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Sweetpotato Research Front

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Contents

Report of the Saga Forum on the Utilization of Sweetpotatoes and Potatoes

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The Saga Forum on the Utilization of Sweetpotatoes and Potatoes was held June 5, 2003, in Saga Prefecture. The forum was attended by more than 120 people, including researchers, farmers, manufacturers, and consumers, surrounded by many sweetpotato and potato cultivars, processed goods made by the participants, and research posters.

Dr. Suda lectured about characterization and utilization of new sweetpotato cultivars developed at KONARC, such as "Joy White," "Konahomare," "Benimasari," "Tamaotome," "Sunny Red," "J-Red," "Ayamurasaki," "Murasakimasari," and "Suioh," and the multiple physiological functions of purple-fleshed sweetpotatoes, such as radical-scavenging activities and restoration of the liver function and blood pressure levels to normal in volunteers with impaired hepatic function and/or hypertension.

Purple-fleshed sweetpotatoes attracted special attention as a superior resource for production of foods with health benefits and as a natural food colorant with its brilliant red and purple colors. Another topic was "Suioh" (SPORF, No. 15, p4) and "Simon-1" (SPORF, No. 16, p2) for utilization as edible green vegetables.

Research Paper

Radical-Scavenging Components in Sweetpotato "Simon-1" Leaves

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.Sweetpotato variety "Simon-1," which originates from Brazil, has attracted the attention of Japanese consumers interested in the health benefits arising from its high content of minerals, vitamin K, and polyphenolic compounds in root tubers. The leaves of Simon-1 also contain the physiological functional constituents, and the yield of the leaves is almost the same as that of the root tubers. Simon-1 grows abundantly in Kuratake, Kumamoto (Fig. 1), and the leaves are processed as material for a tea-like drink, a seasoned powder for sprinkling over rice (furikake in Japanese), and for other uses. We studied the radical-scavenging components extracted from Simon-1 leaves with hot water, based on the utilization of Simon-1 leaves as material for a tea-like drink.

Extraction from freeze-dried leaves of Simon-1 was performed with hot water at different temperatures (60°C, 80°C, and 100°C). The highest 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging activity was obtained when the leaves were extracted at 100°C (data not shown).

An extract from freeze-dried leaves of Simon-1 was prepared using hot water at 100°C to identify the dominant radical scavenger, and it was analyzed by RP-HPLC while the eluate was fractionated. The measured DPPH radical-scavenging activity of each fraction revealed four components (indicated by arrows in Fig. 2) that were radical scavengers with high activity.

The components were identified using LC-ESI-MS. Peak 1 was identified as 3-mono-*O*-caffeoylquinic acid (chlorogenic acid). Peaks 2, 3, and 4 were considered to be di-*O*-caffeoylquinic acid due to the molecular ion peak at m/z 515 $[M]^-$ and an abundance of mass fragments (m/z = 353 and 173) (data not shown). This evidence clarified that caffeoylquinic acid derivatives (3-mono-*O*- and di-*O*-caffeoylquinic acids) were the dominant radical-scavenging components in hot water extracts from Simon-1 leaves.

Fig. 1 Simon-1 growing in Kuratake, Kumamoto

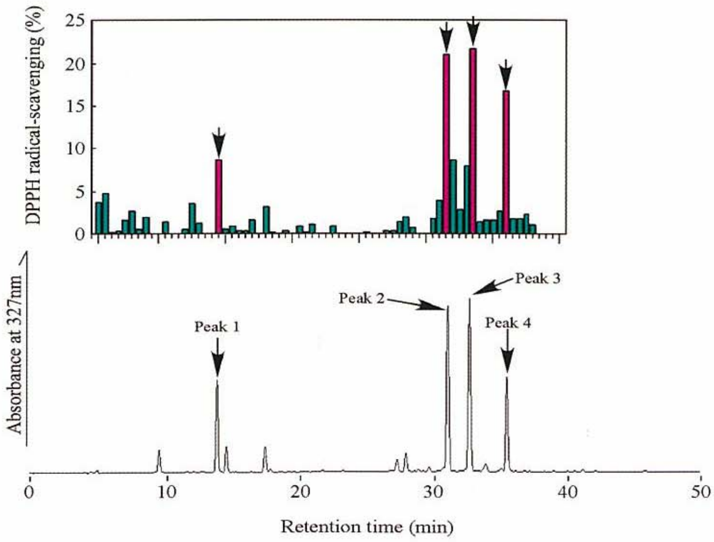

Fig. 2 HPLC elution profile and DPPH radical-scavenging activity of hot water (100°C) extract from Simon-1 leaves

Research Paper

Mechanized Direct Planting of Sweetpotatoes

Hideo Fukazawa

Field Management Division III

The common sweetpotato planting system involves raising and cutting seedlings. This part of the work is done manually; most of the other aspects of cultivation are mechanized. The primary stages of sweetpotato production are raising the seedlings, preparing the fields, transplanting, management work, and harvesting. The long working hours spent raising and cutting seedlings is one factor that causes a low yield in sweetpotato production (see figure). Direct planting is a promising technique for solving this problem. The development of suitable cultivars for direct planting would enable the grower to simply plant the seed tubers. Unfortunately, there are only a few suitable sweetpotato cultivars for starch and processing. There are three varieties for processing, "Siroyutaka" for starch, "J-Red." and "Murasakimasari."

Direct planting is economic, requiring less labor and fewer facilities for nursery beds, and seedling raising becomes unnecessary. The walking and self-propelled types of planting machines (see photograph) are semi-automatic. They consist of a feeding device and planting beak mounted on a two-wheel-drive chassis. The optimum weight for the seed tubers is 51 to 150g. The seed tubers are cut crosswise into halves to accommodate the planter and to produce a better yield. Seed tubers are fed by hand into eight feed cups with intermittent revolutions; the planting beak with the seed tubers is driven and releases the tubers into the soil. The planting speed is restrained by the manual feeding efficiency, which is 0.19 to 0.33 m/s for mulching ridges with a 33cm inter-row spacing. The position and direction of the seed tuber can be controlled when the machine is fed. A complex machine has also been developed for starch-type sweetpotato.

The ideal cultivation conditions for the planting machine are as follows. Planting posture: the cut portion of the sweetpotato faces downward or is vertical. Planting depth: 5cm. The most important factor is that the seed tuber size and shape must match the planting machine. The planting hole shape in the plastic multifilm is circular, and an 80mm diameter is suitable. It's possible to use the planting beak to make an elliptical hole. The curing treatment accelerates the seedling growth after the seed tuber is cut. The curing treatment conditions are under 27 degrees Celsius atmosphere temperature at 82 to 90% relative humidity for four days. Early April (max. temperature is 20 degrees Celsius) is the best season for planting to obtain maximum growth. The growth decreases if the planting season is delayed. Planting takes two hours per 10a of farm field; we will shorten this time to about 1.5 hours to increase the work speed.

Kyushu is often struck by typhoons, and this disaster poses great danger for such an important crop. However, the greatest production barrier is the time and cost of raising and transplanting plants. A method to realize high quality and productivity at low cost is necessary. The direct planting system is one solution to this problem. The most suitable variety that can presently be planted directly is the processing type. It is necessary to develop and expand breeding of additional varieties for other uses.

Fig. 1 Planting machine and its function

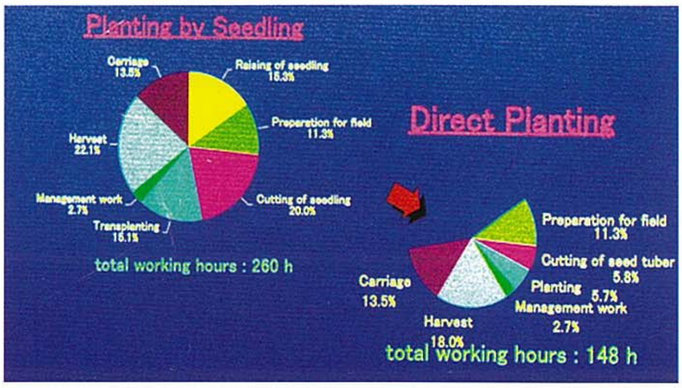

Fig. 2 Shortening Effect on Working Hours

Research Paper

Increase of Virulent *Meloidogyne incognita* Populations on a Resistant Sweetpotato Cultivar, Beniotome

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Laboratory of Plant Nematology

A large number of sweetpotato cultivars resistant to the southern root-knot nematode, *Meloidogyne incognita*, a major pest, have been developed in Japan. However, cultivars for table use are not sufficiently resistant for commercial production, other than a few cultivars, such as Beniotome.This resistant cultivar was cropped alternating with Kokei 14, which is a highly susceptible cultivar, in field plot (9 m^2) experiments, and the increase of the nematode was examined through nine cropping seasons.

Continuous cropping of Kokei 14 revealed, densities of the second-stage juveniles (J2) of the nematode in the soil that were always high at harvest time (150 days after cultivation). In contrast, the densities were very low on Beniotome untill the first and third crops in alternating cropping of Beniotome with Kokei 14. However, the nematode increased even on this resistant cultivar after the fifth crop, and the densities attained were 50 to 80% of those on Kokei 14 cropped continuously (Fig. 1). Heavily galled roots caused by the nematode were also observed, and distorted storage roots were frequently found, though no clear yield decrease of the storage root was detected on this resistant cultivar, despite infection by the nematode (Fig. 2). Beniotome exhibited tolerance to nematode attack.

The above results suggest that virulent populations of *M. incognita* will be increased by frequent cropping of the same resistant sweetpotato cultivars. Natural populations seem to be heterogeneous in parasitism of the sweetpotato. We have already detected some populations virulent to Beniotome, e.g. from Okinawa Prefecture. Thus, nematode infestation may occur even by cropping of resistant cultivars, and it could disturb the growth of subsequent nematode-susceptible crops.

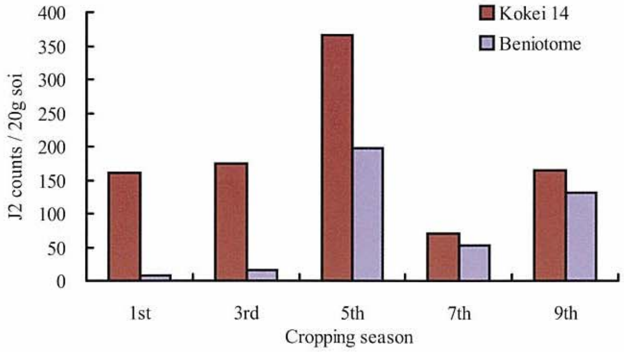

Fig. 1. Changes in population densities of *Meloidogyne incognita* at the harvest time in two cropping systems examined by the Baermann funnel technique.
Kokei 14: continuous cropping of Kokei 14; Beniotome: alternating cropping of Beniotome with Kokei 14

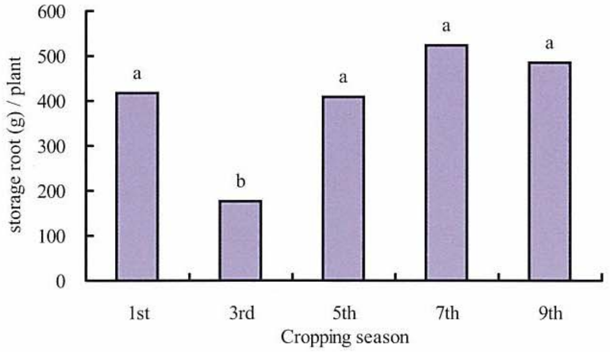

Fig. 2. Yields of the storage root of Beniotome in alternating cropping seasons.
Bars with the same letter are not significantly different according to the Tukey-Kramer HSD test at a 5% level.

Research News

Exploration and Collection of Sweetpotato Landraces in Southeast Sulawesi Province in Indonesia

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3. RIFCB, Indonesia, 4. IATADISESP, Indonesia, 5. RILET, Indonesia

Exploration for and collection of local cultivars of sweetpotato were conducted in the Southeastern Sulawesi Province of Indonesia under the collaborative MAFF Genebank project between CRIFC, Indonesia, and the National Institute of Agrobiological Sciences, Japan.

A total of 112 sweetpotato cultivars, 27 from Kendari, 13 from Kolaka, 43 from Muna, and 29 from the Buton districts, was collected during the mission from 14 to 25 June 2003. Relevant data concerning the origin, cultivation, and usage as well as the phenotypic characteristics were recorded for each collected material by interviewing the farmers and by visual examination.

Matured tubers were not available in most collection sites since this period was far prior to the sweetpotato harvest in this region, and therefore vines of each cultivar were collected for conservation and characterization. Most of these cultivars were grown on a small scale (e.g. 5x10m) in a primitive manner without creating ridges before transplanting or applying fertilizers and chemicals; they were primarily for domestic consumption.

Although their main usage was as food, leaves and vines of some cultivars were also used as vegetables, animal feed, and/or medicine. The interviews revealed that a considerable portion of farmers who grew sweetpotatoes in this region had migrated from other regions of Indonesia, such as Bali, Java, or the South Sulawesi province. The collected materials were transplanted and conserved in Kendari, Malang, and Bogor, and their genetic variations will soon be analyzed in Japan.

Laboratory of Sweetpotato Breeding

The Laboratory of Sweetpotato Breeding is responsible for developing new sweetpotato cultivars. We have been developing new sweetpotato cultivars for table consumption, starch, for the fermentation industry, food processing, and other such uses. We also maintain many genetic resources as breeding materials.

We released "Benimasari" for table use in 2001 and three new cultivars will be released in the near future, "Kyushu No. 122," "Kyushu No. 123,"and "Kyushu No. 134." Kyushu No.122 is a line for dried products after steaming and has a high carotene content. Kyushu No. 123 is a line for the starch industry and offers a high starch content and high yield. Kyushu No. 134 is a line with high carotene content for food processing and table use. We are presently developing new types of sweetpotato cultivars,such as those for direct planting, sweetpotatoes with high enzyme content, dwarf plant types, and others. We are proceeding through cooperation with the related laboratories.

Photo. Staff of Lab. of Sweetpotato Breeding

Reader's Talk

Letter to the editor

Studies of Sugar Composition of Cell Wall Polysaccharides from Tropical Root Crops and Their Enzymatic Conversion into a New Foodstuff

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There is a substantial production of sweetpotatoes in Kagoshima. Sweetpotatoes are used primarily in industry; more than 50% of the sweetpotatoes are used for starch production and about 15% to make a traditional distilled liquor, shochu. About 60,000 tons of residue is generated yearly after starch extraction. This residue was previously further utilized as a starting material for citric-acid fermentation, although the manufacture is now declining because of inexpensive imported citric acid has been imported from China. The residue has caused some problems as agricultural waste.

We started a research project several years ago to convert the starch residue to new food material and proposed a revised procedure for citric-acid fermentation to obtain by-products such as a fibrous product for dietary fiber. The following results were obtained primarily through the efforts of a graduate student, Lorena Salvador, who came from the Philippines and got her PhD last spring from the Kagoshima University United Graduate School of Agricultural Sciences.

The manufacture of starch from tropical root crops like sweetpotato (SP) and cassava (CA) produces considerable amounts of starch residue as a by-product. This residue is rich in cell wall material (CWM), which makes it a potential source of dietary fiber. This study characterized the CWM obtained from the starch residues of three root crops, SP, CA, and potato (PO) as a control in terms of their sugar composition and attempted to enzymatically convert them into soluble dietary fiber.

The sugar compositions were first analyzed to characterize the CWMs from the root crops. A monosaccharide analysis using the, HPAEC-PAD method with a CarboPac PA10 column, instead of a PA1 column, yielded a reliable sugar composition of these samples. Sweetpotato CWM had the highest amount of pectin fractions among the root crops and consequently the highest galacturonic acid content. Cassava had the highest amount of cellulose fraction, and fucose was found in its hemicellulose fraction.

In potato, galactose was present in the highest amount.It was only in the hemicellulose fraction that significant differences in the sugar composition, particularly in the galactose content, were observed among the three root crops. This is the first report on the sugar composition of cassava CWM.

A bacteria that produces a CWM-degrading enzyme, *Bacillus sp.* M4, was isolated from the soil, and the crude enzyme solution from its culture filtrate was used to solubilize the residues to convert the CWMs into soluble dietary fiber. A sugar analysis of the solubilized product from the CWM of the three root crops revealed that it is primarily composed of galacturonic acid and the neutral sugars commonly found in the pectin fraction, suggesting the presence of alkaline protopectinase activity in the M4 enzyme. The mode of action of the crude enzyme was determined by a terminal sugar analysis using HPAEC-PAD after hydrolysis of the reduced products. The results revealed that the M4 enzyme attacked the galactan as well as the rhamnogalacturonan moieties of the protopectin, resulting in the release of soluble dietary fiber of the pectin fraction.

Announcements

The 17th Research Meeting for Root Crops will be conducted in the Japanese language on Dec. 4-5, 2003 at Kagoshima. The summarized reports of the previous meeting are in the back of SPORF, which also introduces the KNAES home page (http://konarc.naro.affrc.go.jp/sporf/sporf.html).

Editor's note

My experience with sweetpotato research is limited. I find distinguishing the varieties of sweetpotato to be very difficult.(Y.N)

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