Effect of heavy-ion beam irradiation on seeds reduction of 'Konta' kumquat fruit

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'Konta' kumquat was found as a bud mutant in the field by a farmer in Shizuoka Prefecture. 'Konta' has some unique characteristics compared with 'Neiha' kumquat. It has higher sugar content and lesser citric acid content than 'Neiha' kumquat, which tastes extremely good. On the other hand 'Konta' has more seeds (6-7) than 'Neiha' (5-6).[1)] If we can develop seedless 'Konta', it will be a valuable cultivar. Recently, heavy-ion beam irradiation has been reported as an effective mutation breeding technique. Especially since 'Konta' has multi-embryonic seeds, it is difficult to breed this cultivar.

In this study, we investigated the effect of heavy-ion beam irradiation on seed reduction and attempted to obtain a mutant of 'Konta' kumquat fruit with reduced number of seeds.

In 2007 and 2008, dormant scions from the hard branches of 'Konta' kumquat were irradiated with $^{12}C^{6+}$ and $^{20}Ne^{10+}$ at a dose of 10Gy(135 MeV/u, 61.1 keV/μm). After irradiation, the scions were grafted on *Poncirus trifoliata* to create the vegetative mutant 1(vM_1) generation. After sprouting, the treetops were subjected to cutting back at least 3 times. As the control, original 'Konta' was grafted on P. trifoliata. These plants are pollinated naturally, and superfluous fruits were not removed for securing the number of fruits.

We counted the number of perfect seeds on the equatorial cut surface of all the fruits obtained from Ne-ion irradiated vM_1 and C-ion irradiated vM_1 in 2011 and 2012. We considered fruits with 0-2 perfect seeds as "seeds reduced fruit" (Fig. 1) and calculated the ratio of seeds reduced fruits (i.e., number of fruits with two or less seeds/number of examined fruits).

For Ne-ion beam irradiation, the appearance ratio of seeds reduced fruit in vM_1 plants was 6%, while that in the control was 1% (Table 1). One of thirty-six vM_1 plants bore more than 80% seeds reduced fruits by Ne-ion beam irradiation. For C-ion beam irradiation, the appearance ratio of seeds reduced fruit in vM_1 plants was 13%, while that in the control was 8% (Table 2). In four plants, the ratio of seeds reduced fruit per vM_1 plant exceeded 70% by C-ion beam irradiation. The ratios of seeds reduced fruit per control plant were less than 10% in both the irradiation studies. These results indicate that heavy-ion beam irradiation is effective for seed reductions in 'Konta' fruit.

We selected the vM1 plants with high seeds reduced fruits rate (Fig. 2). Furthermore, we isolated the branches bearing more seeds reduced fruits from these selected vM_1 plants. The fixation of seeds reduction is currently under investigation.

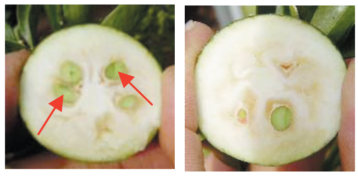

Fig.1 fruit surfaces after equatorial cuts.
Perfect seeds (left) and reduced seed (right)

Table 1. Appearance of seeds reduced fruits of 'Konta' by Ne-ion beam irradiation

Irradiation	Number of vM_1	Number of total fruits	Number of perfect seeds (%) 0-2 seeds	>3 seeds
Ne	36	2125	128(6%)	1997(94%)
Control	29	1651	21(1%)	1630(99%)

Table 2. Appearance of seeds reduced fruits of 'Konta' by C-ion beam irradiation

Irradiation	Number of vM_1	Number of total fruits	Number of perfect seeds (%) 0-2 seeds	>3 seeds
C	128	7307	962(13%)	6345(87%)
Control	5	208	17(8%)	191(92%)

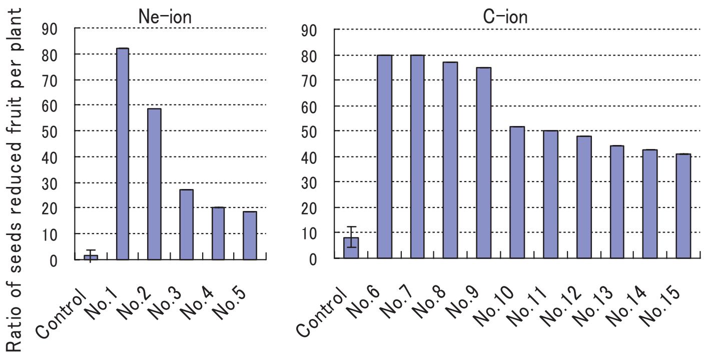

Fig. 2 Examples of vM_1 plant with high seeds reduced fruits rate. Vertical bars represent ± SD(Ne: n = 29, C: n = 5).

References

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