

## Mutants of sorghum variety “WRAY” induced by heavy-ion irradiation

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Sorghum [*Sorghum bicolor* (L.) Moench;  $2n = 2x = 20$ ] is one of the most important cereals for food, forage, sugar, and biofuel worldwide.<sup>1)</sup> Sorghum, maize (*Zea mays*), rice (*Oryza sativa*), wheat (*Triticum aestivum*), and barley (*Hordeum vulgare*) are called the world's five major food crops, and sorghum is the staple for more than 500 million people worldwide (<http://www.fao.org>). In this study, to induce mutations, dry seeds of sweet sorghum variety “WRAY” were treated using Ar- and C-ion beams in RIBF from 2015 to 2016.

The seeds were irradiated with Ar (290 keV/ $\mu\text{m}$ ) ions and C (30 keV/ $\mu\text{m}$ ) ions. The doses of the Ar and C ions were 5 to 50 Gy, and 50 to 125 Gy, respectively. Survival rates were estimated by counting  $M_1$  plants surviving in the field.  $M_2$  seeds were harvested separately from each self-pollinated  $M_1$  plant. The mutants were identified from  $M_2$  plants. Mutation rates were calculated based on the numbers of  $M_1$  lines, which showed morphological mutants in  $M_2$  generation. The highest rate of morphological mutants was observed at a C-ion irradiation dose of 75 Gy (Table 1). A total of 9 morphological mutants were identified from 374 lines, among which, 2 mutants were in Ar- treated plants and 7 mutants were in C- treated plants. The phenotypes of mutants were dwarf, yellow leaf, late heading and early heading (Fig. 1). *Ma3* is an important flowering-time gene that will be useful in sorghum breeding.<sup>2)</sup> A next-generation sequencing and genetic analysis revealed that an early-heading mutant has a 1-bp deletion in *Ma3*. The genetic analysis of other mutants is ongoing.

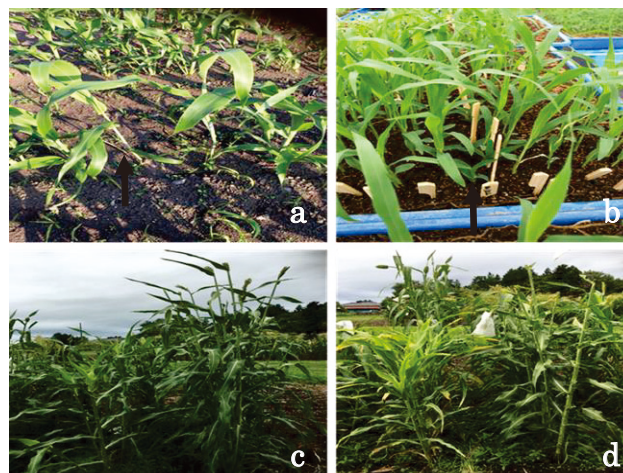


Fig. 1. Mutations induced by heavy-ion beams. (a) Early line, (b) dwarf line, (c) late line (left) and wild type (right) and (d) yellow leaf line (left) and semi-dwarf line.

### References

- 1) A. H. Paterson *et al.*, *Nature* **457**, 551 (2009).
- 2) K. L. Childs *et al.*, *Plant Physiol.* **113**, 611 (1997).

Table 1. Effects of ion-beam irradiation on mutation induction.

Ions	Dose (Gy)	Survival rate (%)	No. of $M_1$ lines	No. of morphological mutants				Total	Mutation rate (%)
				yellow leaf	dwarf	late heading	early heading		
Control	0	80							
Ar	5	83	85	1				1	1.2
	10	48	49		1			1	2.0
	15	18	5					0	0
C	50	91							
	75	67	235	1	3	2	1	7	3.0
	100	21							
	125	15							

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