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Sweetpotato Research Front

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Contents

Expectation to SPORF from the new director general of KNAES and director of Upland Farming Department

Hitoshi Mikami
Director General of Kyushu National Agricultural Experiment Station(KNAES)

On July 1, 1998, I became Director General of KNAES after succeeding Dr.Masayosi Kamio who was retired from the ministry after a service of 37 years. KNAES has been promoting studies for the improvement of the productivity and quality of agricultural products, in harmony with environmental conservation, in Kyusyu and Okinawa districts since its establishment in 1950. Although sweetpotato is still a main crop here, the conditions surrounding sweetpotato production have remarkably changed with the recent trend to internationalization of agriculture, and diverstication and sophistication of the consumers' needs. KNAES conducts intensive research aimed on creation of new demand of sweetpotato. I hope that SPORF will continue to play an active part in the research coordination and extension of sweetpotato research in the world.

Toshihiro Senboku
Director of Dept. of Upland Farming of KNAES

Sweetpotato is one of the most important crops worldwide. The extensive studies on the production and post harvest technology of sweetpotato, such as breeding, processing, mechanization, and cultivation, are conducted by the research group of Upland Farming Dept. in Miyakonojo, for farmers in Kyushyu and Okinawa and also for industrial purposes.

To identify the functional components and to promote the efficient utilization of the stems and leaves, further studies on sweetpotato are also carried out jointly works with other research groups. We would like to establish a sweetpotato research information center, through collaborative work among researchers worldwide. I am convinced that SPORF will be able to promote communication among the sweetpotato researchers.

Research Paper

"Sunny Red " : New Sweetpotato Cultivar for Powder

Toru Kumagai, Osamu Yamakawa and Koji Ishiguro
Laboratory of Sweetpotato Breeding

"Sunny Red" is a newly released cultivar with high starch and carotenoid contents, developed at Kyushu National Agricultural Experiment Station. It was evaluated at prefectural agricultural experiment stations and food processing companies as breeding line "Kyushu No. 114," and officially registered as "Sweetpotato Norin No.51" by the Ministry of Agriculture, Forestry and Fisheries in 1998 for food processing use, especially for sweetpotato powder.

Origin

"Sunny Red" is a progeny from a cross between "Kyukei-79" and "Benikomachi" conducted at the Ibusuki Branch of the Station in 1986. Collected 1,184 seeds were sown in the nursery of the Sweetpotato Breeding Laboratory and selected based on field performance and processing adaptability. "Kyukei-79" has a red skin and good appearance. Steamed roots of "Benikomachi" have a good taste.

Description

"Sunny Red" displays a moderate sprouting ability and a slightly prostrate plant type. The top leaves are light green. The mature leaves are green and cordate. The vines show a medium thickness with a slightly short internode length. There is a slight anthocyanin accumulation in the veins. Storage roots are long, fusiform with red skin and orange flesh. Beta-carotene content of dried roots ranged from 25 mg to 50 mg / 100 g DW depending on the cultivation conditions. The sweetpotato powder made from "Sunny Red" exhibits a better quality with a clear orange color and good quality for processing, compared with other carotenoid lines. As the taste of steamed roots is better than that of other carotenoid lines, "Sunny Red" is considered to be suitable for table use.

Performance

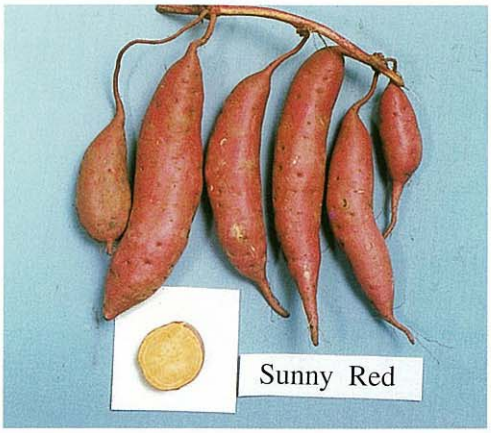
Yielding ability, dry matter content and starch content of "Sunny Red" are considerably higher than those of "Benihayato" and comparable to those of "Koukei No.14."

"Sunny Red" exhibits a slightly weak resistance to black rot, but an intermediate resistance to the root lesion nematode, and strong resistance to the root knot nematode. Storage ability of the roots is slightly low throughout the winter.

Yield and other traits of "Sunny Red" in yield trial (1991-1997, standard harvesting)

Traits	Sunny Red	Benihayato	Koukei-14
Root yield (t/ha)	19.7	14.8	18.7
Root size (g)	181	152	184
No. of roots per hill	2.8	2.4	2.7
Dry matter content (%)	32.1	25.0	32.2
Starch content (%)	15.0	24.7	24.3
Brix value (%)	4.3	3.9	4.0
Root knot nematode resistance[1)]	R	SR	SS
Root lesion nematode resistance[1)]	I	I	I
Black rot resistance[1)]	SS	—	SS
Storage ability[2)]	SL	SH	M
Beta-carotene content (mg/100g DW)[3)]	34.2	44.2	—

1) R : Resistant, SR : Slightly Resistant, I : Intermediate, SS : Slightly Susceptible
2) SH : Slightly High, M : Medium, SL : Slightly Low
3) Data collected for 1993-1997



Research Paper

Storage Conditions of Orange- or Purple-Colored Sweetpotato Powder and Sticks for the maintenance of color

*Shu Furuta, Ikuo Suda, Yoichi Nishiba and Hideo Fukazawa**

Laboratory of Crop Quality, Storage and Processing
***Laboratory of Farm Operation Mechanization Systems**

Sweetpotatoes with orange or purple flesh contain β-carotene or anthocyanin, respectively. Therefore it is anticipated that dried powder and sticks could be used as natural food materials with healthy effects on human body. We studied the storage characteristics and determined the conditions to maintain the color over a long period of time. The results obtained were as follows.

1) Purple color of the powder and sticks did not fade in the dark, regardless of the presence of oxygen (Fig.1-A, B).
2) Orange color of the powder and sticks faded in the presence of oxygen, and the fading was more conspicuous in the stick type (Fig.1-F,G).
3) Fading of the orange color was prevented by keeping the storage temperature below 15℃ (Fig.1-J). As for the gas conditions, vacuum was most effective, followed by exposure to carbon dioxide and nitrogen (Fig.1-F,G). Deoxidizer could be used instead of gases (Fig.1-H,I).
4) Under ultraviolet radiation, orange and purple color of the powder faded (data not shown). The use of an aluminum bag to avoid the light was effective in maintaining the color of the powder.

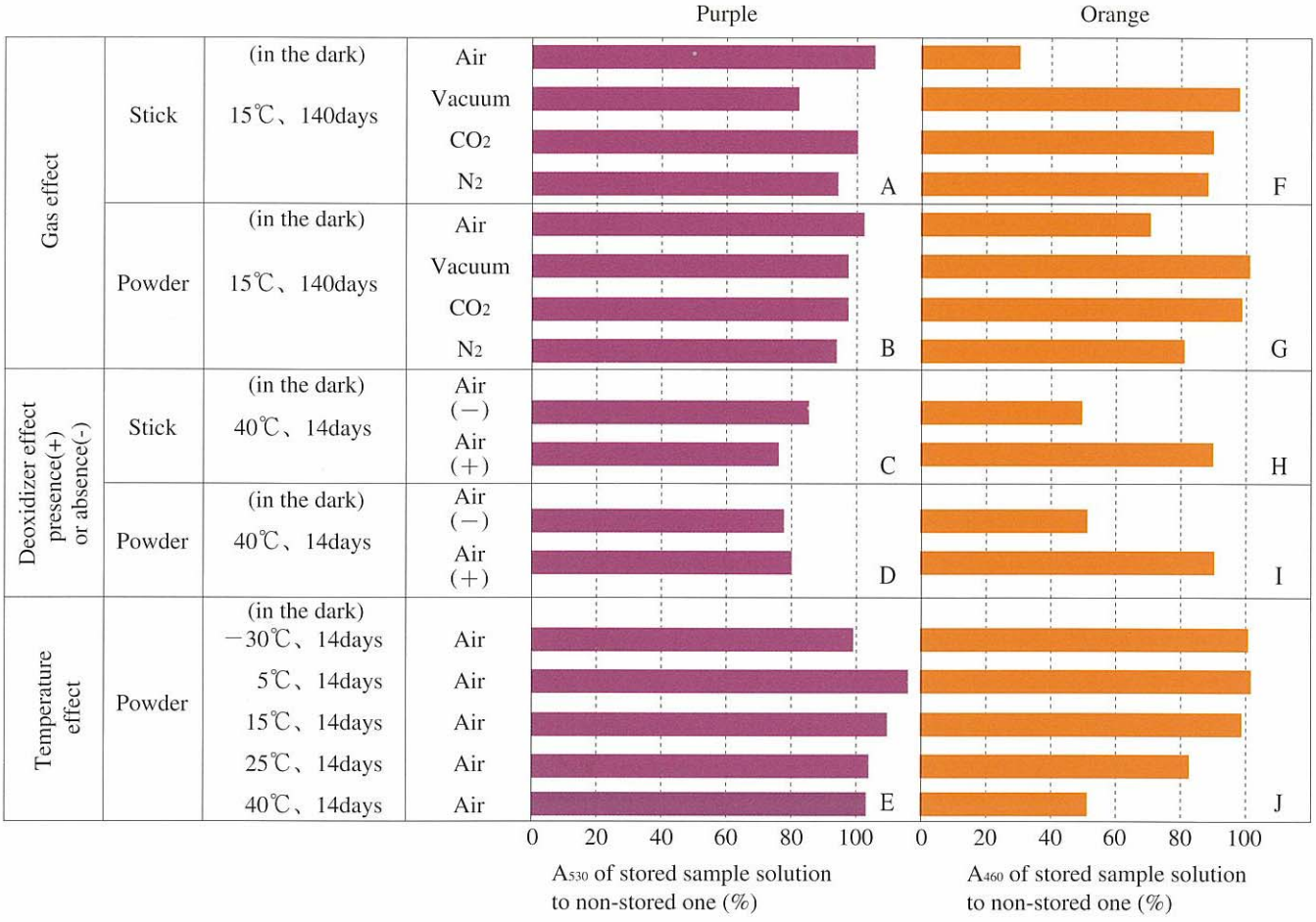


Fig.1 Stability of orange or purple color of sweetpotato powder and sticks.

Research Paper

Transgenic sweetpotato (*Ipomoea batatas* L. (Lam)) exhibiting resistance to sweetpotato feathery mottle potyvirus

A. Saito, T. Kimura, 0. Ideta, M. Mori**and M. Nishiguchi***

Laboratory of Plant Biotechnology
*** Okinawa Subtropical Station, Japan International Research Center for Agricultural Station**
**** National Institute of Agrobiological Resources**

In Japan, most of sweetpotato cultivars are susceptible to a sweetpotato feathery mottle virus (SPFMV-S) which causes severe damage to the production. To obtain the resistance to SPFMV-S by plant biotechnology, we have produced transgenic sweetpotatoes with a expression vector (pMMHA-4) harboring the coat protein (CP) gene of SPFMV-S and hygromycin phosphotransferase gene (HPT) which were driven by 35S promoter (Fig.1). Using electroporation method, the expression vector including CP and HPT genes was introduced into mesophyll protoplasts of a sweet potato variety, Chikei 682-11 (*Ipomoea batatas* L.(Lam))for starch production. Some of the hygromycin resistant calli were grown to form adventitious shoots and roots, and to regenerate fully. Southern blot analysis using CP and HPT genes as probes, showed that these genes were integrated stably in the chromosomes of four transgenic plants. Expression of the CP gene was confirmed by Northern and dot immuno blot analyses. To investigate the virus resistance, each transgenic line was grafted with morning glory (*I. nil*) infected with the purified virus. After three months from the graft-inoculation, these transgenic plants showed no morphological change in terms of the agroecotype (Fig. 2). We also performed ELISA analysis to quantify the virus production. The synthesis of virus particles was severely reduced in these transgenic plants tested. We concluded that these transgenic plants were highly resistant to the virus.

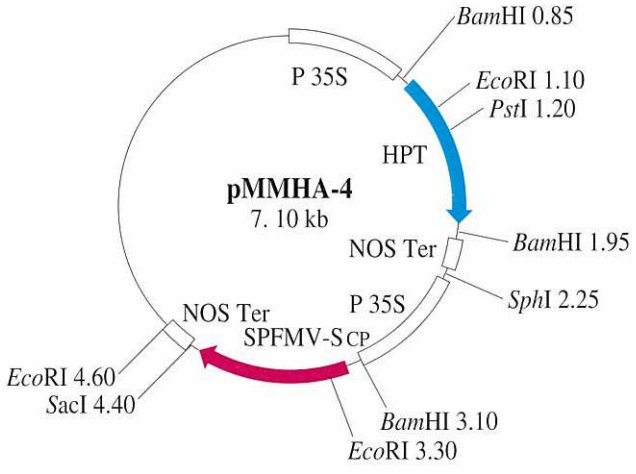


Fig. 1 Physical map of pMMHA-4 for transformation

Fig. 2 Tuberous roots of a transgenic line

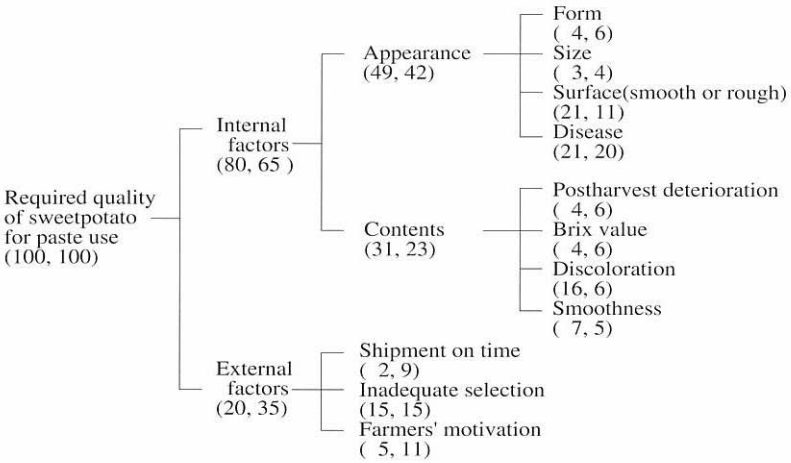
Research News

Laboratory of Socio-economic Analysis (Nishigoshi)

As a result of the reorganization of the laboratories at the Experiment Station, studies on marketing for upland farming in the Kyushu area were transferred from the Lab. of Marketing System to the Lab. of Socio-economic Analysis on October 1996.

Based on recent investigations on the production and marketing organization of sweetpotato for processing use and customers, we pointed out some problems of the organization, these are poor quality, inadequate selection and over-concentration of shipment and so on. To address the former two problems, we developed a marketing decision support system for quality control using the method of Quality Function Development. The system consists of the following procedures:

1. Select the Quality Evaluation Factors
2. Draw up the Quality Evaluation Hierarchy
3. Decide the weight of each factor for the farmers and customers based on the investigations
4. Prepare a Quality Table
5. Make decisions



(Customer weight, Farmer weight)

Relative weight of quality evaluation factors for customers and farmers

MAFF has honored a sweetpotato breeder at KNAES for the development of new cultivars

Dr. Osamu Yamakawa, Chief of the Sweetpotato Laboratory at KNAES, was honored for the development of new cultivars for food processing by the Ministry of Agricultural, Forestory and Fisheries. He attended the award ceremony held at the headquater of MAFF in April, 1998 with his wife. He developed 6 cultivars for food industry reaches to six as follows: Benihayato, Satsumahikari, Joy White, Ayamurasaki, J-Red and Sunny Red from 1985 to 1998. Especially, Ayamurasaki with a high anthocyanin content is used for colorant industry and sweetpotato flour or drink.

Besides, Benihayato, J-Red and Sunny Red are the cultivars with high beta-carotene content and used as the materials for paste, juice and flour. As the people get richer and older, they become more interested in their health. Sweetpotato with high content of pigment like anthocyanin and carotene can be noticed much in the future as healthy foods with physiological function.

Reader's Talk

Letter to the editor

Developing Weevil Resistance in Sweetpotato with Genetic Transformation

Giselle Cipriani, Ali Golmirzaie and Dapeng Zhang

Department of Crop Improvement and Genetic Resources
International Potato Center (CIP)

The damage of sweetpotato weevil (Cylas spp.) accounts for major production and post-harvest problems in the tropical and sub-tropical sweetpotato producing countries. Sweetpotato varie ties with weevil resistance is an ideal solution for this problem. Unfortunately, no germplasm with reliable weevil resistance has been found. So far no resistant varieties have been developed.

Use of biotechnological approaches to introduce insecticidal genes thus holds the greatest promise in protecting sweetpotato against weevil. One group of the novel insecticidal genes is the genes coding for plant protease inhibitors. The recombinant proteinase inhibitors delay the protein digestion in the target pest, by blocking their middle intestine (midgut) digestive proteolytic enzymes. This metabolic interference can leads to reduced growth rates, and developmental abnormalities, such as incomplete metamorphoses or fertility problems in the insect pest.

Transgenic sweetpotatoes expressing soybean trypsin inhibitor have been developed in the International Potato Center, in collaboration with Laval University of Canada, and Axis Genetics Ltd. of UK. Agrobacterium tumefaciens system was used for transformation. The plasmid pKTI-4 contains (-glucoronidase gene (GUS), the neomycin phosphotransferase II (NPT II) and the soybean kunitz trypsin inhibitor gene (SKTI-4) which is driven by a CaMV35S promoter.

Leaf segments were used as explants and regeneration occurred by means of embryogenesis and organogenesis. The transformations were confirmed by Southern analysis of DNA. These transgenic plants are being propagated for bioassay and weevil feeding test.

In addition to the use of proteinase inhibitor genes, CIP scientists, with their collaborators, are planing to diversify the resistance mechanism by adding other insecticide genes, such as Cry genes encoding toxic protein of Bacillus thuringiensis, and Streptomyces gene encoding for cholesterol oxidase. Our ultimate goal is to develop sweetpotato with durable resistance to sweetpotato weevil.

We thank SPORF for offering this excellent window for information exchange among researchers working on sweetpotato. We hope to join our effort with other researchers in battling with this devastating pest.

P.O.Box: 1558, Lima, Peru
E-mail: g.cipriani@cgnet.com

Announcements

Ipomoea Mailing List

KNAES has been in charge of a mailing list named "imopoea" to promote the exchange of information and any possible collaboration in sweetpotato research using the Internet since May, 1998. This "ipomoea mailing list" was established according to the recommendation of "International Workshop on Sweetpotato Production System toward the 21st Century", which was held in Japan on December 9-10, 1997. Chairperson of the ipomoea ML is Dr. Il-Gin Mok, CIP-Bogor and the Administrator is Dr. Makoto Nakatani, KNAES, Japan.

If you are interested in it, please access "ipomoea ML home page (http://duf.mykz.affrc.go.jp/ipomoea/ipomoea.html)".

If you want to join it, please send e-mail to Dr. Makoto Nakatani (mnakatan@mykz.affrc.go.jp).

Editor's note

First SPORF started just 3 years ago. Articles and photographs were collected for this SPORF by staffs of KNAES. We make an acknowledgment to every author and person who contributed to the publishing of this issue. We wish that the SPORF is useful for circulating sweetpotato researches. (Y.M.)

Sweetpotato Research Front (SPORF)

Address : Department of Upland Farming, Kyushu National Agricultural Experiment Station, MAFF, Miyakonojo, Miyazaki 885-0091, JAPAN
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