



# Sweetpotato Research Front

National Agricultural Research Center for Kyushu Okinawa Region(KONARC) No.22, September 2009

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## Four Colors Accepted by Japanese Consumers

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Editor in SPORF and Chief of Crop Functionality and Utilization Research Team,  
National Agricultural Research Center for Kyushu Okinawa Region



This April, I returned to research after an interval of three years. I experienced a splendid opportunity to leave sweet potato research and to observe the movement of the food market in Japan. During this period, the number of Japanese suffering from metabolic syndrome and related fasting hyperglycemia, high blood pressure, and hyperlipidemia increased, causing a consumer movement to seek healthy foods. In addition, purple, red, yellow, and green were recognized as healthy colors, and vegetables and fruit with these colors became recognized as healthy.

After anthocyanin was reported to have beneficial health effects, the image "Purple is a healthy color" was accepted by the consumer, and food including anthocyanin, such as purple-fleshed sweet potatoes, blueberries, grapes, purple carrots, and purple cabbages, began selling well. Moreover, a new breeding material with a high anthocyanin content like potatoes, corn, and buckwheat sprouts has been developed. Yellow foods began selling well

also. The main yellow color originates in  $\alpha$ - and/or  $\beta$ -carotene contained in carrots, pumpkins, and yellow-fleshed sweet potatoes. Other yellow coloring sources are the quercetin in onions and the curcumin in turmeric. The color red originates mainly in the lycopene included in tomatoes, carrots, and watermelons; another coloring source is the capsanthin in red bell peppers and chili peppers. Green coloring sources include chlorophyll and lutein contained in spinaches, green bell peppers, and broccolis.

Thus, the consumer began to recognize four colors as indicative of typical healthy foods. The coloring sources that compose these colors are contained in sweet potatoes. For instance, anthocyanin is included in purple-fleshed sweet potatoes (Ayamurasaki, Murasakimasari, and Akemurasaki),  $\beta$ -carotene and novel carotenoids are found in yellow- and orange-fleshed sweet potatoes (Ayakomachi and Beniharuka), and  $\beta$ -carotene and lutein are contained in green leaves of sweet potatoes (Suiou). Detailed information on these cultivars will be introduced in this SPORF.

# Research Paper

## New Sweetpotato Cultivar “Akemurasaki” with High Anthocyanin Content

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“Akemurasaki” is a newly released sweet potato cultivar with high anthocyanin content and good appearance, developed by National Agricultural Research Center for Kyushu Okinawa Region. Performance and local adaptability tests were conducted at prefectural agricultural experimental stations, and anthocyanin content and composition were evaluated by a sweetpotato processor. It was officially registered as “Sweet Potato Norin No. 62” by the Ministry of Agriculture, Forestry and Fisheries in 2005.

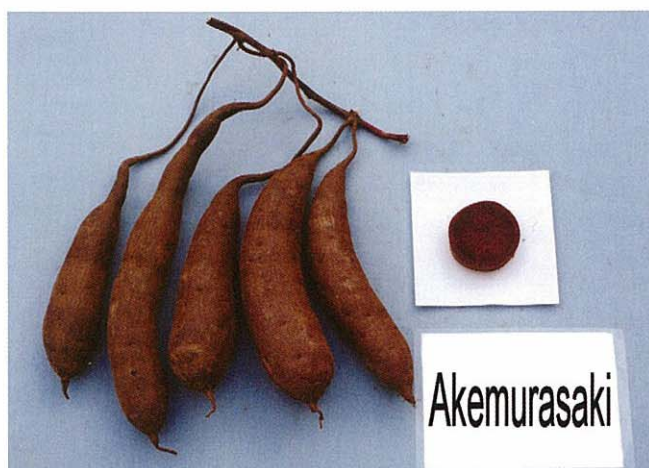
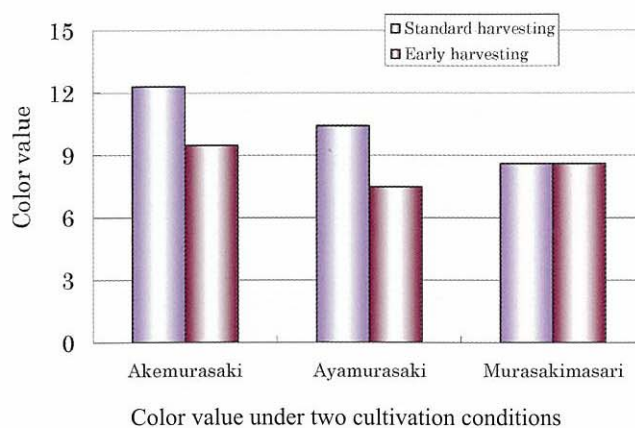
### Origin

This cultivar was selected for high anthocyanin content and good appearance from the cross of “Ayamurasaki” and “Kyukei-174”. Both parents have storage roots with purple flesh.

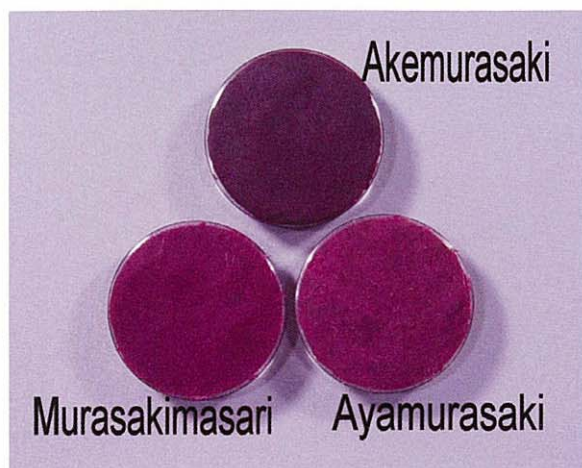
### Description

“Akemurasaki” features light green and toothed heart-shaped leaves, with slight amounts of anthocyanin accumulated in vines and nodes, and a long, fusiform root. “Akemurasaki” is resistant to root-knot and root-lesion nematodes, and its yield is

comparable to that of “Ayamurasaki”. This cultivar corrected the root shape disorder of “Ayamurasaki” and the low pigment extraction efficiency of “Murasakimasari”. The color value of “Akemurasaki” is 10 to 40% higher than those of “Ayamurasaki” and “Murasakimasari” under the same cultivation conditions. The paste and the powder from “Akemurasaki” appear dark bluish purple because the ratio of cyanidin to peonidin is higher than previously released cultivars. This cultivar is promising as a new coloring source and for extending the usage of purple-fleshed sweet potatoes for processed foods.



Storage root and cross-section of “Akemurasaki”



Comparison of the paste color of three cultivars

## Radical-Scavenging Activity of Purple-Fleshed Sweet Potato Miso and Related Compounds

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The purple-fleshed sweet potato (PSP) is known to possess higher radical-scavenging activity than yellow- or white-fleshed cultivars. The compounds related to this activity have been determined to be acylated anthocyanins and caffeic acid derivatives (e.g., chlorogenic acid) (1). Recently, a method for producing “PSP miso” was established. Miso is a Japanese traditional food fermented with *Aspergillus* sp. and usually made from soybean, rice or barley. In this report, we present the result of comparing the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging activity of PSP miso and ordinary miso (2).

When the PSP cultivar Murasakimasari was used for brewing the PSP miso (Fig. 1), the PSP miso exhibited the highest radical-scavenging activity among the miso samples (Fig. 2). The activity was 18.7  $\mu\text{mol-Trolox/g dw}$  for the mixture of the ingredients (before fermentation), and 22.9  $\mu\text{mol-Trolox/g dw}$  for the PSP miso and became slightly higher during fermentation. The main radical-scavenging compound of PSP miso was caffeic acid (2), whereas the activity of the ingredient was

due to chlorogenic acid, acylated anthocyanins, etc. It was speculated that caffeic acid derivatives and acylated anthocyanins were degraded by esterase of *Aspergillus* sp. and caffeic acid was released. It was clearly demonstrated that the radical-scavenging components of PSP retained their activity after fermentation and that PSP miso possessed higher radical-scavenging activity than ordinary miso. PSP seems to be a good ingredient for fermented foods with high functionality.

### REFERENCES

- (1) Oki et al., Involvement of anthocyanins and other phenolic compounds in radical-scavenging activity of purple-fleshed sweet potato cultivars., *J. Food Sci.*, 67(5), 1752-1756 (2002).
- (2) Nishiba et al., Changes in anthocyanins, polyphenols and  $\beta$ -carotene in the manufacture of colored sweet potato miso., *J. Jpn. Soc. Food Sci. Technol.*, 55(2), 69-75 (2008).



Figure 1. The appearance of PSP (Murasakimasari) miso.

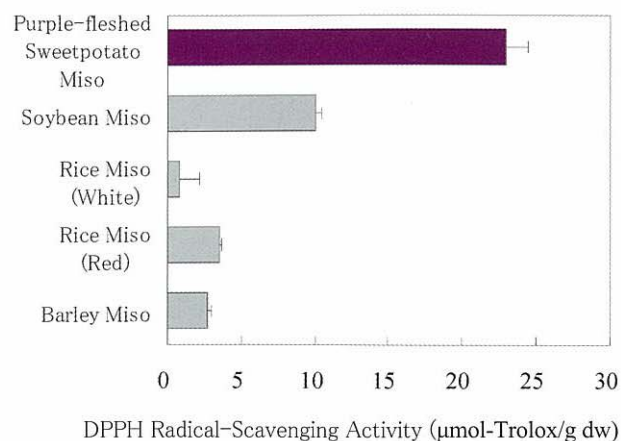


Figure 2. DPPH radical-scavenging activity of miso samples.

## Suppression of Root-Knot Nematode Damage to Sweetpotato by Preceding Fall Cropping of Oat Variety “Tachiibuki”

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Root-knot nematodes (*Meloidogyne* spp.) are major pests of sweetpotatoes in Kyushu. These nematodes cause yield loss and cosmetic defects of storage roots. Application of nematicides is costly for less profitable sweetpotato production. Thus it is important to develop cropping systems to reduce nematode densities. However, the present cropping systems using known nematode-suppressive plants (e.g., guinea grass) are not always practical because their suppressive effect mainly occurs in summer cropping, a period important for farm profitability. Consequently, it is necessary to develop an economic cropping system using alternative nematode control agents in non-cropping seasons.

Although many oat (*Avena sativa*) varieties are suitable hosts of nematodes, “Tachiibuki” is an early forage oat variety suitable for fall cropping and causes poor reproduction of the southern root-knot nematode

(*M. incognita*). Fall cropping of oat in late summer to early winter is considerably advantageous because it can be applied to the non-cropping period after the forced sweetpotato cropping.

Fall cropping of “Tachiibuki” was conducted in an experimental field infested with *M. incognita* and *M. arenaria* and suppressed the density increase of the nematodes in the soil (Fig. 1). Nematode damage to storage roots of susceptible sweetpotato “Kokei 14” was also suppressed following “Tachiibuki” fall cropping (Fig. 2). The storage roots were severely damaged following “Haeibuki”, a common oat variety and following the fallow period.

The potential of “Tachiibuki” as a nematode control agent has been basically demonstrated in a few farm fields. It is important to clarify the optimum conditions in order to enhance the nematode suppression of “Tachiibuki” cropping.

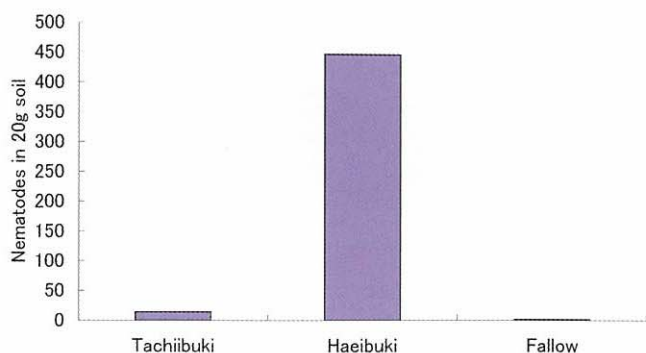


Fig. 1. Population densities of the second-stage juveniles of root-knot nematodes in field plot soil after fall cropping of oat varieties.

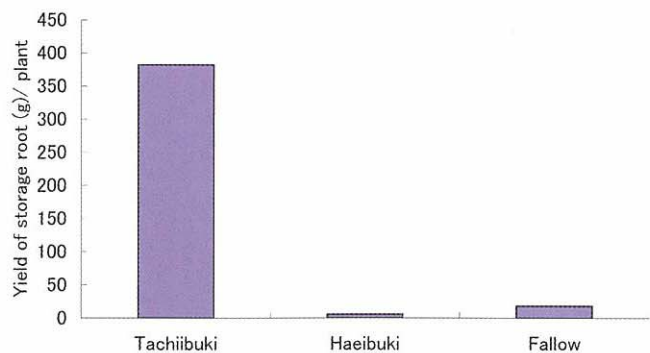


Fig. 2. Yield of “Kokei 14” storage root with no or slight defects caused by the root-knot nematodes in field plots previously cropped with oat varieties.

# Research News

## The 3rd China-Japan-Korea Workshop on Sweetpotato in China

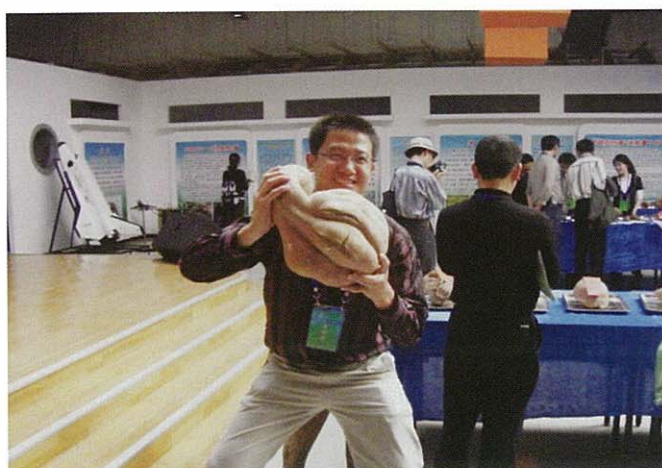
*Masaru Yoshinaga*

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The 3rd China-Japan-Korea Workshop on Sweetpotato was held in Longxi Hotel in Daxing District of Beijing from 13 to 15 Oct. 2008. The workshop was organized by Dr. Qingchang Liu, a professor of Beijing Agricultural University, and representatives of Chinese sweetpotato researchers, supported by the Daxing local government. A total of more than 200 participants, including 15 Japanese, gathered for the workshop. Thirty-two research papers were presented orally, and 44 papers were delivered by posters. These included wide research areas of genetic resources and breeding, cultivation and physiology, diseases and pests, biotechnology and molecular breeding, and functionality and processing of sweetpotatoes. It was remarkable that 24 of the presented papers were related to the area of biotechnology and molecular breeding. Korean researchers seemed to specifically focus on transgenic sweetpotatoes tolerant to environmental stresses. Chinese researchers were working energetically on developing DNA markers for stem nematode resistance. I was impressed by the advance of research in molecular breeding in both China and



Korea. A sweetpotato field trip was conducted in the afternoon of the second day. Participants enjoyed a sweetpotato festival in Daxing, at which many sweetpotato varieties and processed products were on display. We visited the Daxing Sweetpotato Industry Association that provides virus-free seedlings and conducts new variety testing for farmers. I was interested in the excellent greenhouses for sweetpotato propagation and sweetpotato plants with heavy storage roots growing on the ceiling.



# Reader's Talk

## Letter to the editor



### Sweetpotato Research in Japan Has Been Interested High in Africa

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It is interesting to write something to the SPORF Newsletter. The SPORF Newsletter is probably the only newsletter devoted exclusively to research and development of sweet potatoes. Though the newsletter is an official publication of KONARC, I am always eager to wait for the arrival of the News Letter to acquire new information on sweet potato research. Unlike in some African countries, the sweetpotato is not a major food staple in many countries. This crop is always termed a poor man's crop as it is being cultivated by marginal and disadvantaged farmers in the Complex, Diverse and Risk-prone (CDR) conditions in many parts of the globe. Although the sweet potato is produced in developed countries such as the USA and Japan, it has not attained the status of other tuber crops like potatoes and cassava. Besides fresh human consumption, it has diverse

uses such as livestock feed, starch, alcohol, bio-fuel, and biodegradable plastics. The high carotene- and anthocyanin-rich varieties are important for combating malnutrition in developing countries. The orange-fleshed variety with high carotene content can prevent children worldwide from suffering acute vitamin A deficiency. The anthocyanin- and carotene-rich varieties, which have anti-oxidant properties, can reduce the risk of several degenerative diseases such as sclerosis, cardiovascular diseases, cancer, and diabetes. In addition to roots, other plant parts like leaves, stems, and petioles are also eaten and are highly nutritious. In many countries, the transition of sweetpotato utilization from a staple food to an industrial raw materials is taking place. Despite having so many good qualities, the sweet potato is still grappling with an identity crisis.

## Editor's note

Here is the first issue of SPORF in nearly three years. We will make efforts toward semiyearly publication from now on (M.Y).



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