



Sweetpotato Research Front

National Agricultural Research Center for Kyushu Okinawa Region (KONARC) No.13, March 2002

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Introduction of the National Agricultural Research Center for Kyushu Okinawa Region (KONARC)

Kiyotsugu Takagi

Vice President of the National Agricultural Research Organization



Most of Japan's national testing and research institutions have become independent administrative institutions (IAIs), which have been released from direct supervision of the government.

The National Agricultural Research Organization (NARO), founded on April 1, 2001, is an IAI composed of headquarters and eleven research laboratories responsible for research on agricultural production.

The National Agricultural Research Center for Kyushu Okinawa Region (KONARC) was established as a laboratory under NARO on the basis of the former Kyushu National Agricultural Experimental Station (KNAES).

The organization and role of KONARC are similar to those of KNAES. The managing system of the research organization has changed the most. The discretionary authority of the head of the laboratory has increased significantly in regard to management of personnel affairs, organization, and the budget.

KONARC has produced excellent results through the employment of learned personnel obtained by public recruitment or term-limited appointments, introduction of the accounting system used by private companies, and improvement of research facilities for public use.

While independent management has been promoted, the organization has been exposed to strict evaluations by knowledgeable persons from the outside.

NARO is presently planning to develop a fair and straightforward evaluation system to assess its own research.

Research on sweetpotatoes is presently one of the most important objectives of KONARC.

The purposes of this research are as follows: i) to reveal the latent potential of sweetpotatoes, ii) to develop sweetpotatoes with excellent quality, suitable for the needs of consumers, including foreigners, iii) to discover other applications for the sweetpotato, such as medical treatment.

It is important that we engage in research by enhancing cooperation with other fields and international organizations, while effectively utilizing the IAI system, to achieve these goals.

Research Paper

Host Suitability of the Sweetpotato, *Ipomea batatas* to Major Root-Knot Nematodes, *Meloidogyne* Species

Zen-ichi Sano and Hideaki Iwahori

Laboratory of Plant Nematology

Root-knot nematodes, *Meloidogyne* species are one of the most important plantparasitic nematodes that cause serious damage to many field crops, most vegetable crops, and ornamentals. It is widely known that *Meloidogyne incognita* seriously damages sweetpotatoes, but limited research has been conducted on other *Meloidogyne* species. Therefore, we examined the penetration of second-stage juveniles (J2) and their early development and production of egg masses to determine the host suitability of sweetpotatoes to major root-knot nematodes.

Cuttings of four sweetpotato cultivars, Norin No. 1, Norin No. 2, Kokei No. 14, and Beniazuma, were rooted in 200 g of sterilized potted soil. These cuttings were inoculated with approximately 500 newly hatched J2 of *M. arenaria*, *M. hapla*, *M. incognita* and *M. javanica* and grown in a greenhouse at an average temperature of 27 °C. Penetration and development of J2 were examined five days after inoculation, and number of egg masses on the root systems were counted after 35 days.

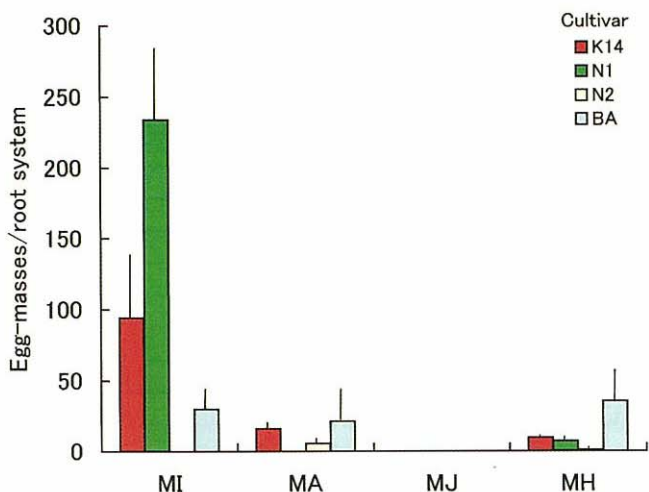


Fig. 1. Differences in numbers of egg-masses produced by 4 *Meloidogyne* species 35 days after inoculation on 4 cultivars of sweetpotato.

Nematodes: MI, *M. incognita*; MA, *M. arenaria*; MJ, *M. javanica*; MH, *M. hapla*. Sweetpotato cultivars: K14, Kokei No.14; N1, Norin No.1; N2, Norin No.2; BA, Beniazuma. Number of J2 inoculated per plant: MI, 462.4; MA, 423.6; MJ, 500.4; MH, 518.8. Vertical lines indicate 95% confident interval.

The numbers of egg masses produced by *M. incognita* varied markedly according to the cultivars (Fig. 1). Many egg-masses were laid on Norin No. 1 and Kokei No. 14, though there were none on Norin No. 2. *M. arenaria* laid some eggmasses on all cultivars except Norin No. 1, on which no egg mass was observed. A few eggmasses were produced by *M. hapla* on all four cultivars, but none were produced by *M. javanica*. J2 of *M. arenaria*, *M. incognita*, and *M. javanica* penetrated the roots of all cultivars well, and more than 50% of the penetrated J2 enlarged as early as five days after inoculation on cultivars with egg-masses, though only a few J2 enlarged on those cultivars with no egg masses (Fig. 2). J2 of *M. hapla* penetrated the roots of all cultivars, but only a few J2 penetrated and developed.

These results demonstrate that *M. incognita* is the most pathogenic species, but *M. arenaria* and *M. hapla* can also infect and reproduce on sweetpotatoes. Cultivation of sweet-potatoes could increase the populations of these nematodes, which could become a problem in intensive cropping schemes with *Meloidogyne* susceptible crops.

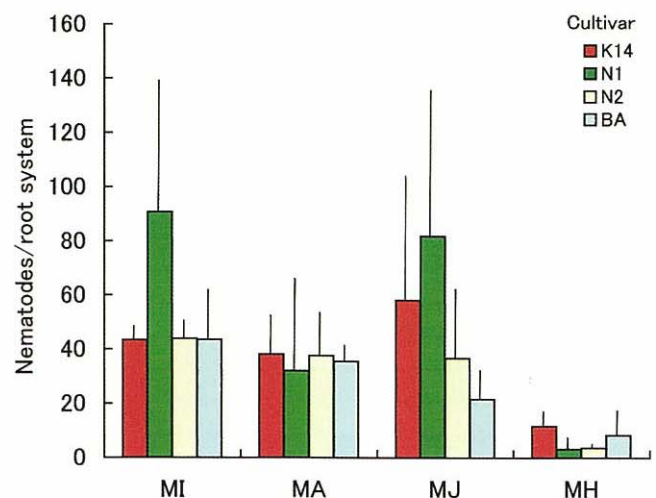


Fig. 2. Comparison of penetration rates of 4 *Meloidogyne* species on 4 cultivars of sweetpotato examined 5 days after inoculation.

See Fig. 1 also.

Research Paper

Murasakimasari: New Sweetpotato Cultivar for Processing

Toru Kumagai, Osamu Yamakawa, Yumi Kai and Koji Ishiguro

Laboratory of Sweetpotato Breeding

Introduction

“Murasakimasari” is a newly released cultivar with a high anthocyanin content and good root shape, developed at the National Agricultural Research Center for Kyushu Okinawa Region (formerly Kyushu National Agricultural Experimental Station). It was evaluated at prefectural agricultural experimental stations as breeding line “Kyushu No. 132” and was officially registered as “Sweetpotato Norin No. 54” by the Ministry of Agriculture, Forestry and Fisheries for processing in 2001.

Origin

Murasakimasari is the progeny of a cross between Ayamurasaki and Shiroyutaka that was conducted at the Ibusuki Branch of the station in 1992. Ayamurasaki is a variety for processing with high anthocyanin content. Shiroyutaka is a variety for starch production with a high root yield and high starch content. Seven hundred eighty-nine single-crossed seeds were sown in the Sweetpotato Breeding Laboratory nursery. Selection was based on field performance, anthocyanin content and processing adaptability.

Description

Murasakimasari displays a moderate sprouting ability and is a somewhat prostrate plant type. The top leaves are light green. The mature leaves are green, lobed, and triangular. The vines are of medium thickness with a slightly short internode

length. There is anthocyanin accumulation in the node. The storage roots are uniformly fusiform with a good shape and deep purple skin. The flesh is uniformly deep purple. The color value based on the absorbance coefficient (FAO, 1983) is the same as that of Ayamurasaki. The taste of the steamed root is not palatable, and thus Murasakimasari is not suitable for table use. Murasakimasari is adaptable to direct planting culture using small tuberous roots or cut sections.

Performance

The yield, dry matter content, and starch content of Murasakimasari are superior to those of Ayamurasaki.

Murasakimasari exhibits a strong resistance to root knot nematode (*Meloidogyne incognita*) and root lesion nematode (*Pratylenchus coffeae*) and a somewhat strong resistance to black rot (*Ceratocystis fimbriata*). The storage ability of the storage roots is slightly high during winter.



Table. Yield and other traits of Murasakimasari in yield trails (1997-2000, standard harvesting)

| Traits | Murasakimasari | Ayamurasaki | Koganeseengan |
|---|----------------|-------------|---------------|
| Root yield (t/ha) | 22.1 | 20.7 | 24.2 |
| Root size (g) | 154 | 183 | 205 |
| No. of roots per hill | 3.8 | 3.1 | 3.3 |
| Dry matter content (%) | 38.1 | 35.7 | 36.6 |
| Starch content (%) | 24.7 | 22.8 | 25.3 |
| Starch yield (t/ha) | 54 | 47 | 62 |
| Anthocyanin color value | 6.6 | 7.1 | - |
| Brix value (%) | 4.6 | 3.7 | 5.3 |
| Root-Knot nematode resistance ¹⁾ | R | SR | SS |
| Root-Lesion nematode resistance ¹⁾ | R | SR | SS |

1) R: Resistant. SR: Slightly Resistant. I: Intermediate. SS: Slightly Susceptible. S: Susceptible.

Research Paper

Antioxidative Compounds in the Leaves of Different Sweetpotato Cultivars

Md. Shahidul Islam, Makoto Yoshimoto, Osamu Yamakawa*, and Koji Ishiguro**

Laboratory of Upland Crop Utilization
*Director of Upland Farming Research
**Laboratory of Sweetpotato Breeding

Previous experiments revealed that sweetpotato leaves is an excellent source of antioxidative compounds namely polyphenolics and anthocyanin pigments as compared to any other commercial leafy vegetables. Nowadays antioxidative compounds have attracted special attention because they can protect human body from oxidative stress, which may cause many diseases including cancer, aging and other cardiovascular diseases. The aim of the present study is to clarify the relationship between the anthocyanin and polyphenolics, radical scavenging activity in sweetpotato leaves using three different cultivars.

Vine cutting (20 cm long) of the three sweetpotato cultivar namely Simon No. 1, Kyushu 119 and Elegant Summer were grown in a greenhouse using standard production practices. After 45 days of planting the leaves were harvested on 15 August and immediately kept at -85°C . The freeze-dried sample with ten replications was used for the polyphenol, anthocyanin and radical scavenging activity analysis. Figure 1 shows that there were significant differences ($P>0.01$) in case of polyphenol content and anthocyanin pigments among the cultivars. The highest polyphenol content was found in Simon No.1 ($9.68\text{g } 100\text{g}^{-1}$ leaf

powder) and the lowest in the Elegant Summer ($7.45\text{g } 100\text{g}^{-1}$ leaf powder). On the other hand, Elegant Summer had the highest (18.89 color value) anthocyanin pigments followed by Kyushu 119 (11.78 color value), and Simon No. 1 had the lowest (2.99 color value). In the case of radical scavenging activity, the cultivar Simon No. 1 showed highest activity ($0.65 \mu\text{mole Trolox mg}^{-1}$) and Elegant Summer was the lowest ($0.48 \mu\text{mole Trolox mg}^{-1}$) (Figure 2). Among the three cultivars studied, the Simon No. 1 was designated as high polyphenol and the Elegant Summer was designated as high anthocyanin accumulator. Our data clearly demonstrated that there was a significant positive correlation between sweetpotato leaves polyphenol contents and radical scavenging activity in all the three cultivars studied ($r=0.999$) but there was a negative relationship with anthocyanin pigments and radical scavenging activity ($r=-0.994$). Furthermore, the relationship between polyphenolics content and anthocyanin pigments in sweetpotato leaves are found negative ($r=-0.987$). The results may help in future breeding programs and enhance recent progress in molecular biology designed to increase antioxidant components available for human consumption.

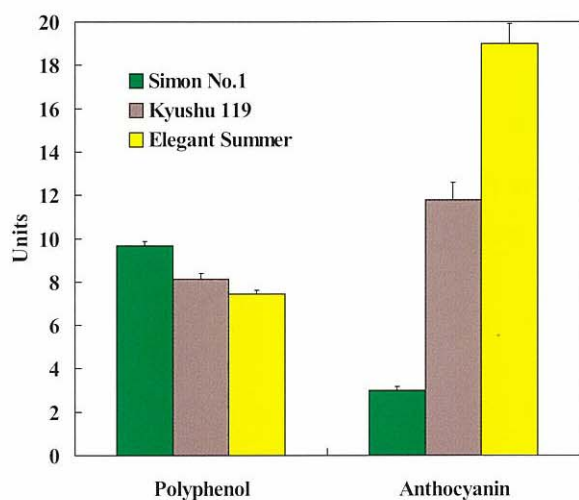


Fig. 1. Polyphenol content ($\text{g } 100\text{g}^{-1}$ dry leaf powder) and anthocyanin pigment (color value g^{-1} dry leaf powder) in leaves of three different sweetpotato cultivars.

Bars indicate the standard error from the mean of ten replicates.

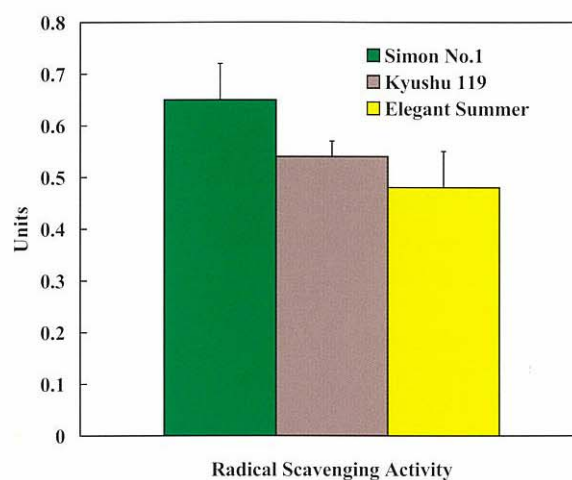


Fig. 2. Radical scavenging activities ($\mu\text{mole Trolox mg}^{-1}$) in the leaves of three different sweetpotato cultivars.

Bars indicate the standard error from the mean of ten replicates.

Research News

International Workshop of Asian Network for Sweetpotato Genetic Resources
was held in Indonesia, October 2-4, 2001

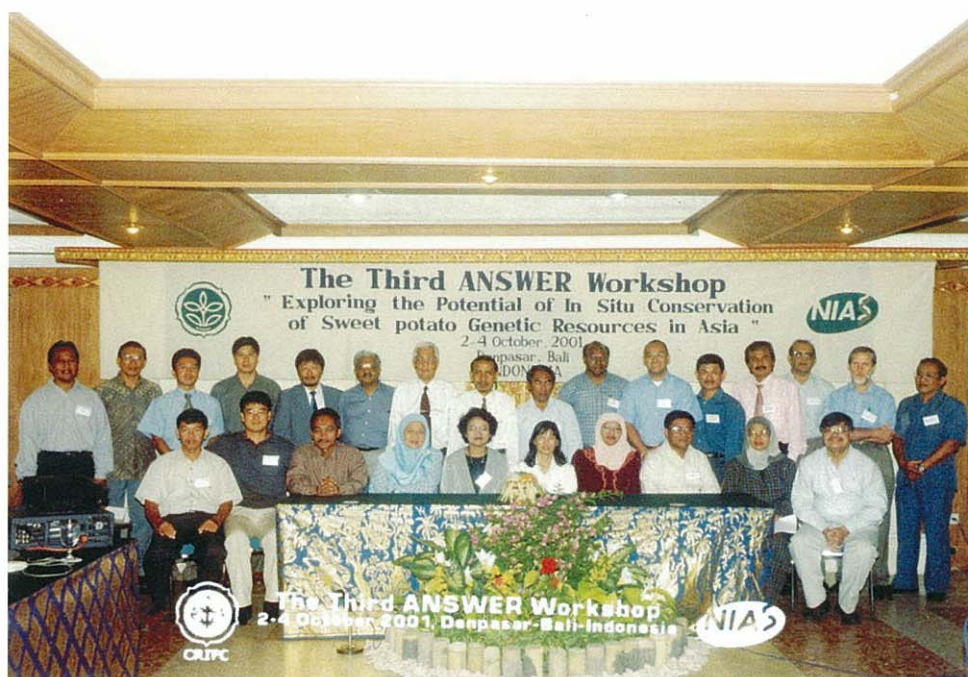
Koji Ishiguro

Laboratory of Sweetpotato Breeding

The Third International Workshop of the Asian Network for Sweetpotato Genetic Resources on Exploring the Potential of *In Situ* (On-Farm) Conservation of Sweetpotato Genetic Resources in Asia was held in Denpasar, Bali, Indonesia, on October 2-4, 2001 (<http://www.eseap.cipotato.org/ANSWER/Index.htm>). This workshop was sponsored by the Japanese Gene Bank, and was organized by the National Institute of Agrobiological Sciences (NIAS), Japan; the Central Research Institute for Food Crops (CRIFC), Indonesia; the Asian Network for Sweetpotato Genetic Resources (ANSWER); the International Potato Center (CIP); and the International Plant Genetic Resources Institute (IPGRI). Sweetpotato researchers from China, Indonesia, Korea, Malaysia, Papua New Guinea, the Philippines, Thailand, Vietnam, and Japan were present, and their activities regarding genetic resources, breeding, post-harvest, and

other aspects of sweetpotato management were introduced. Dr. Makoto Nakatani and I were the representatives from Japan, and our presentations were titled "From *ex situ* to *in situ*, Japan's Domestic and International Experiences" and "Genetic Resources and Breeding of Sweetpotatoes in Japan," respectively. The use of *in situ* (on farm) conservation, which complements field gene bank maintenance (*ex situ* conservation), was also discussed during the workshop. The *ex situ* conservation had encountered some problems, such as extinction of some resources and high maintenance costs.

I reached a new understanding of the importance of sweetpotato genetic resources and the difficulties with their maintenance. I thank all participants and the secretariat staff of the workshop for their kindness and look forward to the further development of ANSWER.



Participants of the Third International Workshop of ANSWER on Exploring the Potential of *In Situ* (On-Farm) Conservation of Sweetpotato Genetic Resources in Asia, October 2-4, 2001, Denpasar, Bali, Indonesia

Research News

Report of the International Symposium Sweetpotato: Food and health for the future

Osamu Yamakawa

Director of Upland Farming Research, KONARC

An international sweetpotato symposium titled "Food and health for the future" was held at the main auditorium of the Universidad Nacional Agraria La Molina in Lima, Peru, on November 26-29, 2001. All presentations were grouped into four workshops: genetic solutions for the future, crop management, physiology and agronomy, and food and health. The latest results of over one hundred studies from all over the world were reported by oral or poster presentations.

The author presented a lecture entitled "Sweetpotatoes as a New Food Material with Physiological Functions" as the keynote presentation. Dr. Yoshimoto, from the same department, reported on the antibacterial activity of the sweetpotato leaf against several poisonous bacteria, particularly pathogenic *E. coli* (O-157). The content of the keynote presentation can be summarized as follows. Sweetpotatoes are one of the most important upland crops in central and southern Japan. The roots of some varieties of sweetpotato contain higher contents of various vitamins, minerals, and protein than other vegetables. Consumption of the sweetpotato has declined in recent decades despite its agronomic and nutritional advantages. Interest has been focused on the development of new uses to solve this problem. A better understanding of the physiological functions of the sweetpotato is an important factor in developing new uses. Functional foods that offer nutritional or health benefits to the daily diet become popular in Japan.

The top three causes of deaths in Japan are cerebrovascular disease, heart disease, and cancer. The physiological functions of sweetpotatoes have been investigated with particular attention to disease prevention. Recent studies have indicated that sweetpotatoes contain functional components such as anthocyanins, polyphenols, and dietary fibers, which are effective for pro-

tection against disease. However, the content of these functional components is influenced by the specific variety, cultivation conditions, and intake portions. The outer portion of the roots near the skin contains a substantial amount of anthocyanins, polyphenols, and calcium. Therefore, the outer portion of the roots provides for an effective intake of functional components. A new method for processing the whole root into flour has recently become practicable. This is an excellent processing method from the standpoints of not only the effective intake of physiologically functional components but also a beneficial use of an available natural resource.

New utilization of sweetpotato tops and processing of waste have also been investigated. The leaf has some interesting functions, and its components are being identified. New technology for using the tops and the waste will be developed in the future. These research projects demand close collaboration among different research fields and organizations.



Author with researchers of North Carolina University in CIP.

Research News

Report on the 15th Meeting on Root Crop Research held in Oita Prefecture

Yoshinori Nakazawa

Laboratory of Sweetpotato Breeding

The 15th Meeting on Root Crop Research was held December 6-7, 2001, in Oita Prefecture. Eighty researchers engaged in study of the sweetpotato and the potato attended the meeting to exchange information on results and plans for future studies. The discussions of sweetpotato are summarized as follows.

1. Performance trials on sweetpotato conducted by the Prefectural Agricultural Experiment Station for newly distributed breeding lines were described. Kyushu-141 has a high starch content and superior yield. Kyushu-142 and Kyudhu-143 have good taste and good shape for table use. Kyushu-144, with a rich carotene content, was selected for food processing use due to its agreeable taste. Kyushu-130 will be registered as a new variety.

2. Performance trials on potatoes conducted by the Prefectural Agricultural Experiment Station for newly distributed breeding lines were described. Saikai-28 will be registered as a new variety.

3. Nine short research topics were presented: 1) A new SPFMV line isolated in Oita prefecture; 2) Breeding of taro and its performance trials; 3) Variety distinction of purple sweetpotatos by RAPD; 4) Nitrogen fixation azotobacter of

sweetpotato; 5) Use of beta-amylase from sweetpotato; 6) Processing characteristics of purple sweetpotatos in Tanega-shima; 7) Potato and sweetpotato remains in Peru; 8) Report titled "Sweetpotato, Food and Health for the Future" (November 26-29, 2001, in Lima, Peru); 9) Report on sweetpotato genetic resource exploration in Indonesia.

4. A presentation on biodegradable plastics was given by the Secretary-General of the Biodegradable Plastics Society.

The next meeting will be held in Saga Prefecture.

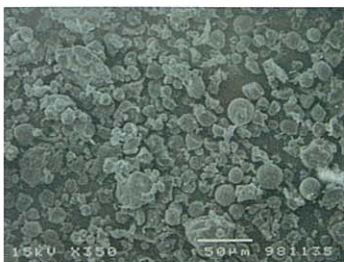


Announcements

Erratum

Sugawara, T.(2001); Extrusion processing for sweetpotato powder to improve product quality. SPORF, 12, p.4

Figure 1 is exchanged. The new photographs appear below.



condition No. ②



condition No. ⑤



condition No. ⑦

Fig. 1. The photos of the starch in the products by SEM

Reader's Talk

Letter to the editor



DNA Analysis of Indonesian Sweetpotato Germplasms Collected from Bali, Lombok, Sumbawa and Sumba Islands Using RAPD at KONARC, Miyakonojo, Miyazaki, Japan

Ida Hanarida S. and Minantyorini, Dra.

Plant Genetic Resources Division, Research Institute for Foodcrop Biotechnology (RIFCB), Bogor, Indonesia

Sweetpotato exploration had been conducted in the islands of Bali, Lombok, Sumbawa and Sumba under the research cooperation between CRIFC (Central R&D Institute for Food Crops, Indonesia), and NIAS (National Institute of Agrobiological Science, Japan). A total of 236 sweetpotato accessions were collected from Bali (80), Lombok (51), Sumbawa (23) and Sumba (78) during July 11 - August 1, 2001. Along with domesticated type (*Ipomoea batatas L.*), some wild species such as *I. triloba*, *I. obscura*, *I. pes-caprae* etc, were also found.

The extractions of DNA were carried out in RIFCB, Bogor (The DNA extraction methodology from dried young sweetpotato leaf was trained by Mr. M.Tanaka and Dr. M. Nakatani). The extracted DNA was brought to KONARC, Miyakonojo, Japan, and RAPD analysis was done to clarify the genetic diversity of the collected accessions. Eleven kinds of 12mer primer, which tested by Mr.

M. Tanaka, were used to the same.

Products of PCR reactions were performed by using 2.0% agarose gel, and the polymorphic band profile scored individually based on the existence (1) or non-existence (0). The results indicated that the numbers of polymorphic bands generated by each primer were ranging from one to six, and primer number A12 (TTC GGA CGA ATA) exhibited the highest number of polymorphic band. However, to obtain the dendrogram (cluster analysis), the data will be analysis by NTSYS software program. Furthermore, to understand the dice coefficient that determine the relative genetic distance of the above accessions, further analysis as formation of Biner data can be done by using the formula of Nei and Li (1979).

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Announcements

The SPORF mail address was newly made and the homepage address changed, respectively.

E-mail: sporff@ml.affrc.go.jp

URL: <http://konarc.naro.affrc.go.jp/sporff/sporff.html>

Editor's note

SPORF is a comprehensive periodical on sweetpotato research. As a nematologist, I wish more colleagues would contribute research papers or news concerning pest management of sweetpotatoes. (Z.S.)



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