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Sweetpotato Research Front

Kyushu National Agricultural Experiment Station (KNAES)

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Contents

Interview: Clarifying the Physiological Functions of Sweetpotatoes

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I interviewed Dr. Ikuo Suda, who was honored for his studies on the physiological functions of food products made from sweetpotatoes and soybeans by the Science & Technology Agency in April 1999.

Yamakwa: Congratulations! I was very glad to hear that you, a sweetpotato researcher and co-editor of SPORF, had been recognized for your splendid work.

Suda: Thank you very much. This award was given to me personally, but I really think it was given to me as a representative of our sweetpotato researchers in KNAES. I would therefore like to express my profound gratitude to all my colleagues working in KNEAS.

Yamakawa: Could you tell me about your early career?

Suda: After I obtained my PhD (Doctor of Agriculture) from Kyushu University, I then worked in the University of Kumamoto Medical School. There, I learned toxicology, biochemistry, clinical chemistry, and so on through the study of the Minamata Disease which was caused by methyl mercury poisoning. The tragedy of all the patients who suffered from Minamata Disease is too great to express. When I came to KNAES eight years ago, I therefore redirected my research target from toxic substances to safety and healthy substances contained in food.

Yamakawa: You had experience in an facinating research field before you joined us. I am sure that experience is really connected with the present work for which you now are being honored. Please explain the physiological functions you are attracted by.

Suda: The most interesting physiological function is radical-scavenging (antioxidant) activity, because radical scavengers possess superior potential for preventing many disease including cancer, hepatitis and arteriosclerosis. Thus, I first evaluated the radical scavenging potentiality of soybean, vegetables, sweetpotato, buckwheat, and so on by *in vitro* assay. Plant materials with high radical scavenging potentialities were further evaluated with animals and humans.

Yamakawa: Plants can not move to escape from harmful conditions. Ultra-violet light is one such harmful condition and causes super oxidants in plants. Therefore they have acquired the ability to produce chemical substances to neutralize the toxic materials. These substances are pigments like carotene, anthocyanin and so on. In your opinion, are these pigments useful for protecting the human body as well?

Suda: Anthocianin, flavonoid and carotenoid pigments have potential radical scavenging activities. When they are incorporated into our bodies, they will protect us from free radicals that may cause many diseases. Actually, human beings with impaired hepatic function can achieve a normal heptatic function after drinking high anthocyanin sweetpotato juice for 44 days. At the same time, the juice reduces the blood pressure of those suffering from hypertension.

Orange- and Purple-Colored Sweetpotato Juice.

Yamakawa: I think there are a lot of things left to study about sweetpotatoes. Please tell me about your planned future research work on sweetpotatoes.

Suda: Our KNEAS sweetpotato research group has clarified that the sweetpotato has various physiological functions by *in vitro* studies. However, *in vivo* study is only one early step for research on physiological functions. Thus, I want to relate the results from *in vivo* studies to the metabolic fate of substances concerned with physiological functions by using experiment animals, for example, bodily absorption of functional substances, the turnover and excretion. In particular, anthocianin, flavonoid and carotenoid pigments are the most influential candidates exhibiting physiological functions in animals and humans.

Yamakawa: Thank you for your kind cooperation. I hope you can develop your work further.

Research News

New Research Facility for Sweetpotato Biotechnology Built in KNAES (Miyakonojo)

In January 1999, KNAES built a new research facility on the Miyakonojo campus to promote biotechnology research of sweetpotato.

This research facility is equipped with a laboratory and a phytotron which follows the genetic transformation guidelines of the Science & Technology Agency of Japan. The guidelines require that the facility constantly maintain a negative pressure to prevent the leaking of transformants including pollen, vectors, and insects. Liquid waste from the facilities is drained only after sterilization by automatic autoclaving and filtration.

This facility also includes normal laboratories and phytotrons to maintain virus-free materials. We are now trying to develop a sweetpotato transformant having heat-resistant β -amylase and to select virus resistant lines using this facility.

Research Paper

Using of Hardened Ridge-Surface Method for Environmental Conservation Compatible with Crop Production

Hiroki Ikoma, Nobuharu Kihou and Sasakazu Imazono

Research Project Team 2

Ground water is polluted by nitrate-nitrogen leached from agricultural upland when nitrogen fertilizer is carried under ground by rain water. The hardened ridge-surface method developed by our team prevents ground water pollution by increasing the amount of run-off water and decreasing the amount of percolation water. This method employ a bobbin-like rotator to harden the ridge surface, it is rotated by the PTO of a tractor (Fig.1). When this method is applied to sweetpotato cultivation, it reduces among leaching of nitrate-nitrogen by 60 to 80% compares with conventional ridging.

With the hardened ridge surface method, storage roots of sweetpotato grew well and the yield was 10% higher than that of the conventional ridge method, with both normal and 1/2 amounts of fertilizer applied (Table 1). The number of storage roots produced under the hardened ridge-surface method was equal to that in the conventional ridge method, so the hardened ridge-surface method seems to promote thickening growth rather than numbers of storage roots.

With regard to quality, storage roots grown under the hardened ridge-surface method had a short fusiform shape and deeper skin color than those produced by the conventional ridge method.

Crop management was easy, because to be formed same smooth surface ridges were formed by this method. There is also lower soil loss because of the hardened soil surface. Soil surface applied herbicides were also more effective, and fewer weeds germinate because brined seeds can't appeared hardened surface.

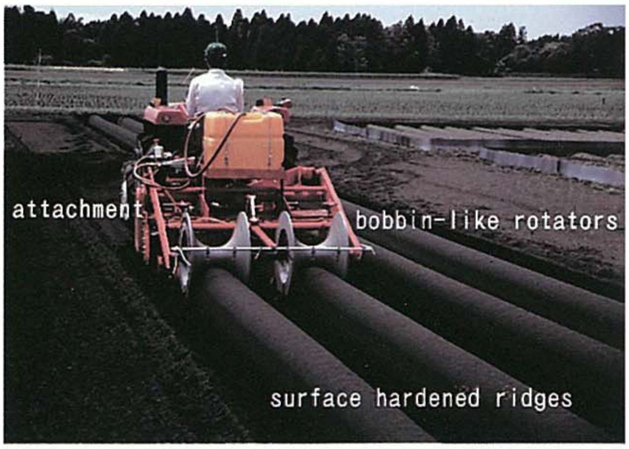

Fig. 1. Picture of hardening ridge surface by bobbin-like rotator

Table 1. Influence of hardened ridge-surface method on yield of sweetpotato (Kokei-14)

Treatment	Root yield (gm^{-2})	Root number (m^{-2})	Root weight (g)	Root length (cm)	Root thickness (cm)	Skin color L*	a*	b*
Hardened ridge-surface								
N-fertilizer 4.8g/m^{-2}	3380	16.0	212.5	14.8	5.6	43.6	14.6	9.5
N-fertilizer 2.4g/m^{-2}	2967	12.2	244.4	14.6	5.4	-	-	-
Conventional ridge								
N-fertilizer 4.8g/m^{-2}	3014	16.6	182.0	14.6	4.8	44.5	13.5	9.6
N-fertilizer 2.4g/m^{-2}	2786	12.3	229.1	16.6	5.0	-	-	-

Research Paper

Biological Control of *Meloidogyne incognita* on Sweetpotatoes for Table Use by *Pasteuria penetrans*

Yasushi Tateishi

Laboratory of Plant Nematology

The southern root-knot nematode, *Meloidogyne incognita*, is a major pest of sweetpotatoes. This nematode causes not only a yield loss but also cosmetic defects which decrease the market value of fleshy storage roots. Most cultivars for table use are not highly resistant at present. Therefore, a large amount of fumigants are frequently applied for commercial production. However, some agrochemicals are now considered to be a source of environmental pollution. In order to develop alternative control measures, the suppressive effects of *Pasteuria penetrans*, an obligate bacterial parasite of the nematode on *M. incognita* were investigated.

Sweetpotato cv. Kokei-14 (highly susceptible to *M. incognita*) and Beniazuma (moderately resistant) were cultured from June 7 to October 6, 1997 (119 days) in andosol field plots (0.99 m^2) infested with *P. penetrans* to which 5×10^9 or 2×10^{10} endospores per m^2 were applied in 1994.

For both cultivars, the population of second-stage juveniles of *M. incognita* in soil samples at harvest was significantly lower in plots to which *P. penetrans* was applied (Table 1). Marketable yields of fleshy storage roots with few or no cosmetic defects related to infection of *M. incognita* were significantly increased by *P. penetrans* (Table 2). These effects were equal to those of fumigation with 1,3-D which was a regular control practice (Tables 1 and 2). Although *P. penetrans* is a promising biological control agent, the suppressive effects occur two or three years after application. Therefore, practical management in combination with other control agent (e.g. cropping systems and nematicides) is feasible.

Table 1. The numbers of 2nd-stage juveniles of *Meloidogyne incognita* recovered from 20 g soil samples by the Baermann funnel technique in 1997

Treatments	Beniazuma (moderate resistant cultiver)		Kokei-14 (highly susceptible cultiver)	
	Planted June 9	harvested Oct. 6	Planted June 9	harvested Oct. 6
Control	0.6^a	44.8^a	0.4^a	163.1^a
Nematicide application 1,3-D (92% a. i.) 20 *l* / 10a	0.0^a	12.0^{ab}	0.0^a	54.4^b
Pasteuria penetrans application 5×10^9 endospores / m^2	0.0^a	7.8^b	0.1^a	26.6^b
Pasteuria penetrans application 2×10^{10} endospores / m^2	0.0^a	9.4^a	0.0^a	49.0^b

Data represent means of three replicates; figures in a column followed by the same letter are not significantly different at 1% level using the Tukey test.

Table 2. Yields of fleshy storage roots of sweetpotato cultivars Beniazuma and Kokei-14 in 1997

Treatments	Beniazuma (moderate resistant cultiver)		Kokei-14 (highly susceptible cultiver)	
	Marketable yields[a)] (kg / a)	Percentage of marketable yield (w / w)	Marketable yield[a)] (kg / a)	Petcentage of marketable yield (w / w)
Control	65.2^a	20.3^a	22.0^a	7.9^a
Nematicide application 1,3-D (92% a. i.) 20 *l* / 10a	308.9^b	76.7^{ab}	340.8^b	76.3^b
Pasteuria penetrans application 5×10^9 endospores / m^2	258.7^{ab}	64.9^b	231.7^b	50.4^{ab}
Pasteuria penetrans application 2×10^{10} endospores / m^2	327.2^b	89.9^b	272.2^b	67.8^b

Data represent means of three replicates; figures in a column followed by the same letter are not significantly different at 5% level using the Tukey test.

a) Yield of fleshy storage roots with little or no cosmetic defects e.g. cracks, lesions, and constriction related to infection by *Meloidogyne incognita*.

Research Paper

High Quality Method of Drying High-Colored Sweetpotato for Powder and Stick

*Hideo Fukazawa and Ken-ichi Yakushido**

Laboratory of Farm Operation Mechanization Systems

***Research Project Team 3**

High-colored sweetpotatoes that have purple or orange flesh containing anthocyanin or β-carotene have been developed. To apply these advantages, a drying method has been developed in order to produce primary processed food for bread and noodle making. Previous sweetpotato powder manufacturing processed required steaming and boiling. However, these processes change the properties of products and increase cost. We directly dry cut roots to avoid steaming and boiling processes. The most important thing is to prevent the loss of the functional elements, e.g., anthocyanin and β-carotene.

The technical points are as follows.

1) The root fine cutting treatment consists of square shreds like juliene strip (2.8 × 4.2 mm square).

2) An air-flow dryer is used to dry shreds. Compared to a flow dryer, a rotary-type cross-flow dryer dry shreds homogeneously because the tumbling material travels in a drum. In addition, the product has a good shape with no twists.

3) The dryer is operated at an air flow of 80℃ in the first half of the drying cycle then at 55 to 60℃ in the later half of drying (Fig. 1). Temperature in the drum range for 40℃ to 50℃ in the later part of drying. The temperarture is not more than 50 ℃. This temperature in a drum is approximately equal the temperature of the material. This reduced temperature operation prevent rises in material temperature, thus, minimizing the breakdown of anthocyanin or β-carotene.

4) These dried sticks can be ground into flour immediately. They thus, have a good storage conditions to maintain the color over a long period of time.

The first high quality drying plant is now in operation(Fig. 2).

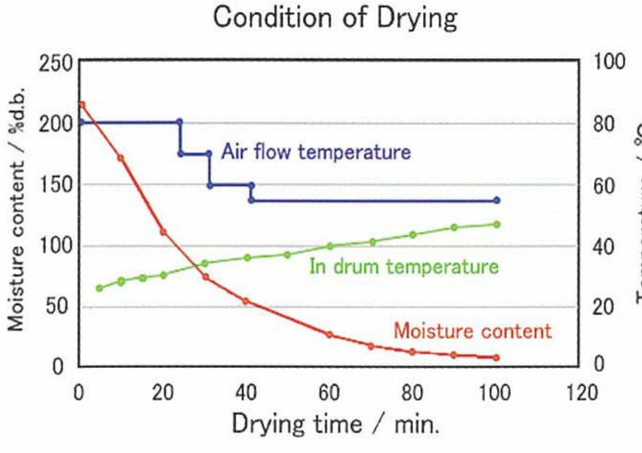

Fig. 1. Drying conditions

Fig. 2. Process of powder production from colored sweetpotato

Reader's Talk

Letter to the editor (1)

Sweetpotato Researchers in the Cuban Republic

*Dr. Alfredo Morales Tej**

Leader of Sweetpotato Researcher Institute of Tropical Root and Tuber Crops

First, I would like to thank you for your publication "Sweetpotato Research Front (SPORF)", which I consider to be a good idea for all sweetpotato research. I am sure this newsletter will be a good way for us to exchange information. In Cuba, sweetpotato and cassava are the two most important tropical root and tuber crops. This crop is planted in almost 60,000 hectares annually, but the yield is really too low (about 5 t/ha). Our Institute has been working with this crop for 30 years. We keep a field genebank which includes about 600 accessions. More than 50% of the sweetpotato growing area in Cuba is planted with varieties recommended by our Center, and all technologies have been obtained at INIVIT. We have some limitations in developing this important crop. These are: 1) High infestation levels of sweetpotato weevil (*Cylas formicarius*). No resistant varieties are available. 2) Prolonged dry seasons in Cuba. 3) There is a lack of culture in relation to sweetpotato uses. I consider the sweetpotato to be a very important crop in Cuba and in the Caribbean area as a food source, and we are far from reaching its potential uses as in other countries like Japan, the People's Republic of China and other countries where high yields are obtained and several sub-products are produced from sweetpotato. It would be valuable to exchange information with KNAES and institutions from other countries in order to make efforts to satisfy the people in growing demands. Once more, I congratulate you for publishing SPORF because it constitutes an important way to learn about interesting sweetpotato research are taking place in Japan and other countries around the world.

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Letter to the editor (2)

SPORF: A Valuable Tool for Sweetpotato Researchers Worldwide

*Raquel Rojas Mir**

Specialist on Information

First of all, I would like to thank you because of the wonderful idea you had in producing SPORF, which is a nice way to exchange information on this important crop. I work as a librarian in the Information Center of the Research Institute of Tropical Root and Tuber Crops, and I can tell you this newsletter is highly demanded by many users from our Institution and Cuban sweetpotato growers. I have informed the researchers about this newsletter, and many of them are interested in writing letters to the editor in order to congratulate him for such a work and to exchange information on the mentioned crop. The sweetpotato is one of the most important crop in Cuba. Although, yields are too low at present, efforts are being made to secure its potential yield and uses. Once more, I congratulate you for sending us Sweetpotato Research Front.

Editor's note

I am now correcting spelling and preparing the layout of the front and rear pages of this ninth SPORF using a Windows-based computer. The font size used in SPORF has gradually become smaller and smaller with each publication since the first issue. This small print is ruining my eyes tonight, but the rich abundance of sweetpotato research information collected in this issue will surely cure my eyestrain tomorrow morning. **(I.S.)**

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