PROGRESS REPORT OF EXPORT HANDLING IMPROVEMENTS MADE BY THE NORTH CAROLINA YAM INDUSTRY

By

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Report on research concerning new packaging for exporting yams. It also is consistent with the MUM concept.

Introduction

The North Carolina yam industry has directed considerable resources toward developing an export market in recent years. As a result of these efforts, households in the United Kingdom and other western European countries are now enjoying North Carolina yams. The volume of yams exported varies annually. This variability is related to such factors as: post-harvest climatic conditions, quality and condition following curing, domestic market price, currency exchange rates, total transport costs, import tariffs and other trade barriers, and the availability of supplies and price from competitive sources.

Having a good knowledge of market demands is of utmost importance for developing a new market as well as for expanding market share. The North Carolina yam industry has compiled considerable information related to buyer requirements and consumer demands in western Europe.[3] The industry is utilizing state, federal, and private marketing and research organizations to accomplish their marketing objectives.

For instance, the NC Yam Commission is actively supported by the industry and is organized to promote trade and marketing research activities. The NC Department of Agriculture, Division of Marketing, maintains a marketing specialist in western Europe who promotes yams and other NC products. The USDA's network of Foreign Agricultural Counselors and Attaches provide promotional and marketing services. Biological and physical distribution research is being conducted by NC State and USDA researchers to develop and test improved techniques of storage, packaging and handling methods to maintain and/or improve satisfactory con-

dition of NC yams on arrival in export markets. North Carolina growers/packers and commercial marketing organizations work cooperatively to incorporate progressive changes that will improve product acceptance. Each of these organizations work cooperatively with commercial growers/shippers toward the same goal of delivering NC yams to export markets in the best possible condition at the least possible cost.

Objective

Describes research conducted through the combined efforts of the various organizations mentioned above toward developing an improved shipping container for exporting NC yams that will better meet buyer demands in western Europe.

Procedure

Discussions held during 1980-81 by personnel of the NC Yam Commission, NC Department of Agriculture, USDA-ARS, and commercial exporters with European receivers indicated that reducing the size (net weight) of the conventional 50-lb (22.7 kg) box for yams would improve their acceptance to European buyers. The conventional export box for NC yams was a two-piece full telescope corrugated box measuring 17.125 x 11.625 x 11.0 in. (43.5 x 29.5 x 27.9 cm) I.D. in size, and packed with 50 lb (22.7 kg) of yams. In 1981, US exporters tested a smaller box which contained 22 lb (10 kg) net weight. The USDA cooperated in this project by determining 1) the physical performance of the new box on arrival in western Europe; 2) weight loss of yams during transit; 3) the effect of the smaller box on maintenance of product temperatures during transit; and 4) the condition of yams on arrival as compared with their condition at origin.

Data and information presented in this report are based on a van container shipment of yams packed and shipped from the Benson, NC area on November 19, 1981, which arrived in London on December 9, 1981. Yams were cured after harvest and placed in storage until packed. They were removed from storage, washed, treated with 150-200 ppm/chlorine and approximately 450 ppm Botran (2,6-dichloro-4-nitroaniline), graded and packed on the day of loading.

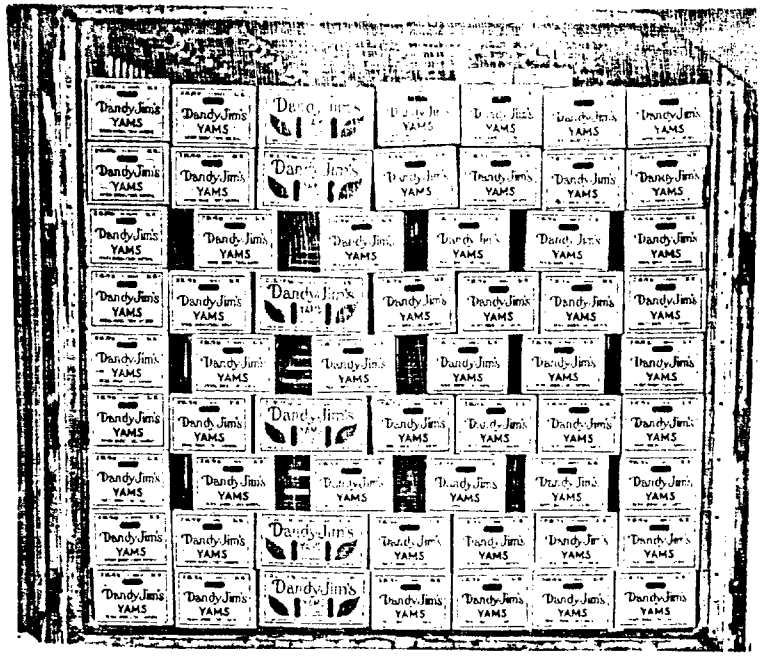
Description of new box: The experimental box designed to contain 22 lb (10 kg) of yams (Photo 1) is constructed of double-walled corrugated fiberboard. Material strength is rated at 350 lb/in.^{2} (Mullen test). It is a two-piece full telescope design with a 4 x 0.5 in (10.16 x 1.27 cm) top and bottom gap. Each side panel has two 3 x 1 in (7.62 x 2.54 cm) vertical ventilation slots and a 3 x 1 in handhold in each end panel. Inside dimensions are 14.75 x 10 3/4 x 8 in (37.5 x 27.3 x 20.3 cm).

The total load consisted of 1680 boxes. Yams for this load were packed at two independent grower/packers. Each provided one-half the load or 840 boxes. Ten boxes were selected at random from the packing line at each packinghouse and designated as control test boxes. Yams in these sample boxes were evaluated for condition after packing and on arrival in London. To determine shrinkage, net weight was obtained at shipping point and on arrival in London. Outside measurements of the boxes (length, width, and height) were recorded at points of maximum buldge at shipping point and on arrival to determine physical performance of the experimental shipping containers.

Stacking boxes in van container: Inside dimensions of the van container were 454 x 87 x 88 in (11.53 x 2.21 x 2.23 m). Boxes were individually placed in a lengthwise parallel airflow stacking pattern (Photo 2). This stacking pattern was selected because the refrigeration system delivers air from the plenum located at the front

PHOTO 1. NEW EXPORT SHIPPING CONTAINER FOR NORTH CAROLINA YAMS.

PHOTO 2. REAR VIEW DEPICTING BOXES IN A PARALLEL AIRFLOW STACKING PATTERN.



bulkhead, through fingerducts extending toward the rear of the van container. Two return air inlets were located at the bottom outside corners of the front bulkhead in front of the "T" rail floor. Boxes in the first stack at the front bulkhead were arranged so as to minimize restriction of airflow to the return air inlets. Photo 3 shows boxes placed in 6 vertical columns, with the exception of layers 4, 8, 9, where boxes were stacked tightly to provide rigidity. A piece of lumber (1 x 6 in; 2.54 x 15.24 cm) measuring approximately 70 in (177.8 cm) in length was placed vertically between the front bulkhead and each of the 6 columns of boxes in the first stack. This provided a pathway for return air to flow unrestricted to the return air inlets. Spaces between columns in the first stack align with air channels of the remaining load mass.

Temperature monitoring instruments: During the loading operation, temperature sensing probes were placed at predetermined locations to record both pulp and air temperatures within the load during transit. The automatic temperature recording instrument used was a Grant model CRW3-18. At 1-hour intervals, 18 sensors recorded pulp temperatures of yams in preselected boxes located front, center, and rear of the load. Air temperatures were recorded by 6 sensors: 1 at the discharge air duct, 1 at the return inlet, 2 at the ceiling, and 2 at the floor. A single humidity sensor placed at the ceiling above the load mass recorded relative humidity (RH). The refrigeration unit thermostat of the van container was set at 55°F (12.8°C).

Results

Product condition: At shipping point, yams in the 20 sample boxes were in excellent condition, i.e., free of decay, good external and internal color and firm. Yams per box averaged 40 each and size varied in length, mostly from 5-7 in (12.7 - 17.8 cm). On arrival, a total of 10 tubers from these same boxes were decayed, 4 slightly and 6 seriously. Most decay was caused by soft rot and penicillium organisms. Total decay was approximately 1%.

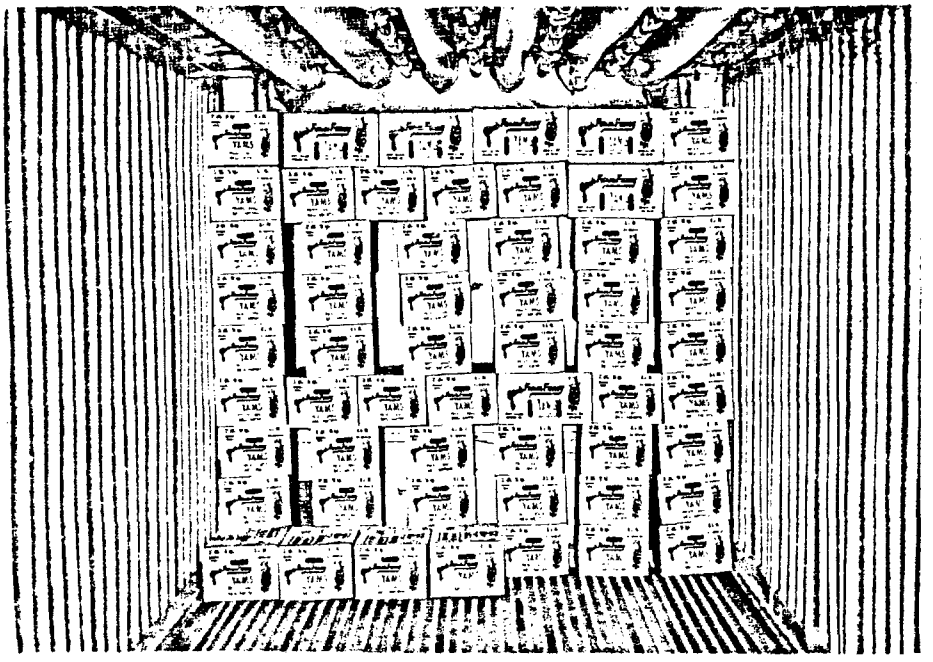
Transit temperatures and RH: Pulp temperature immediately after loading averaged 61°F (16.1°C), range 58-64°F (14.4-17.8°C). At 12, 24, and 36 hours after loading, pulp temperatures averaged 57, 54, and 54°F (13.9, 12.2°C), respectively. Pulp temperatures throughout the load were equalized to near discharge air temperature of 55°F $\pm$ 3° (12.8°C $\pm$ 1.6°) 20 hours after loading. Pulp temperatures were relatively uniform during the rest of the voyage, averaging 54.5°F (12.5°C) and ranging from 52-58°F (11.1-14.4°C) at different locations in the load. Discharge air ranged from 52-58°F while return air fluctuated between 53-56°F (11.7-13.3°C). Relative humidity fluctuated between 83-90%.

Transit shrinkage (weight loss): At packing, net weight per box averaged 24.2 lb (11.0 kg). On arrival, average net weight per box was 23.1 lb (10.5 kg), or an average weight loss of 4.5% during transit.

Box and load alignment condition: Boxes bulged an average of +0.15 in (0.39 cm) lengthwise, +0.27 in (0.69 cm) in width, and compressed -0.07 in (0.18 cm) in height during transit. Observations of boxes at the rear of the load and during unloading on arrival at the receiver's facilities revealed the load maintained excellent alignment. Boxes located at the rear floor area were not seriously crushed or bulged.

Economic considerations: The new metric box costs approximately $0.03 more per box than the 1-bushel box, but the metric box holds 10 kg, whereas

PHOTO 3. STACKING ARRANGEMENT FOR BOXES IN THE FIRST STACK AT THE FORWARD BULKHEAD OF THE VAN CONTAINER



the traditional 1-bushel box normally is packed to hold 22.7 kg (50 lb). For example, box material for packing 100 1-bushel boxes of yams costs $51 with a 2,272.7 kg (5,000 lb) net packout. Boxing costs for this same amount of yams in the new metric box would cost approximately $123.42. Therefore, the packer's costs are about 2.4 times greater when using the metric box.

Conclusion

The dimensions of this new shipping container are consistent with the metrication, unitization and modularization (MUM) concept proposed by the United Fresh Fruit and Vegetable Association. The MUM concept proposes 40 x 30 cm (length and width) O.D. as one of the standard box dimensions that industry groups should adopt. Most references written to date concerning MUM do not discuss tolerances to allow for box bulging during distribution. Allowing for bulging, however slight, a user may expect the new export yam box to measure approximately 39.8 x 29.8 cm O.D. (15.65 x 11.67 in) at destination. Photo 4 shows how these boxes fit, 10 per layer, on a 48 x 40 in (121.9 x 101.6 cm) wooden pallet base. (Although these boxes were not shipped unitized, they were handled in-house on pallets.) This is an important consideration for domestic shippers and receivers currently unitizing and using 48 x 40 in bases, but the dimensions of this box also allow for a near optimum fit for those shippers expecting to use a standard metric-sized base of 120 x 100 cm (47.2 x 39.4 in). The 120 x 100 cm pallet base is the standard size most used for fresh fruits and vegetables in western Europe. Therefore, the size of this new box for NC yams is most acceptable

PHOTO 4. A STACKING ARRANGEMENT OF THE NEW BOXES ON A 48 x 40 IN. WOODEN PALLET

for the export market and it may become more acceptable for domestic use as shippers and receivers standardize and adopt box sizes consistent with the MUM concept.

As this report indicates, the metric box does not crush and does protect the yams during export shipment, whereas receivers have repeatedly complained that the traditional 1-bushel box does crush and is too large for efficient handling in export markets. Further studies are needed to determine if the increase in packaging costs when using the metric box, as compared to the 1-bushel box, would be offset through increased handling and merchandising efficiency for yams shipped to European markets.

FOOTNOTES

[1]The authors gratefully acknowlege the cooperative effort of the following organizations in providing this information: NC Yam Commission; NC Department of Agriculture, Division of Marketing; Seald-Sweet Sales, Inc.; Highland-Exchange Service Cooperative; James Massengill & Sons Produce Co.; Jimmy McLamb's Produce, Inc.; Dr. Larry Hammett, USDA-ARS, Raleigh, NC.

[2]Mention of a chemical or proprietary product does not constitute a recommendation for use by the U.S. Department of Agriculture to the exclusion of other products that may also be suitable.

[3]Personal discussions with NC Department of Agriculture, Division of Marketing personnel.