$)**

| Length of hypocotyl(cm) | CK | 40 | 100 | 160 | 240 | 300 |
|---|---|---|---|---|---|---|
| 701 | 0.90±0.09 | 1.18±0.23* | 1.30±0.23** | 0.90±0.18 | 0.52±0.23** | 0.56±0.21** |
| 702 | 1.20±0.16 | 1.05±0.08* | 1.03±0.25** | 1.03±0.13** | 0.65±0.13** | 0.69±0.27** |

* the difference of the length of hypocotyl of 701 or 702 was significant between CK and experimental group, $p<0.05$; ** expressed the difference of the length of hypocotyl of 701 or 702 was extremely significant between CK and experimental group, $p<0.01$.

**Table 4 Effect of $^{12}C^{6+}$ ion to the fresh weight of seedlings of lavender 701 and 702 ($n=3$)**

| Fresh weight of seedlings(mg) | CK | 40 | 100 | 160 | 240 | 300 |
|---|---|---|---|---|---|---|
| 701 | 65.00±4.08 | 78.25±2.22** | 100.50±3.51** | 92.00±4.97** | 153.00±19.63** | 32.00±2.16** |
| 702 | 93.75±3.59 | 118.00±7.83** | 87.50±0.58* | 60.00±0.82** | 33.00±4.24** | 21.67±2.51** |

* the difference of the fresh weight of seedlings of 701 or 702 was significant between CK and experimental group, $p<0.05$; ** expressed the difference of the fresh weight of seedlings of 701 or 702 was extremely significant between CK and experimental group, $p<0.01$.

# 3 - 49 Effect of Carbon Ion Irradiation on Survival and Root Growth in Alfalfa

Jin Wenjie, Liu Qingfang, Lu Dong and Li Wenjian

Alfalfa is a perennial herb plant. It is considered be an important forage grass because of its advantages, such as high yield and quality, resistance to drought and cold, as well as the capacity of nitrogen fixation. Alfalfa is widely cultivated and mainly applied for silage and pasture. At present, there are about 1.33 million $hm^2$ planted in China.

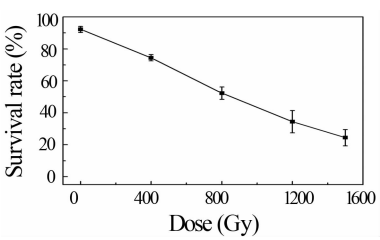


Fig. 1 The effect of carbon ion irradiation on the survival rate in alfalfa

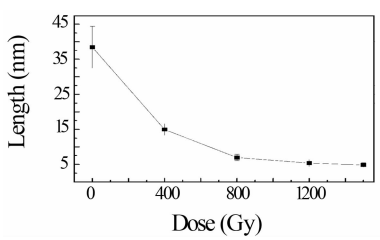


Fig. 2 The effect of carbon ion irradiation on the root length after 2 weeks.

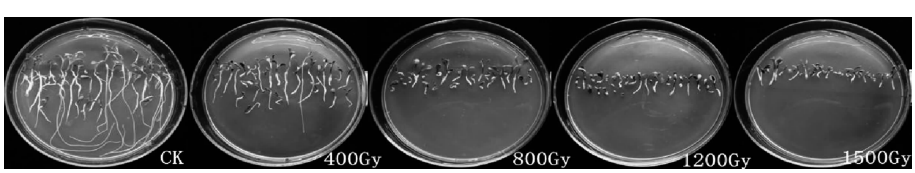


Fig. 3 The effect of carbon ion irradiation on the root growth in alfalfa.

In our study, alfalfa seeds were irradiated by carbon ion beams with different doses to analyze the effects on the survival rate and early root growth. The irradiated dosage were 0, 400, 800, 1200, and 1500 Gy. Growth condition was given to 22 ℃ during the day and 10 ℃ through the night alternatively. Illumination time was 16 h/8 h. Fig. 1 showed the dose-response curve of the survival rate. The results showed the survival rate decreased gradually as the irradiated doses increasing. And the survival rate was to 92.2% in control group, while in the highest dose, it was merely 24.4%. Meanwhile, from Figs. 2 and 3 we can see that carbon ion irradiation with different doses had the influence on root growth. For example, com-

pared to the control, the root growths in 400 Gy got slower, with the dose increasing, they were inhibited severely even ceased. The measure of root length after 2 weeks had the same result with that in Fig. 3. These results suggested that the reduction of survival rate and root length in alfalfa exposure to carbon ion beams had the dose dependent manner.

# 3 - 50 Influence of $^{12}C^{6+}$ on Phenotypes and Photosynthetic Pigments of *Lotus Japonicus*

Du Yan, Yu Lixia, Zhou Libin, Chen Gang, Luo Shanwei, Liu Qingfang and Li Wenjian

As a model legume plant, *Lotus japonicus* has many advantages for legume research. These characteristics contain small plant, large and abundant flowers, easy hand pollination, high seed production, short generation time, easy cultivation, amenable to plant transformation and regenerationfrom tissue culture. At present, a set of genetic resources and tools has rapidly become available. Research on *Lotus japonicus* has greatly contributed to the understanding of both symbioticprocesses, i. e. with *Rhizobium melilotiand* mycorrhiza, making possible the cloning of several keygenes involved in both symbioses. Photosynthesis is the basic substance metabolism and energy metabolism of green plants. It plays an important role in the life-cycle of plants. Experiments aimed to investigate the effect of carbon ions on the phenotypic variation and photosynthetic pigments contents of *Lotus japonicus* have been performed at HIRFL-CSR.

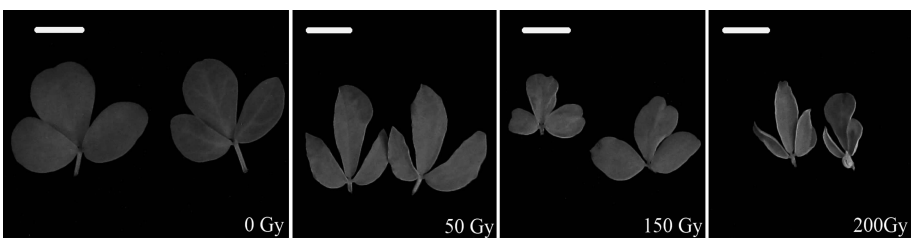


Fig. 1 Phenotypicvariations induced by carbon ions in *Lotus japonicus*. Scale bars, 5 mm.

In order to investigate the effect of carbon ions on the phenotypes of $M_1$ plants, 30-day-old plants were used to capture photos. Fig. 1 shows the typical representative phenotypic variations observed in the $M_1$ plants: compared to the control, treatment groups displayed emaciated and narrow leaves, meanwhile they seemed to be more yellow.

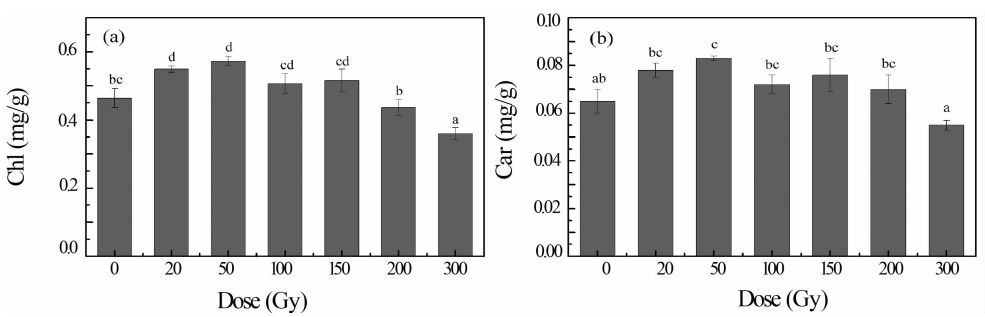


Fig. 2 The effect of carbon ions on the photosynthetic pigments contents of *Lotus japonicus*. (a) total chlorophylls; (b) carotenoids. Data represent mean ±SE of three independent experiments. Different lowercases indicate a significant difference at $p<0.05$.

As the primary and accessory pigments in photosynthesis, the contents of chlorophylls and carotenoids were sensitive to carbon ions. Fig . 1 shows the contents variation of total chlorophylls and carotenoids with the increased dose of carbon ion irradiations. Both the total chlorophyll, and carotenoid show the