Prepackaging Alabama and Florida POTATOES at Production Points

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PREFACE

The report describes the development and evaluation of consumer packages for the extremely perishable early red potatoes grown in the Southeastern States. The study on which this report is based is part of a broad program of research to improve the efficiency of marketing farm commodities and to deliver fresher and tastier products to the consumers.

Recent related reports include:

Lettuce Prepackaged at Shipping Point--A Preliminary Market Survey, U. S. Dept. Agr. AMS-481, June 1962

Evaluation of Selected Consumer Packages and Shipping Containers for Peaches, U. S. Dept. Agr. Mktg. Res. Rpt. No. 533, June 1962

Prepackaging Medium-Size Apples in Shrinkable Films at Shipping Point, U. S. Dept. Agr. Mktg. Res. Rpt. No. 534, May 1962

Evaluation of Shipping Trays and Pads for Pears and Apples, U. S. Dept. Agr. Mktg. Res. Rpt. No. 530, April 1962

Packaging California Cauliflower, U. S. Dept. Agr. Mktg. Res. Rpt. No. 414, July 1960

A free copy of any of these reports may be obtained by writing to the Marketing Information Division, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C.

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SUMMARY

Early red potatoes, which are quite perishable, can be prepackaged in the production areas of Alabama and Florida, and shipped successfully to north-central markets. AMS researchers, who examined 29 test shipments in north-central markets in 1960 and 1961, found less bruising in 5- and 10-pound consumer bags than in conventional 50-pound burlap or paper bags of potatoes.

The consumer bags cost 20 to 70 cents (depending on type and size of bag) more per 100 pounds of potatoes for materials and direct packing labor alone than the 50-pound bags. However, retailers who prefer selling prepackaged produce were willing to make up the difference, because they were saved the expense of packaging the potatoes in their own backrooms. Receivers of the test shipments paid 90 cents and more per 100 pounds for prepackaged potatoes than for bulk. Part of this covered the direct materials and packing labor costs; the remainder went toward higher machinery costs, additional space requirements, more rigid quality control, and other indirect expenses.

The consumer containers evaluated were the newly developed 5- and 10-pound polyethylene mesh bags, 5- and 10-pound polyethylene film bags, 10-pound paper bags with mesh window, and the conventional 50-pound bags.

Researchers working in Alabama and Florida potato packing plants computed that materials and direct labor costs to pack 100 pounds of potatoes in consumer packages ranged from about 50 cents for the 10-pound paper and 10-pound polyethylene film bags to about 90 cents for the 5-pound polyethylene mesh bags. (This does not include operations such as dumping, washing, or sorting; or overhead or equipment costs.) Five-pound bags cost more than 10-pound bags per unit of volume because the 5-pound bags required almost as much time to pack as did the 10-pound bags, and two 5-pound bags cost more than one 10-pound bag. Combined material and direct labor costs for the 50-pound burlap bags used extensively in Alabama were 29 cents per 100 pounds of potatoes packed. Costs of the 50-pound paper bag often used in Florida were a little more than 20 cents.

In their ability to protect the potatoes packed in them, the 10-pound paper bags with mesh windows probably were generally best. Both the clear film and open mesh polyethylene bags permitted slightly more greening of potatoes than did the paper bags with mesh windows, an average of 1.4 percent as compared with 0.6 percent at the end of the first day on display at retail stores.

The film bags, because of their relatively low moisture-vapor permeability, can encourage the development of decay if the organisms are present, but for the same reason they retard evaporation. Potatoes in polyethylene mesh bags lost the most weight, and those in the film bags, the least.

The main advantage of the polyethylene film and mesh bags compared to 10-pound paper bags was that the consumer was offered excellent visibility of the potatoes. Store operators, aware of the hazards of greening and decay, favored the paper bags with mesh windows.

Potato packers were interested in finding out the relative advantages of hydrocooling and forced air cooling in maintaining the quality of their potatoes. In 14 shipments of hydrocooled and air-cooled potatoes, researchers in terminal markets found no consistent difference in the condition of the potatoes that could be attributed to method of cooling.

PREPACKAGING ALABAMA AND FLORIDA POTATOES AT PRODUCTION POINTS

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INTRODUCTION

Continuing research is being conducted by the Agricultural Marketing Service to develop and evaluate consumer packages and shipping containers for early potatoes. A recent study showed that California White Rose early potatoes prepackaged and shipped in either 10-pound paper bags or 10-pound polyethylene bags, arrived at north-central markets in good condition. 2/

In 1960 and 1961, work to develop improved containers for early potatoes was continued in cooperation with south Alabama and Florida growers and shippers. Lasoda and Pontiac are the principal varieties grown and shipped early in the season from these areas. They are more perishable then than when these potatoes are harvested later, and shipping them in various types of consumer packages from point of production to terminal areas has been considered risky for the shipper.

This study evaluates the advantages and disadvantages of marketing early red potatoes packed at Alabama and Florida production points and shipped to terminal markets in 5- and 10-pound polyethylene film bags, 5- and 10-pound polyethylene mesh bags, and 10-pound paper (mesh window) bags. The conventional 50-pound paper and 50-pound burlap bags were used as control containers.

The development and evaluation of improved consumer packages were part of a broad program to assist southeastern growers. Other measures, proposed by the Agricultural Marketing Service and now adopted by segments of the industry included:

(1) Establishment of firm control over the daily volume of harvest to level off glut and slack in the supply of potatoes delivered to the packing plant.

1/ J. L. Ginn of Orlando, Fla., P. W. Hale, and P. G. Chapogas of Fresno, Calif., and F. K. Buxton of the Washington, D. C. headquarters.

2/ Chapogas, P. G., and Hale, P. W. Prepackaging Early Potatoes at Point of Production. U. S. Dept. Agr. Mkt. Res. Rpt. 401, 20 pp. illus. June 1960. (Out of print; available in many libraries.)

(2) Modernization of harvesting operations and construction of a holding shed to shorten the time the potatoes were exposed to field heat.

(3) Replacement of brush washing by a soak and pressure-spray system to reduce skinning.

(4) Installation of a hydrocooler to bring the potatoes to optimum holding temperature as soon as possible after harvest.

(5) Use of two semiautomatic baggers to convert a predominantly bulk packing operation into a predominantly prepackaging operation.

(6) Maintenance of high standards in all phases of production and handling to qualify for use of USDA continuous-inspection shields.

Prior to installation of the hydrocooler, portable forced-air coolers removed field heat from potatoes after they had been packed and loaded for shipment. The forced-air units were ineffective in cooling potatoes in polyethylene film bags and in other consumer-size packages packed in master containers. The hydrocooler dissipated field heat before the potatoes were packed, thus making practical the use of any suitable container.

HOW THE STUDY WAS MADE

Research was conducted in May and June 1960 in Baldwin County, Ala. In January 1961, research was extended to the Belle Glade area in Florida, and in March 1961, to the Princeton Goulds, and Homestead areas. Work was resumed in Alabama in May 1961.

Twenty-nine test shipments of potatoes were made from Alabama and Florida, in cooperation with 11 grower-shippers. Potatoes from the same lot were packed both in the test packages and in conventional 50-pound bags in each shipment. Commercial practices were maintained throughout the project, as far as possible.

The various bags to be evaluated were selected at random from the plant's packing lines, labeled as test containers, and stacked in cars or trucks for terminal and retail researchers' observations. At times it was necessary to pack the various packages by hand when the packing lines were filling only specific types or sizes of bags. An equal volume of potatoes in the various packages being evaluated was in each of the test shipments.

Time studies were made to determine the comparative amounts and costs of direct labor used to pack each of the test containers. Indirect costs such as supervision, equipment depreciation, taxes, interest, insurance, and overhead were not included. Neither were direct labor costs included, when the type of container had no influence on the performance of the operation, such as grading or washing.

Material costs were obtained. Freight and refrigeration charges were the same for potatoes in all containers.

Test packages were weighed before shipment. Weights were marked on the packages. At terminal markets and retail stores, the bags were weighed to determine weight loss.

At terminal markets and retail stores the test shipments were met and inspected for the following types of product damage: (1) Greening, (2) bruising, (3) skinning without discoloration, (4) skinning with discoloration, and (5) decay. Trade and consumer reactions were observed.

The degrees of skinning, with and without discoloration, as used in this report do not conform with U. S. standards for potatoes, but were established especially for these tests to assist in a comparative evaluation of the various types and sizes of bags. The different classifications of these injuries were based on the following criteria:

Skinned and discolored--Skinned area is all or predominantly discolored. (This condition often is called "browning".)

Slight--Less than 5 percent of total surface skinned.
Damage--From 5 to 10 percent skinned.
Serious--More than 10 percent skinned.

Skinned - not discolored--Skinned area all or predominantly without discoloration.

Slight--Less than 25 percent of total surface skinned.
Damage--From 25 to 50 percent skinned.
Serious--More than 50 percent skinned.

DESCRIPTION OF PACKAGES

Some of the packages varied slightly. For example, the number of perforations, size of mesh windows in the paper bags, and the overall dimensions were not always exactly the same. However, most differences were minor, and for simplification, the bags most commonly used in the Alabama and Florida tests are described.

Ten-pound paper (mesh window) bag.--This was a gusseted bag made of two layers of 50/50 3/ wet-strength kraft paper (fig. 1). It held 10 pounds of potatoes and measured approximately 17 by 7 3/4 by 4 3/4 inches. Ventilation was provided by sixteen ½-inch holes and by the mesh window which measured 7½ by 3 inches. This bag was closed by a semiautomatic machine that sewed the top with cotton and rayon twine.

3/ Two layers of paper, each weighing 50 pounds per ream of 500 sheets (24 by 36 inches).

Polyethylene film bags.--A 5-pound gusseted polyethylene bag of 1.5-mil (0.0015-inch) film and a 10-pound gusseted polyethylene bag of 2-mil (0.002-inch) film were included in the test (fig. 2). Before packing, the 5-pound bag measured 6½ by 3 by 17 inches and the 10-pound bag 8 by 3 by 20 inches. Each bag had forty ¼-inch ventilation holes. An automatic machine gathered the tops of the bags and closed them with wire staples.

BN-17278

Figure 1.--Paper bag (mesh window) for 10 pounds of potatoes.

BN-17277

Figure 2.--From left: 5- and 10-pound polyethylene film bags, and 5-pound polyethylene mesh bag.

Polyethylene mesh bags.--A 5-pound and a 10-pound bag were evaluated. They were flat mesh bags constructed from polyethylene filament that formed approximately 9 diamond-shaped openings per square inch (fig. 2). Before packing, the 5-pound bag measured approximately 4½ by 21 inches, and the 10-pound bag approximately 6 3/4 by 19 3/4 inches. The bags were closed by an automatic machine that gathered the tops and closed them with a wire staple.

Fifty-pound baler bags.--The polyethylene bags were shipped in master containers which were 50-pound-capacity paper baler bags. Each baler bag held either five 10-pound polyethylene bags or ten 5-pound polyethylene bags, of either film or mesh (fig.3). These master bags were made of 60/60 4/ multiwall wet-strength kraft paper, and measured 17 by 7 by 36 inches. Ventilation was provided by twenty-four 3/8 inch holes. The balers were closed in some packinghouses with pressure-sensitive tape and in others with a wire-twist closure.

4/ Two layers of paper, each weighing 60 pounds per ream of 500 sheets (24 by 36 inches).

Fifty-pound burlap bag.--The 50-pound bag, which was used as a control container in shipments from Alabama, was made of 6½-ounce burlap. It was a flat bag, 18 by 29 inches. The bag was closed manually by sewing the opening with cotton cord (fig. 4).

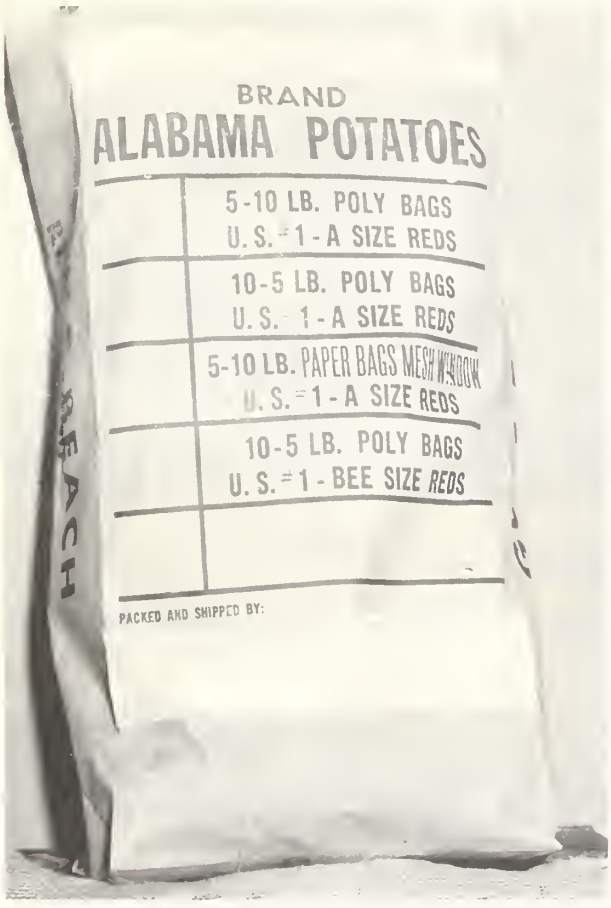

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Figure 3.--An "X" in one of the squares at left will identify contents of this baler bag.

N-26825

Figure 4.--Burlap bag, holding 50 pounds of potatoes, closed by stitching with cotton cord.

Fifty-pound paper bag.--The 50-pound paper bag evaluated in this report was shipped only from the Homestead and Princeton, Fla., areas. It was constructed of three layers of 50-pound-test strength paper. The measurements were 18½ by 31 inches with a 6-inch bottom. The bag was perforated with twelve ¼-inch holes for ventilation; a wire twist was used to close it.

COST OF MATERIALS

Costs of materials for the various consumer packages and shipping containers per 100 pounds of potatoes packed were as follows:

Type of bag	Cost in cents
5-pound polyethylene film	47.3
10-pound polyethylene film	40.9
5-pound polyethylene mesh	73.3
10-pound polyethylene mesh	62.5
10-pound paper with mesh window	42.3
50-pound burlap	23.9
50-pound paper	15.4

These costs include twine, staples, wire twists, or tape for closure. Also included are the costs of master baler bags for both the polyethylene film and mesh consumer bags, but not for the 10-pound paper consumer bags which ordinarily were not packed in a master container.

The consumer package with the lowest materials cost was the 10-pound polyethylene film bag; the costs of the 10-pound paper bag were only 2 cents higher per 100 pounds of potatoes packed. Both the 50-pound paper and the 50-pound burlap bags were substantially less expensive.

DESCRIPTION OF PACKING OPERATIONS

Consumer packages

The paper and polyethylene film consumer bags were filled mechanically; the polyethylene mesh bags semimanually. A description of methods used to fill, close, and load the various bags follows:

Filling and weighing.--the 10-pound paper and 5- and 10-pound polyethylene film bags were filled on automatic machines with from 10 to 18 rotating filling heads to which workers attached empty bags. The heads with bags attached moved under a conveyor belt that carried a continuous flow of potatoes (fig. 5). When the potatoes reached the approximate weight desired in each bag, the head automatically rose and stopped the flow of potatoes. Overflow potatoes dropped onto a lower conveyor belt which later returned them to the filling heads. Filled bags were conveyed to a station where they were adjusted for over or underweight. To compensate for the tare weight of the package and potato shrinkage during the marketing period, the 10-pound bags were packed to approximately 10 pounds 12 ounces and the 5-pound bags 5 pounds 6 ounces. A conveyor belt carried the bags to another station for closing.

The 5- and 10-pound polyethylene mesh bags were packed on a semiautomatic machine. Potatoes were conveyed into weight-controlled scoops. When the desired weight was reached, a worker placed an empty bag over the mouth of a scoop, tilted it, and cascaded the potatoes into the bag (fig. 6). After the bags were filled they were placed upright on a conveyor to the closing machine.

Closing.--The paper consumer bags passed through an automatic machine that sewed the tops with cotton and rayon twine.

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Figure 5.--Potatoes on conveyor flow into chutes leading to scales which are part of automatic bagging machine.

BN-17275

Figure 6.--When the weight of potatoes reached the desired level, a worker fits mesh bags over scoops and tilts scoops to fill bags.

A worker guided the polyethylene film and polyethylene mesh bags into the jaws of a semiautomatic machine which gathered and closed the tops with a wire staple.

Master bagging.--All the consumer packages, except the 10-pound paper bags, were packed manually into paper baler bags which were closed with conventional wire ties. The 10-pound paper bags were normally loaded into freight cars as they were.

Car loading.--A conveyor belt, handtruck, or forklift transported the bags to stackers for loading. The 10-pound paper bags were usually stacked loose, lengthwise in the car, 11 wide, 13 and 14 high. Baler bags were stacked crosswise or lengthwise, four or six wide and nine high.

50-Pound Bags

In the Foley, Ala., and Belle Glade, Fla., areas, only the burlap bag for unpackaged potatoes was evaluated. In the Homestead and Princeton, Fla., areas, the 50-pound paper bag was included to reflect commercial practices.

The method of packing both burlap and paper bags was the same, regardless of area. From the grading table, potatoes moved directly to the packing line. Some plants had more than one line. Each line had six to eight bagging heads. One workman operated two bagging heads (fig. 7). When a bag was filled at the first head, the workman changed the flow of potatoes to the second head by manually moving a diverter gate. He then removed the filled bag from the first head and placed it on a scale for weight adjustment and closing. The cycle was repeated by attaching another bag to the first head for filling. In a few plants the packer filled the bag while it stood on a scale and adjusted the weight as part of the filling operation.

After the bag was weighed, it was removed from the scale and manually closed; the burlap bag was closed by sewing the opening with cotton cord, and the paper bag by application of a wire twist, the same as that used with the paper baler bags for prepackaged potatoes.

COST OF DIRECT LABOR TO PACK

Time studies were conducted in eight packinghouses, to determine comparative amount and cost of direct labor used to pack potatoes in the various types and sizes of bags. This direct labor included supplying bags, filling, weighing, closing, packing balers, stamping, and stacking for car loaders. Such labor as supervisory, dumping, washing, grading, sizing, culling, and car loading was approximately the same regardless of the type of container being packed so it was not included.

Because variations in sizes of the bagging machines existed among packinghouses and, in some cases within the same packinghouse, an average hourly production was determined for each of the packages studied.

BN-17276

Figure 7.--With one burlap bag about full, worker is shifting the flow of potatoes to bag on left.

The 50-pound burlap and paper-bag packing lines were operated intermittently in most packinghouses and frequently were run at less than capacity. Therefore, the amount and cost of direct labor were adjusted to reflect the amount of labor that would be used with 50-pound-bag packing lines running at full volume (table 1).

The 10-pound paper bags were the least expensive of the consumer containers to pack, primarily because the individual bags were not packed in master baler bags. Five-pound polyethylene bags were substantially more expensive than 10-pound polyethylene bags per 100 pounds of potatoes packed, because they required almost as much labor as the larger bags, but held only half of the volume of potatoes. Costs of the 50-pound paper bags were slightly lower than the burlap bags, for the most part, because application of the wire-twist closure took only half the time required to sew the burlap bag opening with cotton thread.

Table 1.--Number of workers in direct packing operations, hourly production and direct labor cost per 100 pounds of potatoes packed, by type of container, Alabama and Florida, 1960-61 1/

Type of bag	Workers in direct packing operations	Packout per hour of baler bags or 50-pound equivalents	Direct labor cost per 100 pounds of potatoes
	Number	Number	Cents
5-pound polyethylene film	11	153	18.6
10-pound polyethylene film	11	288	10.0
5-pound polyethylene mesh	12	187	16.6
10-pound polyethylene mesh	12	296	10.6
10-pound paper with mesh window	10	384	6.8
50-pound burlap	12	600	5.2
50-pound paper	12	634	4.9

1/ Based on hourly wage of $1.30 and including only direct labor; 20 percent allowance made for fatigue and personal time.

COMBINED COST OF MATERIALS AND DIRECT LABOR

When the costs of materials and direct packing labor were combined, the 50-pound paper bag was least expensive, and the 50-pound burlap bag next (table 2). The combined costs of the 10-pound paper bag with the mesh window were lowest among the consumer bags, but the costs of the 10-pound polyethylene film bag were only slightly higher.

Table 2.--Cost of materials and direct labor to pack 100 pounds of potatoes in selected containers, Alabama and Florida, 1961

Type of bag	Materials	Labor	Total
	Cents	Cents	Cents
5-pound polyethylene film	47.3	18.6	65.9
10-pound polyethylene film	40.9	10.0	50.9
5-pound polyethylene mesh	73.3	16.6	89.9
10-pound polyethylene mesh	62.5	10.6	73.1
10-pound paper with mesh window	42.3	6.8	49.1
50-pound burlap	23.9	5.2	29.1
50-pound paper	15.4	4.9	20.3

The cost of the 10-pound paper bag was lower than the film bag, because of its ability to survive transportation, without being packed in a baler bag. This slight advantage of 1.8 cents per 100 pounds of potatoes might well be lost, if the cost of handling the loose 10-pound paper bags were compared with the costs of handling the same number of 10-pound polyethylene film bags packed in one-fifth that number of 50-pound baler bags, particularly when being unloaded from freight cars at the terminal markets. Observers noted that unloading 4,000 10-pound paper bags from a 40,000-pound carload was substantially more time-consuming than unloading 800 50-pound baler bags, but no study was made to determine the difference in costs.

EVALUATION OF CONTAINERS AT TERMINAL AND RETAIL MARKETS

Arrival Condition of Potatoes

Since shipments of potatoes were made from Florida and Alabama over a period of 2 years, and the quality of the potatoes differed considerably between States, and even between the 1960 and 1961 season in southern Alabama, the arrival condition of the potatoes in north-central markets is shown by area of production and season. Potatoes in all tests were packed, shipped, and handled under commercial conditions.

Alabama--1960.--In May 1960, researchers in terminal markets compared the arrival condition of Alabama potatoes packed in 10-pound paper bags, 5- and 10-pound polyethylene film bags, 5-pound polyethylene mesh bags, and 50-pound burlap bags (table 3).

In each of the 14 test shipments, all types of bags were packed with comparable Lasoda potatoes. Most shipments contained samples of all bags. However, the 5-pound polyethylene mesh bags were not available until the latter part of the season, and only four shipments included them. For this reason, the condition of the potatoes in these bags is not listed in table 3.

Eight shipments of air-cooled potatoes and six shipments of hydrocooled potatoes arrived at terminal markets in excellent condition. The differences were slight, and did not consistently favor either method of cooling, so the condition of potatoes cooled by both methods was averaged and listed together in table 3.

Potatoes in all types of consumer bags in the 14 shipments arrived at terminal markets with less slight bruising and less damage by bruising than the potatoes in the large burlap bags. No serious damage by bruising was found. The 50-pound bags were handled more roughly than the others and the burlap fabric was more abrasive than the film or paper.

Table 3.--Condition of Lasoda potatoes on arrival in north-central markets after 4 or 5 days in transit, 1960

(Average of 14 shipments from Alabama)

Type and degree of injury	Amount of injury by type of bag			
	5-pound poly film	10-pound poly film	10-pound paper	50-pound burlap
	Percent	Percent	Percent	Percent
Skinned-not discolored				
Slight	16.6	11.8	12.7	16.5
Damage	0.3	1.2	0.4	0.3
Serious damage	0	0.1	0	0
Skinned-discolored				
Slight	13.6	10.5	10.7	12.5
Damage	7.5	6.1	7.0	6.7
Serious damage	0.1	0.3	0.3	0.2
Bruised 1/				
Slight	2.4	1.7	2.7	6.7
Damage	0.1	0.1	0.1	1.4
Greening 2/				
Slight	0.9	0.8	0.4	0.2
Decay				
Total	0.8	0.6	0.3	0.4

1/ No serious damage by bruising.
2/ No damage and no serious damage by greening.

Statistical analysis of the findings listed in table 3 indicated:

Skinned-not discolored, and skinned-discolored: Although some of the differences among containers were on the fringe of statistical significance, packaging specialists who examined the potatoes in terminal markets did not feel that the differences were sufficiently clear-cut to be conclusive.

Bruising: Significantly more in 50-pound burlap bags than in all three types of consumer bags; no other differences.

Greening: No significant difference among any of the bags.

Decay: No significant difference among any of the bags.

(To be "significant," the odds were computed to be more than 20 to 1 that the differences observed were not due to chance alone.)

Florida--1961.--Eleven test shipments were made from Florida in 1961--five from Belle Glade and six from the Homestead area. The consumer bags evaluated were the same as those included in the 1960 Alabama tests. However, the 5-pound polyethylene mesh bag was available throughout the shipping season. The 50-pound paper bag replaced the 50-pound burlap bag for unpackaged potatoes. None of the potatoes were precooled during packing. All were shipped in refrigerated cars.

Arrival condition of the Pontiac potatoes in terminal markets, by type of container, is shown in table 4. Potatoes in all 11 test shipments were in good condition.

The incidence of skinned-discolored potatoes was highest in the polyethylene mesh bag, and the incidence of skinned-not discolored potatoes was highest in the polyethylene film bags. Skinned areas tend to discolor when dry, to maintain natural color when moist. The mesh bags permitted potatoes to dry out comparatively rapidly. The film bags retained more moisture than the others.

Table 4.--Condition of Pontiac potatoes on arrival in north-central markets after 4 or 5 days in transit, 1961

(Average of 11 shipments from Florida)

Type and degree of injury	Amount of injury by type of bag				
	5-pound poly film	10-pound poly film	5-pound poly mesh	10-pound paper	50-pound paper
	Percent	Percent	Percent	Percent	Percent
Skinned-not discolored 1/					
Slight	12.1	9.5	5.8	7.9	7.3
Damage	2.2	1.7	0.4	1.0	0.6
Skinned-discolored					
Slight	8.9	7.5	19.6	11.6	9.4
Damage	2.1	1.9	5.7	2.5	2.6
Serious damage	0.1	0.1	0.3	0.4	0
Bruised					
Slight	0.1	0.2	0.9	0.4	2.0
Damage	0.2	0.1	0.3	0	0.4
Serious damage	0.2	0.2	0.1	0	0
Greening 2/					
Slight	0	0.5	0.1	0.1	0
Decay					
Total	0.9	0.5	0	0.6	0

1/ No serious damage observed.
2/ All greening was slight.

Total bruising was substantially higher in the 50-pound paper bags of potatoes than in the consumer bags. The 50-pound bags gave less protection than the consumer bags, most of which were packed in baler bags, and the larger paper bags, like the burlap bags, usually were handled more roughly.

Greening and decay were less than 1 percent in all bags.

Statistical analysis of the findings listed in table 4 indicated:

Skinned-not discolored: Significantly more in 5-pound and 10-pound polyethylene film bags than in 5-pound polyethylene mesh bags; no other significant differences.

Skinned-discolored: Significantly more in 5-pound polyethylene mesh bags than in all other bags; no other significant differences among bags.

Bruising: Significantly more in 50-pound paper bags than in other bags; no other significant differences.

Greening: No significant differences.

Decay: No significant differences.

Alabama--1961.--In four test shipments from Alabama to north-central markets, the number of bags of each type was increased to provide ample samples for observation in retail stores. The 50-pound bags were eliminated as controls and the newly developed 10-pound polyethylene mesh bags were added for initial evaluation. Condition of the Lasoda potatoes upon arrival in terminal markets is shown in table 5.

Ten test shipments were planned but adverse weather conditions, which lowered the quality of the potatoes, halted the tests after four shipments. With only four replications, none of the observed differences in the arrival condition of potatoes in the various containers proved statistically significant.

RETAIL EVALUATION

Alabama and Florida--1961.--Eight test shipments of the experimental consumer containers were inspected at retail stores from 1 to 2 days after arrival at the terminals. Four were from Florida and four from Alabama. The 5- and 10-pound polyethylene film bags, the 10-pound paper bags and the 5-pound polyethylene mesh bags were evaluated.

Potatoes in the 5-pound polyethylene mesh bag showed more bruising and skinning with discoloration than in the other consumer bags. The 5- and 10-pound polyethylene film bags contained potatoes with more skinned-not discolored defects and more decay than the other bags.

Table 5.--Condition of Lasoda potatoes on arrival in north-central markets after 4 to 7 days in transit, 1961

(Average of four test shipments from Alabama)

Type and degree of injury 1/	Amount of injury by type of bag				
	5-pound poly film	10-pound poly film	10-pound paper	5-pound poly mesh	10-pound poly mesh
	Percent	Percent	Percent	Percent	Percent
Skinned-not discolored					
Slight	10.4	10.1	6.8	5.6	9.0
Damage	4.0	2.7	0.1	0.2	0
Serious damage	1.5	0	0	0	0
Skinned-discolored 2/					
Slight	10.9	10.0	10.5	12.5	9.6
Damage	3.4	3.1	3.3	3.5	2.8
Bruised					
Slight	1.3	1.2	1.4	4.1	4.4
Damage	0.1	0	0	0.1	0
Serious	0	0	0	0.1	0

1/ Decay and greening were less than 0.5 percent in all bags.
2/ No serious damage by skinning and discoloration observed.

Potatoes in the 10-pound paper bags had the least greening and were near the lowest in all other defects. At the end of the first day on display, greening in the polyethylene film and polyethylene mesh bags averaged 1.4 percent, compared with 0.6 percent in the paper bags.

The 5- and 10-pound polyethylene film bags usually showed considerable moisture condensation when displayed at retail levels. Some produce managers complained of the greening of potatoes in the polyethylene film and mesh bags. However, they liked the complete visibility and ease of display.

The polyethylene film bags usually sold slightly faster than the other bags at equivalent prices. There was considerable consumer interest in the polyethylene mesh bags. Even when consumers purchased potatoes in other types of bags, they still picked up the mesh bag to observe and handle it. Some breakage of the polyethylene mesh bags early in the tests ended when the manufacturer strengthened them. Produce managers said that potatoes in the polyethylene mesh bags tended to dry out and that in general they favored the 10-pound paper bag. They considered it stronger than the other types of containers and said that it minimized greening. Greening can be controlled by rotating the potatoes on display to limit the time they are exposed to light.