

MI decreased in higher doses, and the reduction of prophase cells followed a pattern similar to MI, indicated carbon ion irradiation could cause the cell cycle delay.

References

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3 - 48 Study of M1 Mutagenic Effects of Carbon Ion Irradiation on Lavender Seeds

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Lavender is one species of genus *Lavandula*, which belongs to *Labiatae*. It is a small, aromatic shrub used in the fragrance, specialty food, and alternative medicine industries. The natural geographical environment in Yili of Xinjiang Province the same as France’s, so it is suitable for lavender cultivation. However, it is serious for the degeneration of lavender varieties in Xinjiang. Therefore, excellent variety is urgently required to insure sustainable development in lavender industry in China. Recently, heavy ions have been used to create novel germplasm and breed variety in plants. Aimed to determine the optimal irradiation dose, the biological effects were comparatively studied after carbon ion irradiation in Lavender (701 and 702).

In this study, 50 seeds of 701 and 702 were placed in a culture dish containing a piece of filter paper at 25 ℃ under18h-light/8h-dark cycle, respectively. Germination percentage, the length of hypocotyl and embryonic root were recorded at the 14th day. Fresh weight of seedlings was measured at 30th day.

According to table1, the germination percentage of 701 and 702 increased firstly and then decreased when the dose increased using carbon ion irradiation. As shown in Table 2, we found that the length of embryonic root of 701 and 702 was significant shorter than control’s. However, the length of hypocotyl of 701 significantly increased after irradiation with 40 and 100 Gy and extremely significant decreased above 160 Gy compared with control in Table 3. Obviously, the length of hypocotyl of 702 decreased with the doses increased. In addition, the fresh weight of seedlings of 701 irradiated by 40, 100, 160 and 240 Gy were heavier than control’s, and lighter after irradiation with 300 Gy. Interestingly, the fresh weight of seedlings of 702 was decreased under irradiation doses except 40 Gy.

In conclusion, the carbon ion irradiation had great effects on lavender, and it is helpful to breed novel mutants of Lavender in the future.

Table 1 Effect of carbon ion to germination percentage of 701 and 702(n=3)

Germination percentage(%)	CK	40 Gy	100 Gy	160 Gy	240 Gy	300 Gy
701	57±7.07	54±11.3	59±1.41	45±1.41	25±7.07*	36±2.83
702	55±7.07	48±8.49	52±2.82	34±2.83	33±7.07	32±8.48

* the difference of germination percentage of 701 and 702 was significant between control and experimental group, $p<0.05$.

Table 2 Effect of $^{12}\text{C}^{6+}$ ion to the length of embryonic root of lavender 701 and 702(n=3)

Length of embryonic root(cm)	CK	40	100	160	240	300
701	2.60±0.36	2.01±0.40**	1.35±0.29**	0.95±0.41**	0.79±0.55**	0.27±0.09**
702	2.54±0.15	2.59±0.11	1.86±0.30**	0.96±0.37**	0.36±0.19**	0.34±0.16**

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

Table 3 Effect of $^{12}\text{C}^{6+}$ 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	$1.18\pm0.23^*$	$1.30\pm0.23^{**}$	0.90 ± 0.18	$0.52\pm0.23^{**}$	$0.56\pm0.21^{**}$
702	1.20 ± 0.16	$1.05\pm0.08^*$	$1.03\pm0.25^{**}$	$1.03\pm0.13^{**}$	$0.65\pm0.13^{**}$	$0.69\pm0.27^{**}$

* 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 $^{12}\text{C}^{6+}$ 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	$78.25\pm2.22^{**}$	$100.50\pm3.51^{**}$	$92.00\pm4.97^{**}$	$153.00\pm19.63^{**}$	$32.00\pm2.16^{**}$
702	93.75 ± 3.59	$118.00\pm7.83^{**}$	$87.50\pm0.58^*$	$60.00\pm0.82^{**}$	$33.00\pm4.24^{**}$	$21.67\pm2.51^{**}$

* 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

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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.

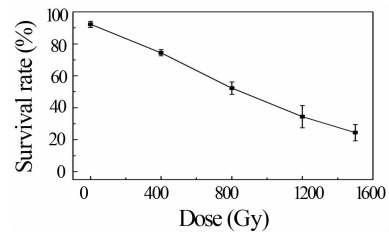


Fig. 1 The effect of carbon ion irradiation on the survival rate in alfalfa

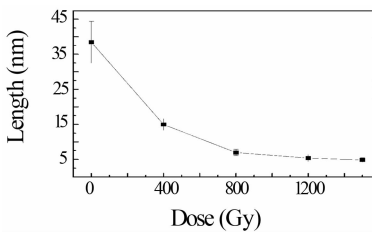


Fig. 2 The effect of carbon ion irradiation on the root length after 2 weeks.

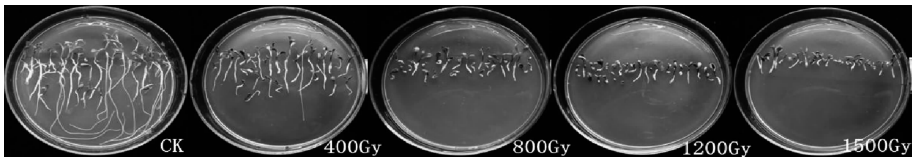


Fig. 3 The effect of carbon ion irradiation on the root growth in alfalfa.

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 $^{\circ}\text{C}$ during the day and 10 $^{\circ}\text{C}$ 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-