and prices that producers obtain are illustrated by the figures in this table.

Financial Analysis

If recommended management and marketing practices are followed, an investment in a peach orchard could be profitable for a producer with sufficient capital or financial backing to establish the orchard. The grower would have to forego a self-sustaining income stream for the first four years. The cash flow analysis in Table 7 indicates that a positive net annual difference between costs and receipts is realized during the fourth year. A positive accumulated net difference occurs during the sixth year. Of course, with variations in production costs, yields, and prices, the cash flow would change and the planted acreage would be the factor that would ultimately determine the returns on investment.

Although peach orchards are relatively costly to establish and maintain, profits may be realized if recommended production practices are followed. Careful economic planning is necessary by peach producers to determine the prospects for profit in their particular operation.

Literature Cited

1. Hewitt, Timothy D. 1979. Developing and using pecan budgets. Proc. Fla. State Hort. Soc. 92:271-273.
2. Rasmussen, Gary D. 1978. How Fresh Peaches Are Marketed. Marketing Bul. No. 64. Agr. Marketing Serv., U. S. Dept. Agr., Washington, D.C., August 1978.
3. Sharpe, R. H. and C. E. Arnold. 1971. Peaches and nectarines in Florida. Cir. 299-A. Florida Coop. Ext. Serv., Univ. Florida, Gainesville, May 1971.

Proc. Fla. State Hort. Soc. 95:101-103. 1982.

PROCESSING OF MUSCADINE GRAPES

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Abstract. **Two new processing devices (a continuous flow density separator and an automatic deseeder) as well as a grape size separator, were developed to use for producing preserved deseeded grapes. Preliminary results on four cultivars ('Dixie', 'Fry', 'Higgins' and 'Southland') showed they could easily be separated and up to 80% of original weight could be recovered. These devices provide the main elements for a process for canned muscadine grapes.**

Due to the growth of the muscadine grape industry alternatives to the fresh fruit market are needed. Over the past few years the market has advanced from roadside stands and you-pick operations to widespread consumer acceptance in retail stores. As grape production and acreage continue to increase market pressures are created due to the short shelf life and short harvesting season. The wine industry can provide an outlet, but another alternative would be packaged deseeded grapes for direct consumption or reprocessing.

Although wine-making uses large quantities, it does not generate as high capital return as other markets. Studies by Stover, et al. (10) showed that 25% of a crop of bunch grapes, if used for wine, would only account for 7.4% of the total returns when the rest of the crop was marketed fresh. Thus, net returns on fresh fruit were much higher than on wine. Return could possibly be increased on other processed products. Most muscadine cultivars even at optimum storage conditions of 1°C and 85% relative humidity (9) remain acceptable only about 2 wk. In recent studies, Coleman, et al. (4) showed canned deseeded 'Dixie' grapes could be stored for 6 months at 70°F or below without significant changes in flavor or texture.

Processing for deseeded muscadine grape products would require the following unit operations: 1) separation of clean grapes by maturity, 2) separation of the mature grapes by size, 3) removal of seeds, and 4) canning or drying the deseeded grapes. Recent procedures for step 1 and step 3 have been carried out on four cultivars: 'Dixie', 'Fry', 'Higgins' and 'Southland'.

Materials and Methods

Equipment. Automatic deseeder. A deseeder (Fig. 1) described by Coleman, et al. (5) was used in these studies. It deseeds 4 grapes at a time, up to 160 grapes/min.

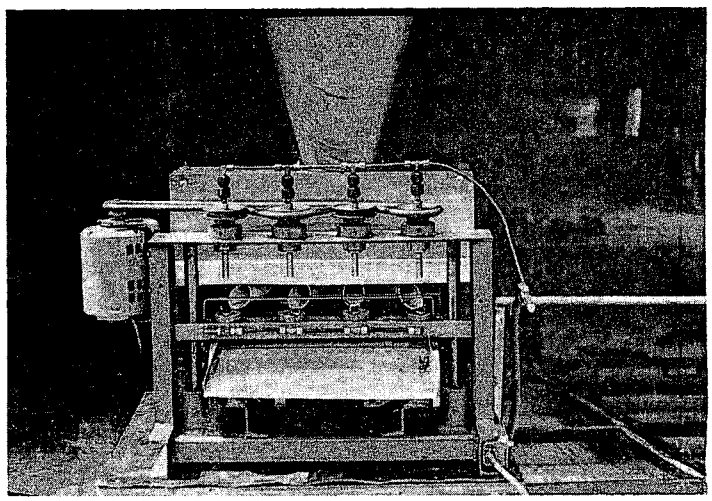

Fig. 1. Front view of deseeder showing cutter drive motor, cutters and hopper.

Density Separators. Two separators were tested: *Preliminary continuous separator.* A 5.3 gal (20 liter) cylindrical glass tank [11.5 inches (29.2 cm) diameter] was fitted with a 2 inch x 19 inch (5.1 cm x 48.3 cm) flat wooden paddle, driven by a stirring motor. An aluminum sleeve with small holes in it, prevented grapes from coming into

[1]Southern Region, U. S. Department of Agriculture, Agricultural Research Service.

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contact with the paddle. *Final continuous separator* (Fig. 2). The tank holds 107 gal (404 liters). On one side of the longitudinal separator are separate screen baskets to separately catch grapes that float and those that sink; an electric boat trolling motor provided agitation and flow.

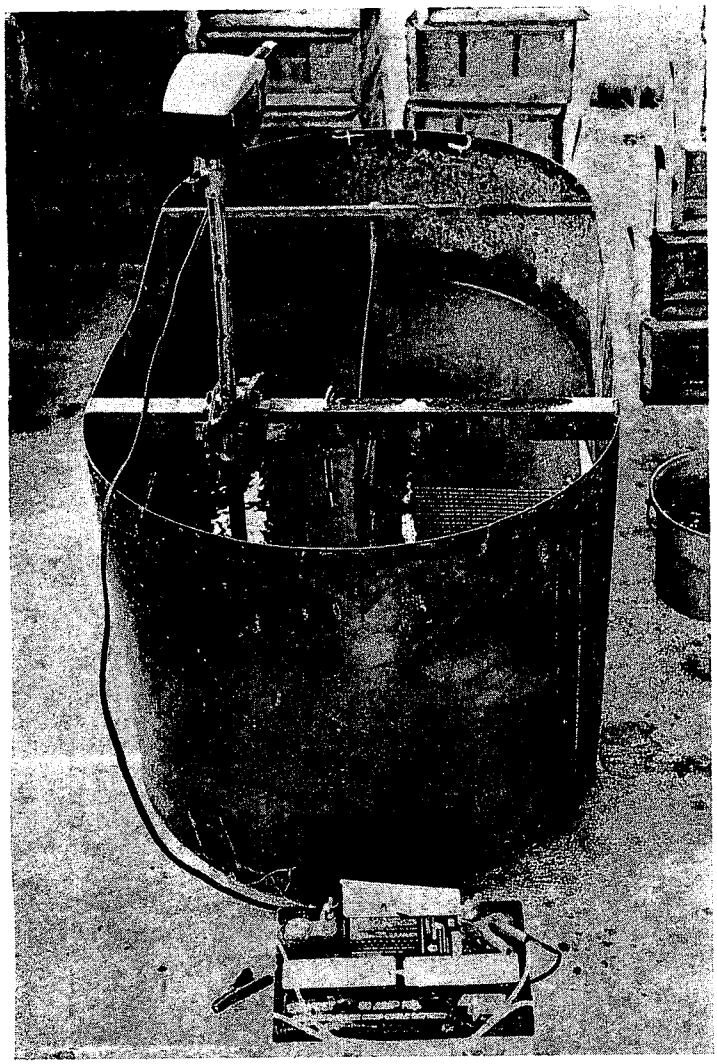

Fig. 2. A muscadine grape continuous flow density separator.

Tests. Four cultivars, 'Dixie', 'Fry', 'Higgins' and 'Southland' of muscadine grape (*Vitis rotundifolia* Michx.) were subjected to preliminary density separation tests to determine whether mature grapes could be separated from immature grapes in a moving solution. Grapes that floated (immature) were removed in a separate stream from those that sank (mature). Grapes from these four cultivars were also fed through the automatic deseeder which separated them into deseeded grapes and plugs containing the seeds and a small amount of grape flesh. Weights of each fraction were taken and then the seeds were removed by hand from the plugs and weighed separately.

Analyses. Physical. Density of grapes was determined from the volume of water displaced by 10 to 40 weighed grapes. Diameter was measured with outside calipers.

Chemical. °Brix (total soluble solids) was measured using a Zeiss refractometer with a sucrose scale. Acid was determined on 10 g juice samples titrated with standard NaOH solution to pH 8.2 (8). pH was determined on an Altex (Irvine, CA) Model 4500 digital pH meter.

Results and Discussion

Average density, °Brix, acid and pH were in agreement with previous reports by Bates, et al. (1) and Mortenson and Balerdi (7), as shown in Table 1. All grapes had densities greater than 1.00 and the 'Southland' was highest (1.08). °Brix of the juice ranged from a high of 16.8 for 'Dixie' to a low of 13.5 for 'Higgins'.

Table 1. Some average characteristics of four cultivars.

Cultivar	g/ml	Juice from deseeded grapes °Brix	Acid[z]	pH
Dixie	1.05	16.8	0.62	3.92
Fry	1.06	14.4	0.65	4.18
"	"	14.4	0.60	4.10
"	"	15.1	0.60	4.14
Higgins	>1.00	13.5	0.65	3.77
"	"	13.5	0.68	3.78
"	"	13.5	0.70	3.76
Southland	1.08	16.1	1.40	3.46

[z]ml of 0.4900 N NaOH/100 ml juice.

For purposes of processing in a continuous process some type of separation by ripeness was required. Hatton and Cubbedge (6) demonstrated that muscadines of different maturities could be successfully separated in static solutions of different densities. Therefore we explored density separation in a continuously flowing or dynamic system. In these tests grapes could be easily separated (10-15 sec) in continuously flowing solutions and the °Brix of separated grapes could be controlled by selecting the appropriate density of the separator solution (Table 2). When the °Brix of the sugar solution was adjusted to about 1-2°Brix above that of the grapes most desired to be separated, less mature grapes floated while those that sank were near (within 1°Brix) or above the selected index. In our continuous flow separator, grapes with the desired maturity were removed from the top 1-2 inches (2-5 cm) and over-mature grapes could be removed below that level.

Table 2. Mean °Brix of grapes separated in flowing sugar solutions.

Cultivar	Sugar soln concn °Brix	Floaters Avg °Brix	Floaters SD	Sinkers Avg °Brix	Sinkers SD
Dixie	18.0	15.1	1.6	—	—
Fry	16.0	14.4	0.8	16.7	0.8
Higgins	16.0	12.2	0.6	14.5	0.8
"	17.0[z]	14.2	0.6	15.1	0.7
Southland	18.0	14.8	1.4	17.8	0.8

[z]Sinkers from 16°Brix solutions used for this test.

Separating muscadines by size became increasingly important with development of the automatic deseeder. Relative uniformity of size improved the performance of the deseeding device by reducing rebounding and blocking. A size separator we are currently testing is shown schematically in Fig. 3. Efficiency of the deseeder was greatly dependent on relation of size of grapes to size of cutter heads. Adjusting the inside diameter of the cutter heads on the deseeder so they were barely large enough to remove seeds reduced wasted pulp and juice.

Grapes have been deseeded using several different devices in the past (2, 3). Testing the automatic deseeding device (Fig. 1) on 'Fry', 'Higgins', 'Dixie' and 'Southland' using a 0.36 inch (9 mm) cutter gave results shown in Table 3. Grapes varied widely in size, from some 'Southland' at less than .64 inch (16 mm) diameter to some 'Fry' in excess of 1.04 inches (26 mm). Extreme diameter variations in

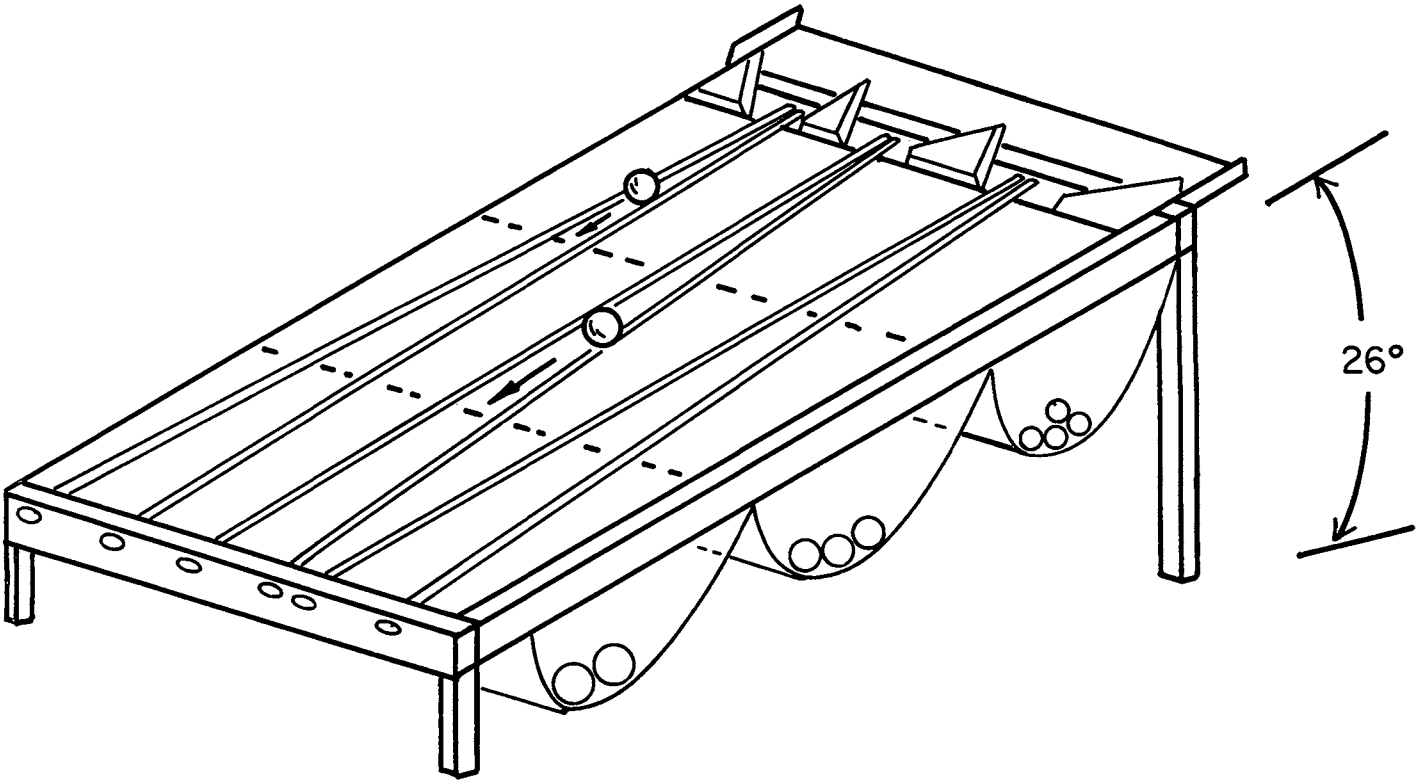

Fig. 3. A simple muscadine grape size separator.

sizes decreased the efficiency of the deseeding device. Coleman, et al. (3) reported results of previous deseeding experiments with 'Fry' and 'Higgins' grapes. Results in Table 3 for those cultivars are similar. The smaller diameter grapes ('Dixie' and 'Southland') should have smaller diameter cutters to increase the efficiency of the deseeder and the weight % of deseeded grape. With optimum size grapes up to 80% of the weight could be recovered as deseeded grapes, and of the 20-30% removed as plugs and seeds, all but about 1.7 to 5.3% of the weight could be recovered by rapid stirring of the cores. The rapid stirring dislodged the seeds which sank leaving the skin and flesh which floated in the stirred solution. Two methods of preservation of the grapes have been explored for final products. Both have been reported in these proceedings—solar drying to produce deseeded muscadine raisins (3) and canning deseeded muscadines (4).

Table 3. Size and fresh weight composition of 4 cultivars tested on an automatic deseeder.

Cultivar	Diam[z] (mm)	Seeds[z]/ grape	Deseeded grape (%)	Plug with seeds (%)	Seeds (%)
Dixie	19.8	3.0	62.8	30.8	5.3
Fry	24.0	1.9	77.0	—	2.2
"	"	"	73.9	—	2.1
"	"	"	80.0	—	1.7
Higgins	21.4	3.2	70.9	23.1	4.4
"	"	"	75.1	21.9	—
"	"	"	74.3	20.9	—
Southland	19.6	3.0	71.3	22.2	4.6

[z]Averages.

In conclusion, three unit operations for processing muscadine grapes have been developed: 1) density separation by maturity in a continuous flow system, 2) separation by size and 3) automatic deseeding. All show potential as main steps in a process for muscadine grape products.

Literature Cited

1. Bates, R. P., R. L. Coleman and C. J. Wagner, Jr. 1981. Grape processing and utilization in Florida. Proc. Fla. State Hort. Soc. 94: 343-347.
2. Coleman, R. L., C. J. Wagner, Jr. and R. E. Berry. 1980. Solar drying of mango slices and mechanically deseeded muscadine grapes. Proc. Fla. State Hort. Soc. 93:334-336.
3. Coleman, R. L., C. J. Wagner, Jr. and R. E. Berry. 1980. Muscadine deseeding and solar drying. Proc. Viticultural *Sci. Symp. 2:33.*
4. Coleman, R. L., C. J. Wagner, Jr. and R. E. Berry. 1981. Storage studies on canned deseeded 'Dixie' muscadines. Proc. Viticultural Sci. Symp. 3:26-30.
5. Coleman, R. L., C. J. Wagner, Jr. and R. Lohiser. 1982. Automatic muscadine deseeder—A progress report on design, development and testing. Proc. Viticultural Sci. Symp. 4:16-20.
6. Hatton, T. T., Jr. and Randall Cubbedge. 1979. Use of a saline solution to segregate maturity of cuscadine grapes. Proc. Viticultural Sci. Symp. 1:28.
7. Mortensen, J. A. and C. F. Balerdi. 1973. Muscadine grapes for Florida: Yields and other characteristics of 48 cultivars. Proc. Fla. State Hort. Soc. 86:338-341.
8. Quality Control Manual for Citrus Processing Plants. 1975. Intercit, Inc., Safety Harbor, FL.
9. Saunders, M. S., F. Takeda and T. T. Hatton. 1981. Postharvest physiology and senescence in muscadines. Proc. Fla. State Hort. Soc. 94:340-343.
10. Stover, L. H., J. M. Crall and J. A. Mortensen. 1977. Marketing Florida bunch grapes as fresh fruit. Proc. Fla. State Hort. Soc. 90: 228-230.