Harunoogi, a high ratoon yield sugarcane cultivar developed by interspecific hybridization between sugarcane and *Saccharum spontanium*

Sugarcane (*Saccharum* spp. hybrid) is an essential crop for food and energy production, and improvement of its productivity will contribute toward promoting food sustainability and energy security around the world. Sugarcane can continue growing by low-cost cropping type ratooning, whereby the post-harvest stubbles in the fields are regrown. Improving ratoon productivity for high-latitude production areas, where low temperatures cause problems in ratooning, have been one of the most important breeding targets; however, the stagnation of genetic improvement arising from the narrow genetic diversity of cultivars and breeding materials in the world has become an issue in breeding, hence expanding genetic diversity using unused genetic resources is required. The wild sugarcane, *S. spontaneum*, is an important genetic resource for improving sugarcane ratoon yield due to its superior tillering and ratooning ability under various environments. The aim of this study therefore was to develop a sugarcane cultivar with good tillering ability and high ratoon yield for high-latitude sugarcane production areas by interspecific hybridization between sugarcane and *S. spontaneum*.

The new high ratoon yield cultivar Harunoogi was developed from a crossing between fodder sugarcane cultivar KRFo93-1 (which was developed by interspecific hybridization between sugarcane cultivar NCo310 and *S. spontaneum* Glagah Kloet and has excellent tillering ability with high ratoon yield at multiple ratooning) and the high-sugar-content sugarcane cultivar NiN24 (Fig. 1, Fig. 2). Harunoogi can produce an extraordinarily large number of stalks with sugar content comparable to that of NiF8, which is a major cultivar in high-latitude areas in Japan, even though its stalk diameter is smaller than NiF8 (Table 1). Its excellent ratooning ability enables the production of more stalks than NiF8 in ratoon crop, especially after machine harvesting (Fig. 3). As a result, cane yield and sugar yield in 1st and 2nd ratoon crops of Harunoogi are much higher than NiF8's (Table 1).

Harunoogi, which was jointly developed by the Japan International Research Center for Agricultural Sciences and the National Agriculture and Food Research Organization, is expected to contribute to sugarcane production in high-latitude areas in Japan. Interspecific hybridization with *S. spontaneum* will be an important strategy toward improving the tillering ability and productivity of ratoon crops in high-latitude areas where low temperature is a critical constraint in sugarcane production.

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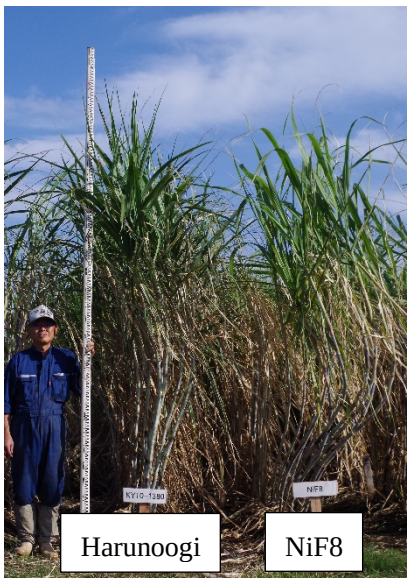

Fig. 1. Harunoogi and NiF8
Photos taken in November 2018
in Nishinoomote, Japan

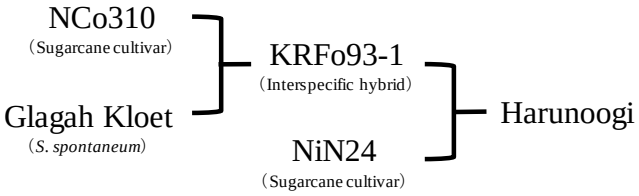

Fig. 2. The pedigree of Harunoogi

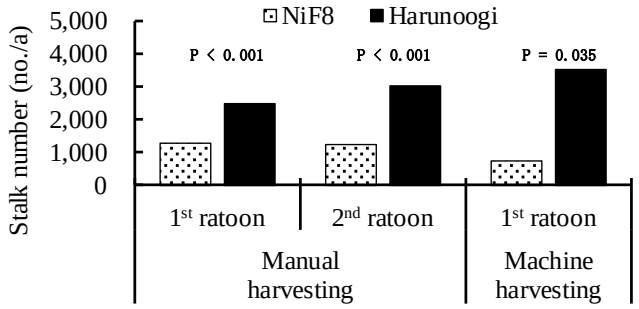

Fig. 3. Stalk number in early growth stage of the ratoon crop
The *p*-values were calculated by a generalized linear model with cultivar (fixed effect) and plot (random effect).

Table 1. The agronomic characteristics of Harunoogi

Cropping type	Cultivar	Stalk number (no./ha)	Stalk length (cm)	Stalk diameter (mm)	Single stalk weight (g)	Cane yield (t/ha)	Sugar content (%)	Sugar yield (t/ha)
New planting	Harunoogi	143,950	224	20.6	685	97.3	12.4	11.0
	NiF8	93,100	244	22.5	818	75.6	12.1	8.4
	p -value	<0.001	<0.001	<0.001	<0.001	<0.001	0.441	<0.001
1st ratoon	Harunoogi	188,667	244	19.4	619	117.2	11.8	12.7
	NiF8	110,633	238	20.5	649	71.9	12.4	8.2
	p -value	<0.001	0.272	0.016	0.337	<0.001	0.098	<0.001
2nd ratoon	Harunoogi	192,950	218	19.6	583	109.7	10.4	9.8
	NiF8	134,800	215	20.5	558	74.6	10.4	6.7
	p -value	0.003	0.733	0.116	0.492	<0.001	0.723	0.003

The experiments were conducted from 2015 to 2018 at Kyushu Okinawa Agricultural Research Center, Tanegashima Sugarcane Breeding Site, Nishinoomote, Japan. The results in the table show the means of 4 years (2015-2018) in new planting, three years (2016-2018) in 1st ratoon, and two years (2017-2018) in 2nd ratoon. The *p*-values were calculated by a generalized linear model with cultivar (fixed effect), year, and plot (random effect).