



# Sweetpotato Research Front

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## Export of Sweet Potato from Japan

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The export of agricultural products of Japan reached ¥443 billion (equivalent to US\$4 billion) in 2015. Major crops exported are apple, Chinese yam, and rice. In 2014, 410 thousand tons of sweet potato for table use was produced in Japan. The sweet potato export of Japan has doubled in this decade, from 300 tons in 2005 to 1,640 tons in 2015. The top three countries for export are China including Hong Kong, Taiwan, and Singapore. In Hong Kong, sweet potatoes are popularly cooked by steaming in electric rice cookers, for which relative small, slender roots are favored.



Considering the demand for sweet potatoes in foreign countries, we may further increase the export of sweet potato in the next decade. One of the most important requirements in the export of agricultural raw products is to maintain a system that can supply the crop in

needed quantities at any time of the year. In other words, the product should be prepared annually in specific amounts as demanded. It is also important to explore acceptable conditions for transporting sweet potato. Export containers of 20 feet rarely transport only sweet potato and are usually filled with other crops in the same space. Since the stock conditions for sweet potato may differ from those of other crops, the conditions required for other crops may not be preferred by sweet potato and could often lead the crop to degrade. Hence, techniques for protecting this crop from deterioration are being studied in Japan. The Kyushu Okinawa Agricultural Research Center of NARO has focused on breeding, with the development of cultivation techniques for sweet potato. Beside this research, future objectives are to establish techniques for storage optimized for individual cultivars, and to evaluate unexplored uses for these cultivars. We believe in the potential of the sweet potato to improve our lives.

# Research Paper

## Effects of Sugarcane Trash Mulching on Occurrences of West Indian Sweet-potato Weevil, *Euscepes postfasciatus* and Weeds

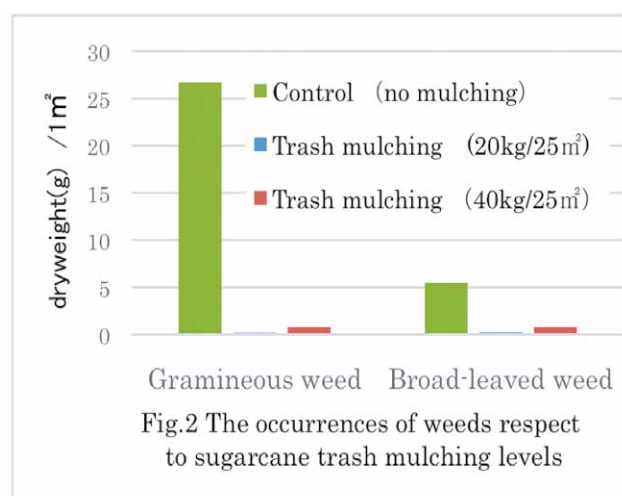
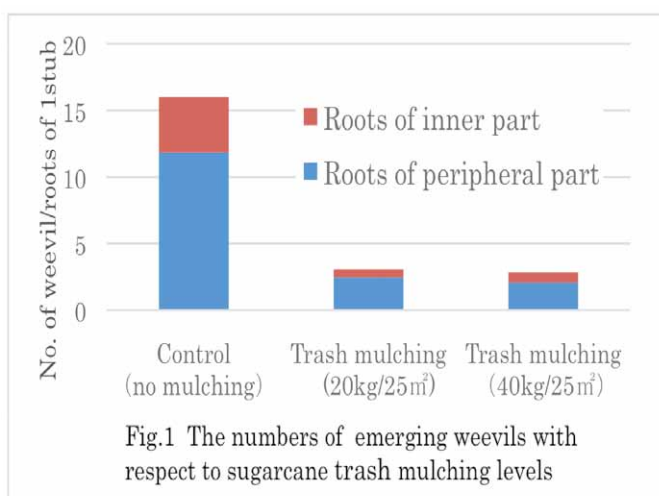
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The West Indian sweet-potato weevil, *Euscepes postfasciatus* (Fairmaire), is one of the most serious sweet-potato pests on the Nansei Islands, southern Japan. Since this weevil lacks flight ability, it searches and reaches host plants by walking, probably in pursuit of substances emitted from hosts. Sugarcane trash, if used as mulch for weed control, may function as obstacles that interrupt the weevil's walking and thus reduce or retard the dispersal of the weevil. This material is widely used for weed control in vegetable cultivation in Okinawa. Different odorous component emitted from the trash may disturb host-searching behaviour of the weevil. In 2013, I performed a field experiment at Itoman, Okinawa, southern Japan, to evaluate the potential of sugarcane trash for reducing the weevil population, as well as its effects on the growth of weeds.

Three treatments of trash application in two replicates were randomly assigned to a total of six 25m<sup>2</sup> plots in which sweet-potato slips had been planted in late March 2013: 0 (no trash for control), 0.8, and 1.6kg/m<sup>2</sup>. The trash was applied two weeks after the planting, when the plants were expected to be rooted,

and 320 weevils (equivalent to two/plant) were released into the outer circumferential edge of each plot in late June when the plants began to be sclerotized at their basement. Tuberos roots were harvested in each plot in mid-September and maintained at 27°C in incubators; weevils emerging from the roots were counted. The number of weevils emerging from tubers of trash-treated plots was only one-sixth that of weevils emerging from the control plots (Fig. 1). In both trash-treated plots, the number of emerging weevils was likely to be correlated with the location of tubers: the closer to the plot centre the tubers were, the fewer the weevils that emerged from them. The results indicate that trash treatment prevented weevils from invading the plots. Trash mulching, regardless of the weight (20kg or 40kg), adversely affected the growth of weeds from spring to summer (Fig. 2). It is supposed that trash mulching declined light transmittance to the soil surface, and it inhibited the growth of seedlings. Future issues include developing techniques of sugarcane mulching for effective reduction of weevil invasion and cost-labour effectiveness in the use of trash.



# Research Paper

## Suzuhokkuri: A New Sweetpotato Cultivar for Table Use

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### Introduction

Suzuhokkuri, developed by the National Agricultural Research Center for Kyushu Okinawa Region (KONARC), is a new sweetpotato cultivar with light yellow flesh and good appearance. The texture of its baked root is slightly dry with a good taste (Fig. 1).



Fig. 1. Baked root of Suzuhokkuri

### Origin

Suzuhokkuri is a progeny of Kyukei 96013-11 as the maternal parent and Benimasari as the paternal parent, crossed at KONARC in 2002. A total of 742 seeds were obtained from the crossing. Suzuhokkuri was selected based on evaluation of field performance, taste, and appearance. These good characteristics may have been inherited from its parents, both of which have been selected for table use.

### Description

Suzuhokkuri has slightly good sprouting ability and

is a slightly spreading plant type. Its vines are relatively thick with intermediate internode length. Neither vines nor vine nodes are pigmented, due to lack of anthocyanin. Young, pale green leaves mature into dark green heart-shaped leaves. The storage root shape is fusiform, which Japanese consumers prefer. Its skin is reddish purple, and its flesh is light yellow. Steaming makes the root texture slightly dry.



Fig. 2. Storage root of Suzuhokkuri

### Performance

Compared to Kokei No. 14, which is the leading variety for table use in western Japan, Suzuhokkuri produces more roots of smaller size; however, the yield is similar. The root contains more dry matter and attains higher brix when steamed (Table 1).

Its resistance to root-knot nematodes is rather strong, whereas its resistance to root-lesion nematodes is moderate.

Table 1. Yield and other traits of Suzuhokkuri in yield trial (2007 through 2015, standard cultivation)

Traits	Suzuhokkuri	Kokei No. 14	Beniharuka
Root yield (t/ha)	23.2	25.9	30.6
Root size (g)	116	208	191
Number of roots per hill	5.3	3.4	4.3
Dry matter content (%)	36.2	31.6	36.0
Brix (%) <sup>1)</sup>	20.9	17.8	27.7
Root-knot nematode resistance <sup>2)</sup>	SR	SS	R
Root-lesion nematode resistance <sup>2)</sup>	I	SR	I
Storability	High	Slightly High	Slightly High

1) Four times the value measured of exudates from steamed root mash with 3 times volume of water.

2) R: Resistant. SR: Slightly Resistant. I: Intermediate. SS: Slightly Susceptible.

# Research Paper

## Rapid Screening for Low Pasting Temperature Starch in Sweetpotato by Alkali Solubility Test with Microscopy

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Sweetpotato cultivar Konamizuki has been developed for starch production, providing starch with a low pasting temperature and an extremely low degree of retrogradation compared with conventional starch. To efficiently develop a cultivar having a unique starch such as Konamizuki, we developed a method for quick characterization of the pasting properties of starches using microscopy in combination with the alkali disintegration of starch. We then established a method for rapid screening for the low pasting temperature genotype.

Konamizuki (low pasting temperature type), Kyukei 09225-2 (intermediate type), and Daichinoyume (normal type) starches were used in this study. Several drops of 1 to 1.5% potassium hydroxide (KOH) solution were added to the starch granules, followed by microscopy three minutes later. Starch granules from the low pasting temperature type swelled and gelatinized in the 1% KOH solution (Fig. 1). In 1.25%

or higher, all of the starch was gelatinized. In contrast, only a portion of the starch from the intermediate type swelled in the 1% KOH solutions. In 1.25%, starch swelling increased, and the starch began to gelatinize at 1.5%. Furthermore, most of the starch from the normal type remained raw in 1.5% KOH, though starch swelled slightly. These results indicate that the starch type can be easily and quickly identified using an alkali solubility test with microscopy. We thus have established a protocol for a breeding program for low pasting temperature starch (Fig. 2). A small amount of starch is taken by rubbing a piece of storage root on a glass slide. A 1.25% KOH solution is then dropped onto the starch, followed by microscopy. This method allows us to identify the starch type without extracting any starch, and accordingly can be incorporated in the screening of sweetpotato for low pasting temperature starch.

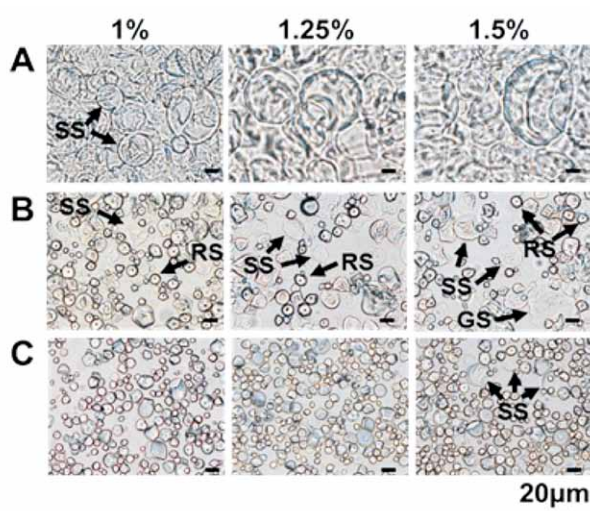


Fig. 1. Light micrographs of starch granules from Konamizuki (A), Kyukei 09225-2 (B) and Daichinoyume (C). RS: raw starch granule; SS: swelling starch granule; GS: gelatinized starch.

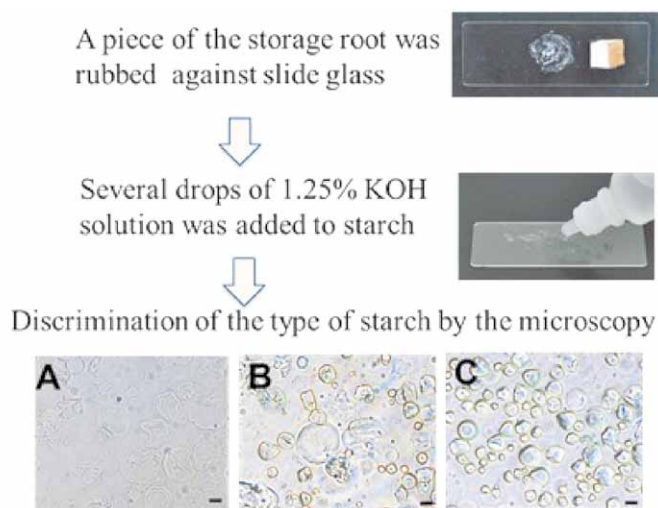


Fig.2. Procedure of screening for low pasting temperature starches in sweetpotato. A piece of the storage root of Konamizuki (A), Kyukei 09225-2 (B) and Daichinoyume (C) were used in the experiment. The bars in the micrographs indicate 20µm.

# Research Paper

## Anthocyanin Composition and Content in Purple-Fleshed Sweet Potato Cultivar Churakoibeni

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A purple-fleshed sweet potato cultivar, Churakoibeni, was released at the Okinawa Prefectural Agricultural Research Center in 2009. This cultivar is high-yielding with a high level of anthocyanin and is utilized mainly for processing. On Okinawa Island, southern Japan, purple-fleshed sweet potatoes, also known as beni-imo, have been eaten since the latter part of the Edo period. In 2006, the three cultivars Okiyumemurasaki, Bise, and Miyano No. 36 occupied more than 60% of the area of purple-fleshed sweet potato under cultivation on Okinawa Island. However, Churakoibeni occupied 52% of the area in 2014. Despite its popularity, little information is available on the anthocyanins and their contents in this variety.

In this study, we examined anthocyanins in Churakoibeni using the method described by Terahara *et al.*<sup>1)</sup> with a slight modification to determine non- and mono-acylated anthocyanins, and compared them with those in Okiyumemurasaki and Bise. Three cultivars of sweet potatoes were harvested on Okinawa Island in the fall of 2015. More than 14 species of anthocyanins were detected from Churakoibeni (data not shown), including cyanidin-group mono- and di-acylated anthocyanins (YGM-1a, 1b, 2, and 3) and peonidin-group ones (YGM-4b, 5a, 5b, and 6), which

were identified as major anthocyanins in the Ayamurasaki cultivar. As depicted in Fig.1, more YGM-5b and 6 were detected than the other anthocyanins, and the sum of these two anthocyanin contents occupied more than 45% of all anthocyanins. Furthermore, peonidin-group anthocyanins (72.8%) are dominant over cyanidin-group ones, and thus paste made from Churakoibeni is reddish purple, similar to that made from Ayamurasaki. However, paste made from Bise and Miyano No. 36 is bluish purple because these two cultivars are rich in cyanidin-group anthocyanins (Fig.1). The total contents of anthocyanins were  $1.76 \pm 0.14$  mg/g flesh weight harvested in farm lands of Itoman City and  $1.95 \pm 0.27$  mg/g flesh weight (mean  $\pm$  standard deviation,  $n = 6$ ) harvested in farm lands of Yaese Town. The mean of total anthocyanin contents (1.86 mg/g flesh weight) in tubers of Churakoibeni tubers was 1.3 times higher than in those of Okiyumemurasaki (1.40 mg/g flesh weight) and 2.5 times higher than in those of Bise (0.75 mg/g flesh weight).

### REFERENCES

(1) Terahara *et al.*, J. Jpn. Soc. Food Sci. Technol. (in Japanese with English summary) 54, 33-38 (2007).

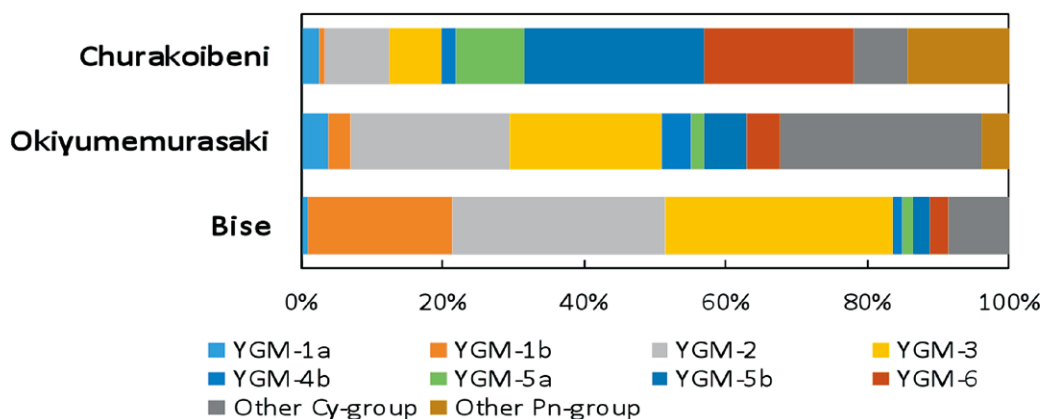


Fig.1 Anthocyanin composition in Churakoibeni, Okiyumemurasaki, and Bise tubers. Each cultivar was harvested in farm lands of Itoman City and Yaese Town. The composition was the average of 12 tubers. Other cyanidin- and peonidin-group anthocyanins were determined as equivalent contents of YGM-6.

# Research News

## The 410<sup>th</sup> Anniversary of the Introduction of Sweetpotato to Okinawa - Report of the Noguni Soukan Sweetpotato Forum -

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In Japan, sweetpotato cultivation began with its introduction in Miyako in 1597, and its re-introduction in Okinawa in 1605. Systematic cultivation of this crop was started by Mr. Noguni with the help of Shinjo Gima. The sweetpotato of the second introduction originated in Fujian, China. The 410<sup>th</sup> anniversary of the sweetpotato introduction in Okinawa was held at Kadena Cultural Center, Okinawa on 15 November 2015. Noticeably, the sweetpotato has significantly contributed to the agriculture, industry, and economics of Okinawa. This forum was organized by both the Kadena municipal government and the local government of Okinawa. It was supported by a local newspaper, the Okinawa Times, with the corroboration of the Japan Root and Tuber Crops Development Association (JRTA). More than 700 people, including officers, farmers and researchers, participated in the forum.

In this forum, a symposium was held titled "Let's Talk Dreams of Sweetpotato: Utilization and Weevil Control." The keynote speech was presented by Mr. Akio Kariya, the

President of JRTA, under the title of "Learning the sweetpotato history for future dreams." Panel discussions were provided by Mr. Katsuo Iha, Prof. Tadahiro Nagata of Seitoku University, Mr. Yasuo Tanaya, senior managing director of the Namegata Agricultural Cooperatives, and me, Yoshihiro Okada. This section targeted the history, nutrition, and utilization of sweetpotato and the control of weevils attacking this crop, and looked toward a hopeful future in sweetpotato cultivation. Issues presented by these panelists included the nutrition of sweetpotato by Prof. Tadahiro Nagata, the history of sweetpotato in Okinawa by Mr. Katsuo Iha, sweetpotato industries by Mr. Yasuo Tanaya, and native cultivars and weevil control by me. For this forum, processed sweetpotato goods and presentations were presented by 34 organizations and participants both from Okinawa and from other regions, and these products were evaluated by the visitors. I hope that the sweetpotato industry will be developed further with consumers.



Fig. 1. Panel discussion for "Let's Talk Dreams of Sweetpotato: Utilization and Weevil Control" (left) and a booth for processed sweetpotato from the Japan Agricultural Cooperation (right). Various kinds of product were sold at the booth: baked sweetpotatoes, sweets, croquettes, gelatos, liquors, and so on.



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