

Isolation of dwarf mutants induced with C-ion beam irradiation in pea cultivar “Kishu-usui”

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Wakayama Prefecture is one of the major pea (*Pisum sativum* L.) production regions in Japan. We developed Kishu-usui, which is a major cultivar of peas in Wakayama. However, the cultural practices and harvesting operations for Kishu-usui are difficult, because the plant is tall. Therefore, we tried to obtain dwarf mutants, which had a short internode, by heavy-ion beam irradiation for Kishu-usui.

On 13 June 2011, we irradiated dry seeds of Kishu-usui with C-ion beams (LET 33 keV/μm) at doses of 30, 50, and 70 Gy. The germination rate of M₁ seeds at all doses was 100% four days after imbibition. The survival rates of M₁ plants a month after sowing in a greenhouse were 83%, 87%, and 53% at 30, 50, and 70 Gy, respectively.

We collected self-pollinated M₂ seeds of every M₁ plant. The M₂ seeds were sown on 5 September 2012. The dwarf mutants were obtained at all doses, and the frequencies of the dwarf mutants tended to increase with increasing irradiation doses (Table 1). Finally, 16 dwarf mutants were selected for M₂. Especially, the two best mutants were obtained at 30 Gy, and their internode length was 50 to 70% of the internode length at 0 Gy.

The self-pollinations were repeated for selected mutants. On 18 September 2014, the M₄ seeds and Kishu-usui were sown and dwarf mutants were obtained (Fig. 1). Then, the elite line ‘30Gy①-12-5-55’ was selected.

The number of nodes of 30Gy①-12-5-55 was almost equal to that of Kishu-usui (Table 2). However, the plant height and internode length of 30Gy①-12-5-55 were about half those of Kishu-usui. In addition, the first date of flowering, first date of harvesting, node order of flowering, and node order of harvesting of 30Gy①-12-5-55 were almost the same as those of Kishu-usui. The shape of the pod, shape of the unripe seed, weight of the pod, and weight of the unripe seed of 30Gy①-12-5-55 were about the same as those of Kishu-usui. However, it was observed that some of the main stems of 30Gy①-12-5-55 were broken (Fig. 2).

These results suggest that C-ion beam irradiation at doses of over 30 Gy may be effective for creating dwarf mutants and that the dwarf mutants, whose height and internode length are about half those of Kishu-usui, can be isolated.

Table 1. Effect of C-ion beam irradiation on frequency of dwarf mutants^z of Kishu-usui in M₂ generation.

Dose (Gy)	Number of plants	Number of dwarf mutants	Frequency of dwarf mutants (%)
0	350	0	0.0
30	802	4	0.5
50	759	6	0.8
70	129	6	4.7

^zInternode length of selected plants by visual judgement was 90% or less than the internode length at 0 Gy. Internode length at 0 Gy:n=9

Table 2. Comparison of no. of nodes, plant height, and internode length for 30Gy①-12-5-55(M₄ plant) and Kishu-usui.

Cultivar or Line	No. of node	Plant height (cm)	Internode length ^z (cm)
30Gy①-12-5-55	53.9	247.1	4.6
Kishu-usui	54.6	485.9	8.9

Data were recorded from Mar. 30 to Apr. 2, 2015.

^zPlant height/No. of node (cm)

30Gy①-12-5-55:n=8 Kishu-usui:n=5



Fig. 1. Kishu-usui (left) and M₄ mutant line (right).



Fig. 2. Broken main stem of 30Gy①-12-5-55(M₄ plant). Arrowheads indicate the broken point.

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