

Developing Conservation Plants for USDA Programs: Benefits for Society, Wildlife and the Environment



A Comparison of Benefits and Costs 1965-1997

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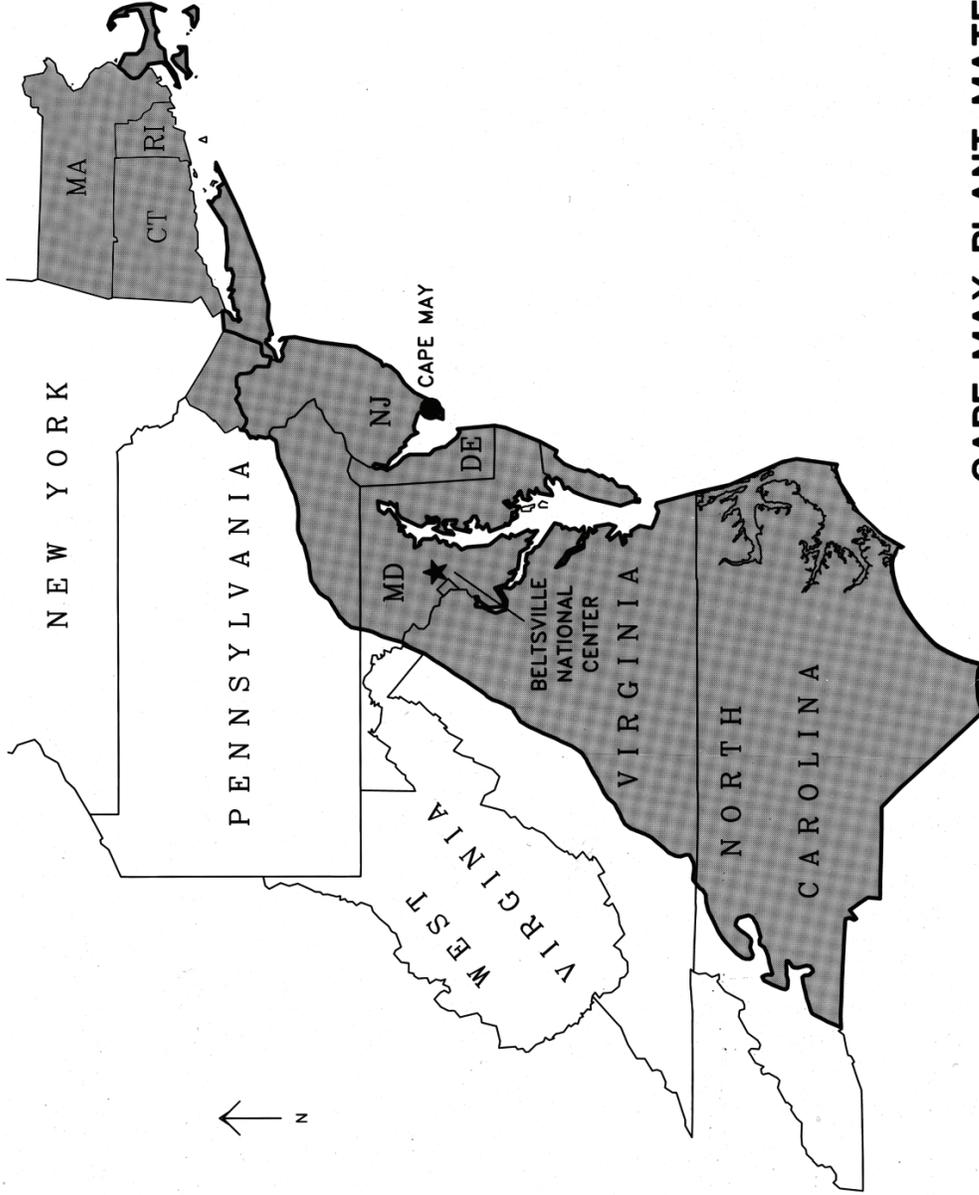
**Cape May Plant Materials Center
United States Department of Agriculture
Natural Resources Conservation Service**

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CAPE MAY PLANT MATERIALS CENTER SERVICE AREA

0 50 100 MILES

SOURCE: DELINEATIONS PROVIDED BY ECOLOGICAL SCIENCES DIVISION, NHD, U.S. DEPARTMENT OF AGRICULTURE, NATIONAL CARTOGRAPHIC CENTER, FORT WORTH, TEXAS, 1991.

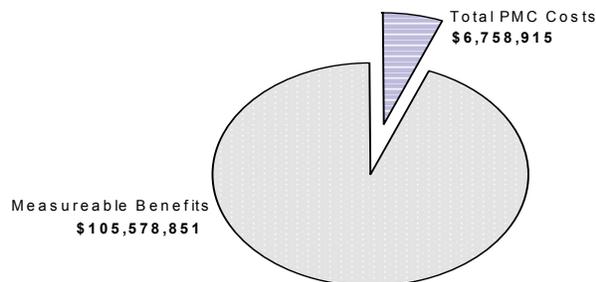
Executive Summary

The Natural Resources Conservation Service (NRCS) Plant Materials Program maintains a network of 26 Plant Materials Centers (PMC) strategically located throughout the U.S. Collectively, their mission is to develop plants and establishment technologies for conservation programs such as: Conservation Reserve Program, Conservation Reserve Enhancement Program, Wildlife Habitat Improvement Program, Environmental Quality Improvement Program and locally identified resource concerns.

The 88th U.S. Congress authorized the establishment of the Cape May PMC in response to a 1962 storm that devastated coastal communities. Primary objectives included Enhancing and Protecting Coastal Dune Resources and Reducing Tidal Shoreline Erosion. The Cape May PMC serves a nine-state area from Massachusetts to North Carolina, which contains over 1,000 miles of coastal shoreline, and the Chesapeake Bay. The tourism industry in five coastal counties of New Jersey alone exceeds **\$25 billion annually**. People go to the coast primarily for the beaches. The existence of beaches is directly related to the sand budget. The sand budget is a function of stabilized dunes and dunes are stabilized with Cape May PMC plant products.

Recently, our nation's citizenry has developed a new attitude toward the size and cost of government at all levels. This attitude has prompted the examination of the cost effectiveness of government programs. Cost effectiveness is commonly expressed in terms of a benefits to cost ratio statement. An analysis has now been completed using only quantitatively measurable data.

Relationship of the value of benefits associated with sand dunes and tidal marshes only as compared to the total costs of establishing and operating the Cape May Plant Materials Center from 1965-1997.



Measurable PMC Benefits and Total PMC Costs

The Cape May PMC has been successful in producing economic benefits in two high priority areas. Its efforts in these two areas, when compared to all PMC costs, have produced \$15.62 in benefits for each \$1.00 spent. On reading this report in its entirety, we are sure that you will foster a greater appreciation why developing conservation technologies and products are actually profitable for society and beneficial to wildlife and the environment.

Appendix III – Per Acre Benefit Values for the Vegetation for Each of the Three Corps Studies (cont.)

Summary of impacts of the PMC on stabilizing coastal dunes

A summary of the above per acre benefits, and the yearly and lifetime benefits of the PMC released plants is shown in the Table below.

Value of Cape May PMC released plants, based on three Corps Studies.

Plant Releases	Unit	Total Commercial Production	Total Acres	Study #1 = \$1,489	Study #2 = \$768	Study #3 = \$1,355	Study #1	Study #2	Study #3
Cape American beachgrass	no.	123,549,048	2,364	\$ 3,519,370	\$ 1,815,229	\$,202,651	\$ 54,550,242	\$ 28,136,055	\$ 49,641,087
Emerald Sea shore juniper	no.	3,825,564	565	\$ 840,653	\$ 433,594	\$ 65,000	\$ 16,813,060	\$ 8,671,881	\$ 15,299,998

Introduction

The Cape May Plant Materials Center (PMC) was established in response to the coastal storm of 1962 that devastated public and personal properties along the Mid-Atlantic oceanic coastline. During this storm, the protective value of sand dunes was clearly demonstrated. Therefor the 88th U.S. Congress authorized the establishment of the PMC, which opened in 1965. The Cape May PMC, as one integral part of the NRCS Plant Materials Program, addresses resource conservation related issues from a nine-state service area that includes: Massachusetts, Connecticut, Rhode Island, Long Island in New York, New Jersey, Maryland, Delaware, Virginia, and North Carolina. This service area encompasses approximately 99,000 square miles or 63.5 million acres and 123 service centers and field offices. The service area is also home to such major metropolitan areas as Boston, Massachusetts; New York City, New York; Philadelphia, Pennsylvania; Baltimore, Maryland; Washington, DC; Richmond, Virginia; Raleigh, North Carolina and more. As a result, human impact on soil and water resources for housing, industry, commerce, food, fiber and recreation is among the highest in the nation.

The Cape May PMC receives its technical direction from a locally led advisory process. Current field needs are assessed and inventoried at the local Soil and Water Conservation District level. Districts or Field Offices will bring their concerns to the State Plant Material Committee Meetings. Representatives from each state committee will bring their concerns to the Cape May PMC Advisory Committee Meeting. Needs are then prioritized and a technical charge is established. The PMC then develops plant products and related establishment technologies accordingly.

Since its opening in 1965, the Cape May PMC has addressed many diverse resource conservation related issues. For the first 25 years, stabilizing coastal dunes and developing fringe marshes received the greatest attention. Plants, and techniques for using them, were also developed for improving habitat for upland wildlife species and stabilizing areas disturbed by nature or human activities. New USDA conservation programs, such as the Conservation Reserve Program, Conservation Reserve Enhancement Program, Environmental Quality Improvement Program, Wildlife Habitat Improvement Program, and more, have recently generated new needs for additional plant products and related technologies.

In light of these new programs and updated technical needs from State Plant Materials Committees, the Cape May PMC is focusing its staff and equipment resources on developing new plant products for: *Bio-engineering; Tidal Shoreline Stabilization; Native cool season grasses, native warm season grasses and native legumes for wildlife value and stabilization of conservation structures*. These new products and the associated cultural technologies will serve to diversify and expound upon the cost effectiveness of the Cape May Plant Materials Center.

Non-Measurable Qualitative Values

The plant products that originate from the Cape May PMC have commercial nursery market values that are measurable and have been quantitatively expressed in the following section of this report. However, because these materials are intended for ecological restoration, environmental enhancement, wetland mitigation and erosion protection, there are many qualitative values that are difficult to express in monetary terms. For instance:

Tourism:

The Tourism expenditures are expressed in terms of billions of dollars per year. In New Jersey alone, the five coastal counties generated the following values:



Travel and Tourism Expenditures in Shore Counties

	1996 (\$Billion)	1997 (\$ Billion)
Atlantic	8.08	8.24
Monmouth	1.57	1.68
Ocean	1.61	1.73
Cape May	2.20	2.32
Cumberland	0.13	0.14
New Jersey	24.05	25.48

Vegetated sand dunes are a part of the natural experience which draws people to the shore. Dunes not only contribute to the aesthetic beauty but also protect valuable properties and infrastructures.

Wildlife Values:



Beach habitats provide three of the four essentials for the survival of many wildlife species that live along the shore: food, cover and living space. Some of the threatened and endangered wildlife species include, but are not limited to, piping plover and the least tern.

Technology Development and Transfer:

Over the years, the Cape May PMC has authored technical guidelines and procedures for successfully getting conservation on the ground. Collectively, the breath of this information is very valuable but not easily quantifiable into monetary terms.

Appendix III – Per Acre Benefit Values for the Vegetation for Each of the Three Corps Studies (cont.)

The costs and benefits associated with the combination of measures and the individual measures are shown below. Since the protective benefits of the seawall-berm are the same as the berm-dune, one might predict that within the seawall-berm part of the Study area the seawall is providing 50 percent of the protection and the berm 50 percent. Using this logic, within the berm-dune system the berm would be providing 50 percent of the protection and the dune 50 percent. To avoid crediting too much benefit to the value of the dunes, the following calculations reflect the berm providing 60 percent of the protective benefit within the berm-dune fields, meaning the dune is providing 40 percent of the protection.

The benefit derived from the vegetated dune is 30 percent, versus a non-vegetated dune, instead of using 10 percent or 15 percent, as in Study 1 and 2, respectively. This is because Study 1 and 2 benefits were derived from a berm-dune combination and the calculations for Study 3 are for the dune only. Typically, berms are not vegetated, and vegetation is essential on the dunes to control wind blowing the dry sand.

The annual cost figures below are based on the total project costs, including cost of capital and maintenance costs, then converted to an annual cost by the Study. Since the Study treats the seawall - berm and berm-dune as providing equal benefits, the annual benefits are a percent of the total benefits relative to the percent of the total area protected by the seawall-berm and berm-dune. From this, the dune benefits are computed.

The figures below are benefits after the project costs, including the vegetation costs, have been subtracted. The annual benefits to property protection from the wave and inundation damage by the dune only are \$1.536 million.

	Study Costs and Benefits	Average Annual
	Total project cost	\$11,613,000
	Average annual berm and dune construction costs	\$1,901,000
	Average annual planting costs	\$39,000
	Total average annual berm and dune costs	\$1,940,000
	Total commercial and residential structures damage reduction benefits	\$10,021,000
Percent of commercial and residential structures damage reduction benefits from berm/dune		38.33
Commercial and residential structures damage reduction benefits from berm/dune		\$3,840,000
Commercial and residential structures damage reduction benefits from dune only (40%)		\$1,536,000
Total benefits from project relating to recreation		\$ 0
Total project benefits relating to dune		\$1,536,000
30 % of benefit gained from vegetating project:		\$460,800
5 % increase to vegetating benefits from use of CMPMC released plants for the project		\$23,040
	Total project acres planted	17
	Value per acre per year of CMPMC released plants	\$1,355

This results in a \$1,355 per acre per year benefit over common strains of the same plants of unknown origin.

Appendix III – Per Acre Benefit Values for the Vegetation for Each of the Three Corps Studies (cont.)

Study damage, yet costs only 50 percent of the project. Because of this, the assumed share of the benefits of vegetation on the dunes value is increased from 10 percent to 15 percent of the benefits derived from the wave and inundation damages. Annual damages and benefits for Avalon and Stone Harbor are combined, and the following is from the selected plan.

Total damages without plan	\$5,125,000
Damage from wave and inundation	\$4,012,000
Percent damage by wave and inundation	78
Benefits from entire project	\$3,770,000
Benefits from wave and inundation damage reduction (78% 3770)	\$2,952,000
Benefits from project relating to recreation	\$2,114,789
Total project benefits for wave & inundation and recreation related	\$5,066,789
Total project acres planted	49.5
15 % of benefit gained from vegetating project:	\$760,000
5 % increase to vegetating benefits from use of CMPMC released plants for the project	\$38,001

Value per acre of CMPMC released plants \$768

Results are a \$768 per acre per year benefit over common strains of the same plants of unknown origin.

Study 3: Environmental Assessment and Appendixes. 1994. Beach Erosion Control and Hurricane Protection Study, Virginia Beach, Virginia. Norfolk District, Virginia

Study 3, which has a benefit to cost ratio of 1.2 to 1, lends itself to a somewhat different evaluation. The area being protected is 33,403 feet long, of which 20,600 feet is protected by a seawall (@ elevation 9 feet) and a beach berm (@ elevation 13.5 feet), and the remaining 12,308 feet protected by a beach berm (@ elevation 13.5 feet) and a dune (@ elevation 18 feet). The level of protection afforded by the two combinations of measures is the same. As a result the benefits from each combination of measures can be determined from the data, as well as the total and unit costs for each measure. For the purpose of this evaluation, the only benefits counted are those associated with the protection of commercial and residential structures. There are no recreational benefits to this project. There are other Projects, such as dune crossings, ramps, and water outlets that do not impact the level of protection. Their costs and benefits have been removed.

This Study does not include cost figures for vegetating the dune, only the costs associated with labor and sand requirement. The vegetation costs are computed based on a per unit cost identical to those used in Study 1. Additionally, the acres to be planted are not shown in the Study. The dune planting costs and acres, shown below, are based on dune length and configuration figures the Study contained.

Dune acreage based on feet elevation above berm elevation	
fore slope 5:1	22.5'
crest	25'
back slope 2.5:1	11.75
total width	60'
total length	12,308'
acres	17
Dune vegetation costs	
Cost to plant 17 acres @ \$18,400/acre (Study 1)	\$312,800

Quantitative Data

Once the PMC was established, work started to select a superior strain of American beachgrass, the initial stabilizer of coastal dunes, and to initiate its commercial production. In 1971 (25), propagating material of 'Cape' American beachgrass, the first PMC released cultivar, went to commercial growers. Associated with this was the development of needed establishment and management technology (1, 7 and 17).

Fringe marshes protect property by halting erosion, keeping sediment out of tidal streams, contributing to the recycling of nutrients, enhancing shore wildlife habitat, and adding to the aesthetic quality compared to the eroding slope. Erosion at the toe of tidal streams has been an ongoing activity for centuries (14, 18 and 30). As with the sand dunes, fringe marshes come and go, influenced by storms, sediment, and changing stream currents and direction. As land adjacent to these shores was converted to farms or home sites, and boat traffic increased, the erosion became a threatening menace. Additionally, actions by adjacent landowners and stream users aggravated and accelerated the loss of the marshes and prohibited the natural re-invasion of vegetation.

The initial fringe marsh work concentrated on the development of techniques for their establishment. The first results were published in 1970 (15), and refined in subsequent publications (16), followed by the development and release of improved cultivars in 1986 and 1992 (23 and 24).

Plants developed and released as cultivars for the stabilization of coastal dunes and the development of fringe marshes include:

Name	Year	Reference
Cape American beachgrass	1972	USDA, SCS. 1972. Release of <i>Cape</i> American Beachgrass. Release Notice: Washington, D. C.
Atlantic coastal panicgrass 1981	Belcher,	C.R, W.C. Sharp, R.L. Duell and F.W. Webb. 1982. <i>Atlantic Coastal Panicgrass</i> . Crop Sci., Vol. 22, p 1262-63.
Emerald Sea shore juniper	1971	USDA, SCS. 1971. Release of <i>Emerald Sea</i> Shore Juniper. Release Notice: Washington, D. C.
Avalon saltmeadow cordgrass	1986	USDA, SCS. 1972. Release of <i>Avalon</i> Saltmeadow Cordgrass. Release Notice: Washington, D. C.
Bayshore smooth cordgrass	1992	USDA, SCS. 1972. Release of <i>Bayshore</i> Smooth Cordgrass. Release Notice: Washington, D. C.
Wildwood bayberry	1994	USDA, SCS. 1972. <i>Wildwood</i> Bayberry. Release Notice: Washington, D. C.
Ocean View beach plum	1994	USDA, SCS. 1972. Release of <i>Ocean View</i> Beach Plum. Release Notice: Washington, D. C.
Sandy rugosa rose	1994	USDA, SCS. 1972. Release of <i>Sandy</i> Rugosa Rose. Release Notice: Washington, D. C.

The PMC cost analysis is the sum of funds for its establishment and operation. Benefits have been measured and presented for:

- I. The commercial value of the plant releases.
- II. The measurable economic value of fringe marshes from PMC products.
- III. The measurable benefits of using commercially produced Cape May Plant Materials Center releases to stabilize sand dunes.

This Analysis is based on published references or otherwise documented sources, with one exception. This is the increased value to the user of PMC released cultivars, as compared to common strains of the same plants of unknown origin. The increased value of the PMC released cultivars is considered to be only five percent superior to other untested cultivars or common plants of unknown origin. Although this figure seems low, it was selected to be sure the results of the Analysis were conservative, leaving any margin for potential error to be one of under estimating the benefits of the PMC. A higher figure could be justified, for example, because there are no other tested cultivars of five of the eight PMC releases discussed in this Analysis. A sixth, Cape American beachgrass, dominates the 4 million annual plant market, simply because of its superior characteristics. The other two are the only cultivars of their species tested for their adaptation to the Mid-Atlantic coastal region. Several additional examples will be found in the Analysis where the potential benefits were deliberately reduced to be sure the results were conservative.

Cost Analysis and Discussion

Costs associated with the PMC are the sum of obligated funds since its establishment. The total of the obligated funds from 1965 through 1997 was \$6,758,915. The average annual cost was \$204,815 These are shown in Table 1.

Table 1 - Total obligations to the Cape May Plant Materials Center

Year	Amount	Year	Amount
		1981	\$ 148.925
1997	\$ 305.584	1980	\$ 124.309
1996	\$ 382.595	1979	\$ 126.089
1995	\$ 407.095	1978	\$ 135.412
1994	\$ 366.831	1977	\$ 116.231
1993	\$ 302.375	1976	\$ 125.000
1992	\$ 303.981	1975	\$ 128.400
1991	\$ 296.072	1974	\$ 131.680
1990	\$ 310.242	1973	\$ 124.599
1989	\$ 222.778	1972	\$ 123.649
1988	\$ 221.999	1971	\$ 137.400
1987	\$ 214.397	1970	\$ 135.765
1986	\$ 191.400	1969	\$ 128.236
1985	\$ 216.000	1968	\$ 125.459
1984	\$ 218.713	1967	\$ 127.589
1983	\$ 233.935	1966	\$ 167.490
1982	\$ 248.685	1965	\$ 210.000
Total		\$ 6,758,915	

Some NRCS funds, other than PMC obligated funds, are used by the PMC such as Plant Materials Specialist and Soil Conservationist time in collecting plants. Conversely, PMC funds are used for other NRCS purposes such as administrative offsets that help cover state office salaries. This Analysis assumes that, had the PMC never been established, none of these costs would have occurred, and any costs and/or benefits are confined only to those dollars obligated for its operation.

Appendix II – Production and Net Profit/Loss – Cape May PMC Released Cultivars (cont.)

Cultivar	Year	Commercial	Producer	Producer	Profit/loss	Cumulative
Bayshore smooth cordgrass	1992	2500	\$ 0.60	\$ 1.05	\$1,125	\$1,125
Bayshore smooth cordgrass	1993	0	\$ 0.60	\$ 1.05	\$0	\$1,125
Bayshore smooth cordgrass	1994	10000	\$ 0.60	\$ 1.05	\$4,500	\$5,625
Bayshore smooth cordgrass	1995	65000	\$ 0.60	\$ 1.05	\$29,250	\$34,875
Bayshore smooth cordgrass	1996	27000	\$ 0.60	\$ 1.05	\$12,150	\$47,025

Cultivar	Year	Commercial	Producer	Producer	Profit/loss	Cumulative
Sandy rugosa rose	1993	400	\$ 2.41	\$ 4.25	\$736	\$736
Sandy rugosa rose	1994	500	\$ 2.41	\$ 4.25	\$920	\$1,656
Sandy rugosa rose	1995	500	\$ 2.41	\$ 4.25	\$920	\$2,576
Sandy rugosa rose	1996	2000	\$ 2.41	\$ 4.25	\$3,680	\$6,256
Sandy rugosa rose	1997	1300	\$ 2.41	\$ 4.25	\$2,392	\$8,648

Cultivar	Year	Commercial	Producer	Producer	Profit/loss	Cumulative
Wildwood bayberry	1993	500	\$ 2.41	\$ 4.25	\$920	\$920
Wildwood bayberry	1994	500	\$ 2.41	\$ 4.25	\$920	\$1,840
Wildwood bayberry	1995	500	\$ 2.41	\$ 4.25	\$920	\$2,760
Wildwood bayberry	1996	1000	\$ 2.41	\$ 4.25	\$1,840	\$4,600
Wildwood bayberry	1997	5100	\$ 2.41	\$ 4.25	\$9,384	\$13,984

Cultivar	Year	Commercial	Producer	Producer	Profit/loss	Cumulative
Ocean View beach plum	1993	150	\$ 2.88	\$ 7.00	\$618	\$618
Ocean View beach plum	1994	400	\$ 2.88	\$ 7.00	\$1,648	\$2,266
Ocean View beach plum	1995	400	\$ 2.88	\$ 7.00	\$1,648	\$3,914
Ocean View beach plum	1996	5300	\$ 2.88	\$ 7.00	\$21,836	\$25,750
Ocean View beach plum	1997	1800	\$ 2.88	\$ 7.00	\$7,416	\$33,166

Benefit Analysis and Discussion

The Benefit Analysis and Discussion section outlines the process used, and presents the results and discussions.

1. The commercial value of the plant releases

Records within the NRCS have been kept since 1977 on the estimated commercial production of all released cultivars, with the exception of 1994.

The estimated producer production costs for each of the released cultivars considered in this Analysis are shown in Appendix I. The production costs and consumer prices were determined through conversations with a number of growers, NRCS plant materials personnel and current market prices. Current costs and consumer prices were used for all years. While it is realized that these will vary by year, the high and the low would average themselves out over the years of production. The net profit or loss for each cultivar was computed for each release, then applied to each year in which there was production of that release. These calculations are shown in Appendix II. A summary is shown in Table 2.

Table 2- Commercial production of Cape May Plant Materials Center releases, cost of commercial production and net profit/loss to the producer.

Released Cultivar	Unit	Commercial	Producer	Producer	Profit/loss
Cape American beachgrass	culms	123,549.084	\$ 2,341.255	\$ 5,559.709	\$ 3,218.454
Emerald Sea shore juniper	plants	3,825.564	\$ 14,957.955	\$ 20,466.767	\$ 5,508.812
Atlantic coastal panicgrass	seed	44.126	\$ 213.570	\$ 264.756	\$ 51.186
Atlantic coastal panicgrass	plants	5,977.000	\$ 3,586.200	\$ 6,275.850	\$ 2,689.650
Avalon saltmeadow cordgrass	plants	2,741.000	\$ 1,644.600	\$ 2,878.050	\$ 1,233.450
Bayshore smooth cordgrass	plants	104.500	\$ 62.700	\$ 109.725	\$ 47.025
Sandy rugosa rose	plants	4.700	\$ 11.327	\$ 19.975	\$ 8.648
Wildwood bayberry	plants	7.600	\$ 18.316	\$ 32.300	\$ 13.984
Ocean View beach plum	plants	8,050	\$ 23,184	\$ 56,350	\$ 33,166
Grand Total					\$ 12,804,375

As with any product, if it can be sold at a profit, it will be produced. The most widely produced, and the most effective plant released by the PMC, has been *Cape American beachgrass*. It became available at a time when the value of dunes as protection was beginning to expand. It has performed extremely well and now dominates the market. As the long-term effectiveness of *Atlantic coastal panicgrass* is recognized, its use is also expanding. The cordgrasses, which were not available until 1986 and 1992, are becoming more widely used as the cost effectiveness value of coastal fringe marshes is recognized. The shrubs that are adapted to secondary dune stabilization, may never be used extensively, simply because there are fewer and fewer secondary dunes. However, with the emphasis on the use of native ecotypes, the availability of these plants should have continuous and sustained use. Not surprising, the plant with the greatest commercial value, *Emerald Sea shore juniper*, is not the most valuable from an environmental perspective. It is well adapted to the harsh coastal climate, for stabilization as well as ornamental use, thus increasing its total consumption.

The economic benefit realized by all producers of PMC released plants is nearly twice the total establishment and operation costs of the Center: \$12,804,375 (Benefits) to \$6,758,915 (Costs).

II. The measurable economic value of fringe marshes from PMC products

The approach used to stabilize tidal shorelines was to establish a narrow or fringe marsh at the toe of eroding slopes. PMC work centered on whether fringe marshes could be established artificially to do the same job as naturally occurring marshes, and if so, what were the characteristics of the site where this was possible.

After many trial plantings, procedures were developed which included a process for determining where this technique could be used, and how to make the plantings. Following this, two plants, *Avalon* saltmeadow cordgrass and *Bayshore* smooth cordgrass, were placed in commercial production for this purpose. These benefits have been measured in two ways.

A. The benefits of marshes potentially established from the production of the two cordgrass releases.

The first measurement considers the per acre value of marshes established from the production of the two cordgrass releases. This value is for the renewable ecological goods and services provided by the newly created tidal marshes, based on two separate studies: Gosselink, Odem and Pope, 1974 and Costanza et al. 1997. The per acre per year value calculated by Costanza was \$4,043 and by Gosselink from \$2,500 to \$3,500. This Analysis uses \$3,500.

The total acres planted with *Avalon* saltmeadow cordgrass and *Bayshore* smooth cordgrass, based on their production figures since released of 2,845,500 plants, is 182.91. The net value of the established marsh from *Avalon* and *Bayshore* was \$5,050,000.

B. Value of developed procedure in establishing marshes and protecting upland Acres from erosion.

The renewable goods and ecological services, which Costanza assigned to tidal marshes, make no attempt to calculate the value of upland that is protected. Since the purpose of the PMC tidal shoreline stabilization work was to protect the upland property, some additional benefits, not accounted for by Costanza, are realized from the fringe marsh that were established with the PMC developed procedure, and from the production of *Avalon* and *Bayshore*.

The following calculations use a modest estimate of 2000 feet per year successfully established since the procedure was published in 1980. Calculations include:

- ◆ The renewable ecological goods and services are valued at \$3,500/acre/year of marsh established.
- ◆ The renewable goods and ecological service and land protected value for 17 years was \$378,000.
- ◆ Establishment costs were \$244,000,
- ◆ Total value of 17 years use of the technique was \$134,000.

Cultivar	Year	Commercial Production	Producer cost/LB	Producer price/LB	Profit/loss	Cumulative Profit/loss
Atlantic coastal panicgrass	1984	600	\$ 4.84	\$ 6.00	\$696	\$696
Atlantic coastal panicgrass	1985	3680	\$ 4.84	\$ 6.00	\$4,269	\$4,965
Atlantic coastal panicgrass	1986	2500	\$ 4.84	\$ 6.00	\$2,900	\$7,865
Atlantic coastal panicgrass	1987	2500	\$ 4.84	\$ 6.00	\$2,900	\$10,765
Atlantic coastal panicgrass	1988	1250	\$ 4.84	\$ 6.00	\$1,450	\$12,215
Atlantic coastal panicgrass	1989	4900	\$ 4.84	\$ 6.00	\$5,684	\$17,899
Atlantic coastal panicgrass	1990	8600	\$ 4.84	\$ 6.00	\$9,976	\$27,875
Atlantic coastal panicgrass	1991	10921	\$ 4.84	\$ 6.00	\$12,668	\$40,543
Atlantic coastal panicgrass	1992	2000	\$ 4.84	\$ 6.00	\$2,320	\$42,863
Atlantic coastal panicgrass	1993	3675	\$ 4.84	\$ 6.00	\$4,263	\$47,126
Atlantic coastal panicgrass	1994	0	\$ 4.84	\$ 6.00	\$0	\$47,126
Atlantic coastal panicgrass	1995	1100	\$ 4.84	\$ 6.00	\$1,276	\$48,402
Atlantic coastal panicgrass	1996	1200	\$ 4.84	\$ 6.00	\$1,392	\$49,794
Atlantic coastal panicgrass	1997	1200	\$ 4.84	\$ 6.00	\$1,392	\$51,186

*note 1998 Market prices for 'Atlantic' was between \$15-20 per

Cultivar	Year	Commercial Production	Producer Cost/PLT	Producer price/PLT	Profit/loss	Cumulative Profit/loss
Atlantic coastal panicgrass	1984	250000	\$ 0.60	\$ 1.05	\$112,500	\$112,500
Atlantic coastal panicgrass	1985	1200	\$ 0.60	\$ 1.05	\$540	\$113,040
Atlantic coastal panicgrass	1986	162000	\$ 0.60	\$ 1.05	\$72,900	\$185,940
Atlantic coastal panicgrass	1987	225000	\$ 0.60	\$ 1.05	\$101,250	\$287,190
Atlantic coastal panicgrass	1988	210000	\$ 0.60	\$ 1.05	\$94,500	\$381,690
Atlantic coastal panicgrass	1989	212000	\$ 0.60	\$ 1.05	\$95,400	\$477,090
Atlantic coastal panicgrass	1990	2330000	\$ 0.60	\$ 1.05	\$1,048,500	\$1,525,590
Atlantic coastal panicgrass	1991	260000	\$ 0.60	\$ 1.05	\$117,000	\$1,642,590
Atlantic coastal panicgrass	1992	615500	\$ 0.60	\$ 1.05	\$276,975	\$1,919,565
Atlantic coastal panicgrass	1993	705500	\$ 0.60	\$ 1.05	\$317,475	\$2,237,040
Atlantic coastal panicgrass	1994	300000	\$ 0.60	\$ 1.05	\$135,000	\$2,372,040
Atlantic coastal panicgrass	1995	590000	\$ 0.60	\$ 1.05	\$265,500	\$2,637,540
Atlantic coastal panicgrass	1996	100800	\$ 0.60	\$ 1.05	\$45,360	\$2,682,900
Atlantic coastal panicgrass	1997	15000	\$ 0.60	\$ 1.05	\$6,750	\$2,689,650

Cultivar	Year	Commercial Production	Producer	Producer	Profit/loss	Cumulative
Avalon saltmeadow cordgrass	1987	40000	\$ 0.60	\$ 1.05	\$18,000	\$32,400
Avalon saltmeadow cordgrass	1988	142000	\$ 0.60	\$ 1.05	\$63,900	\$96,300
Avalon saltmeadow cordgrass	1989	172000	\$ 0.60	\$ 1.05	\$77,400	\$173,700
Avalon saltmeadow cordgrass	1990	177000	\$ 0.60	\$ 1.05	\$79,650	\$253,350
Avalon saltmeadow cordgrass	1991	562000	\$ 0.60	\$ 1.05	\$252,900	\$506,250
Avalon saltmeadow cordgrass	1992	305000	\$ 0.60	\$ 1.05	\$137,250	\$643,500
Avalon saltmeadow cordgrass	1993	570000	\$ 0.60	\$ 1.05	\$256,500	\$900,000
Avalon saltmeadow cordgrass	1994	200000	\$ 0.60	\$ 1.05	\$90,000	\$990,000
Avalon saltmeadow cordgrass	1995	227000	\$ 0.60	\$ 1.05	\$102,150	\$1,092,150
Avalon saltmeadow cordgrass	1996	244500	\$ 0.60	\$ 1.05	\$110,025	\$1,202,175
Avalon saltmeadow cordgrass	1997	101500	\$ 0.60	\$ 1.05	\$45,675	\$1,247,850

Appendix II – Production and Net Profit/Loss – Cape May PMC Released Cultivars

Cultivar	Year	Commercial Production	Producer cost/1000 culms	Producer price/1000 culms	Profit/loss	Cumulative profit/loss
Cape American beachgrass	1973	110,000	\$ 18.95	\$ 45.00	\$2,866	\$2,866
Cape American beachgrass	1974	140,000	\$ 18.95	\$ 45.00	\$3,647	\$6,513
Cape American beachgrass	1975	165,000	\$ 18.95	\$ 45.00	\$4,298	\$10,811

- ◆ Additionally, land is protected by the *Avalon* and *Bayshore* plantings. The total land protected by the 182.91 acres equal 205 acres. At \$1,500/per acre, the benefit is \$308,000. All PMC tidal shoreline efforts are summarized in Table 3.

Table 3 - Summary of impact of the PMC products on creating marshes and Stabilizing tidal shorelines

Impacts	Gross Benefit	
Value of marsh created with <i>Bayshore</i> and <i>Avalon</i> plants	\$5,050,000	
Prevention of upland loss and value of marsh by fringe marsh technique, less establishment costs	\$ 134,000	establishment
Prevention of upland loss with <i>Bayshore</i> and <i>Avalon</i> plants	\$ 308,000	
Total Gross Benefit	\$5,492,000	

The value for developing the technique since 1980 of \$134,000 is a modest amount. This may reflect the lack of reliable data regarding its use. Nevertheless, the fringe marshes established with PMC released plants, or by plants of unknown origin, might never have been possible without the technique. This Analysis shows the net benefit of the fringe marsh products to be \$5,492,000, nearly the total 33-year PMC budget.

III. The measurable benefits of using commercially produced Cape May Plant Materials Center releases to stabilize sand dunes.

Coastal dunes are nature’s way of protecting inland areas, recycling sand that is constantly being moved, and maintaining stability to the coastal zone. During periods between storms sand is moved on shore by tides and waves, swept across the beach by the wind and deposited on the dune. As such, the dune becomes the banking reservoir until the next storm, which may partially or completely remove the dune sand onto the beach or near shore water. As the storm subsides, the process is repeated; a far less costly and immensely more attractive approach than bulkheads and jetties.

The process of stabilizing coastal dunes in 1965 was partially understood, however, the commercial availability of adapted plants was needed. Six plants have been released by the PMC for use on dunes. The most widely used, *Cape American* beachgrass, is the primary stabilizer of dunes. It persists only where there is active sand movement. As sand moves off the beach into the beachgrass, it is trapped and the dune grows taller (31). At some point, the wind dynamics and the height of the dune will prohibit additional sand from moving over the crest of the dune and the backside becomes a stable environment. All the other plants are used as back or secondary dune stabilizing plants, i.e. they are planted after the beachgrass has stabilized the dune and is beginning to deteriorate. Initially, the beachgrass is planted on an entire dune, and the other released plants are planted only behind the crest of the fore dune.

Due to extensive development along coastal areas, the depth or width of sand dunes along the Mid-Atlantic coast is usually only one dune wide. The seaward side of the dune will remain dynamic, and continually support beachgrass. In a typical fore dune configuration, the seaward side, or fore dune, will represent about 70 percent of the vegetated dune, and the back side about 30 percent. For the purpose of determining benefits of planting PMC released plants

on coastal dunes, the life of *Cape* on the fore dune (70 percent of area planted) is calculated at 20 years and on the back dune (30 percent of planted area) at five years. The stabilizing benefits derived from *Cape* are then 15.5 years. The other plants, as shown in Table 4, have a life expectancy of 15 to 20 years.

The released plants, their total commercial production since release, the typical plant spacing for dune plantings, potential failure rate and the resulting acre/years each released plant will stabilize, once established, are shown in Table 4.

Table 4 - Released plants, commercial production, plant spacing, potential failure rate and stabilized acre since release

Plant Releases	Unit	Total Commercial Production	Planting Rate	Plants used per acre	Potential Fail Rate	Life Expectancy	Plants Needed per Acre	Total Acres Release Will Plant
		(number)	(feet-lbs.)	(plants)	(%)	(years)	(plants)	(acres)
Cape American beachgrass	No.	123,549,048	1.5	38,720	35	15.5	52,272	2,364
Emerald Sea shore juniper	No.	3,825,564	3.0	4,840	40	20	6,776	565
Atlantic coastal panicgrass	Lbs.	44,126	20.0	20	60	15	32	1,379
Atlantic coastal panicgrass	No.	5,977,000	1.5	19,360	40	15	27,104	221
Wildwood bayberry	No.	7,600	5.0	1,742	25	20	2,178	3.49
Ocean View beach plum	No.	8,950	5.0	1,742	25	20	2,178	4.11
Sandy rugosa rose	No.	4,700	4.0	2,723	30	20	3,539	1.33

Measurable benefits of coastal dune plantings made with PMC releases is for property and infrastructure protected, and contributions to the tourism industry, based on three studies by the US Army Corps of Engineers (Corps). The following points influence the calculations.

- ◆ The Corps studies utilized in this Analysis have multiple projects for reducing coastal storm related damages. The only damage reducing projects used in this Analysis, as well as any derived benefits, is from the construction of a sand berm and dunes. Two of the three Corps projects require the dunes to be vegetated, and the cost of doing this is a part of the total project costs. The dune project in one Corps project does not, and cost has been added to reflect this.
- ◆ Benefits derived from the Corps projects are based on a life expectancy of 50 years. For this Analysis, the life expectancy of the plants does not exceed 20 years.
- ◆ Each PMC plant has fail rate, shown in Table 4, which will require replanting. This fail rate is reflected in the additional costs of the planting.
- ◆ All sites are assumed to be planted initially with *Cape* American beachgrass on the entire dune, with the back dune plants dying within five years.

Based on these points, per acre benefit values has been determined for the vegetation for each of the three Corps studies. The details of the calculations for each study are shown in Appendix III.

Appendix I – Estimated Producer Production Costs (cont.)

Production Costs for One Gallon Containers for:

Ocean View beach plum

Cost Item	Unit	Cost/unit	Sell/ unit	Profit/unit
One gallon container	each	\$ 0.18		
Soil materials	each	\$ 0.11		
Fertilized	each	\$ 0.09		
Germination, propagation, etc.	each	0.55		
Irrigation, labor, space, cost of capital, etc.	each	\$ 1.95		
Total gallon container	each	\$ 2.88	\$ 7.50	\$ 4.62

Production Costs for Seed of:

Atlantic coastal panicgrass

Cost Item	Unit	Amount	Cost/unit	Cost/acre
Equipment costs pro rated to this production	year	1	\$ 500.00	\$ 500.00
Field prep - 2/				
Tractor time	hr	1	\$ 15.00	\$ 15.00
Fuel (gal. @ 1.00/gal)	gal	1	\$ 1.00	\$ 1.00
Labor.	hr	2	\$ 5.25	\$ 10.50
Planting of seed				\$ -
Seed cost/acre.	lb.	4	\$ 5.00	\$ 20.00
Tractor time	hr	2	\$ 15.00	\$ 30.00
Fuel (gal. @ 1.00/gal)	gal	1	\$ 1.00	\$ 1.00
Labor.	hr	2	\$ 5.25	\$ 10.50
Annual growing season maintenance				\$ -
Weeding, irrigation, fertilizing, etc.				\$ -
Tractor time	hr	2	\$ 15.00	\$ 30.00
Fuel (gal. @ 1.00/gal)	gal	2	\$ 1.00	\$ 2.00
Labor.	hr	4	\$ 5.25	\$ 21.00
Fertilized/herbicide/water cost	acre	1	\$ 60.00	\$ 60.00
Harvesting and processing seed				\$ -
Combine time @ \$15.00/hr	hr	3	\$ 25.00	\$ 75.00
Fuel (gal. @ 1.00/gal)	gal	5	\$ 1.00	\$ 5.00
Processing seed	hr	15	\$ 5.25	\$ 78.75
Packaging	lb.	225	0.0300	\$ 6.75
Shipping	lb.	225	\$ 0.03	\$ 6.75
Management overhead	hr	5	\$ 25.00	\$ 125.00
Cost per acre				\$ 998.25
Cost per pound				\$ 4.44

^{1/} - Data based on growing certified seed, life of field not to exceed 6 years, seed production of 150 pounds year 2, 300 pounds years 3, 4, 5 and 6, for an average of 225 pounds/year/acre.

Appendix I – Estimated Producer Production Costs (cont.)

Production costs for 1-0 Bayshore smooth cordgrass and Avalon saltmeadow cordgrass

Cost Item	Unit	Cost/unit	Sell/ unit	Profit/unit
One gallon pot	each	\$ 0.15		
Soil	each	\$ 0.09		
Fertilizer	each	\$ 0.09		
Irrigation, labor, space, cost of capital, etc.	each	\$ 1.07		
Total gallon pot	each	\$ 1.40	\$ 2.75	\$ 1.35
Four inch pot	each	\$ 0.11		
Soil	each	\$ 0.06		
Fertilized	each	\$ 0.05		
Irrigation, labor, space, cost of capital, etc.	each	\$ 0.89		
Total four inch	each	\$ 1.11	\$ 1.75	\$ 0.64
Plugs	each	\$ 0.04		
Soil	each	\$ -		
Fertilizer	each	\$ 0.01		
Irrigation, labor, space, cost of capital, etc.	each	\$ 0.55		
Total plugs	each	\$ 0.60	\$ 1.05	\$ 0.45
Production = 6 times as many peat pots as 1 gal. and 3 times as many				
Average costs/profit all sizes.		\$ 0.80	\$ 1.57	\$ 0.81

Production Costs for One Gallon Containers for:

Wildwood bayberry
Sandy rugosa rose

Cost Item	Unit	Cost/unit	Sell/ unit	Profit/unit
One gallon container	each	\$ 0.18		
Soil materials	each	\$ 0.11		
Fertilizer	Each	\$ 0.09		
Germination, propagation, etc.	Each	0.35		
Irrigation, labor, space, cost of capital, etc.	Each	\$ 1.68		
Total gallon container	Each	\$ 2.41	\$ 4.25	\$ 1.84

Production Costs for One Gallon Containers for:

Emerald Sea shore juniper

One gallon container	Each	\$ 0.18		
Soil materials	Each	\$ 0.11		
Fertilized	Each	\$ 0.09		
Germination, propagation, etc.	Each	0.35		
Irrigation, labor, space, cost of capital, etc.	Each	\$ 1.68		
Total gallon container/producer	Each	\$ 2.41		
Producer markup	each	\$ 1.50		
Total gallon container		\$ 3.91	\$ 5.35	

Study 1: Environmental Assessment and Finding of No Significant Impact for Beach Erosion Control and Hurricane Wave Protection, Brunswick County Beaches, North Carolina, Ocean Isle Beach Portion. Wilmington, North Carolina. 1997.

Using the PMC plants results in a \$1,489 per acre per year benefit over common strains of the same plants of unknown origin

Study 2: New Jersey Shore Protection Plan. 1997. Townsends Inlet to Cape May Inlet Feasibility Study. Philadelphia, Pennsylvania. 1997.

This results in a \$768 per acre per year benefit over common strains.

Study 3: Environmental Assessment and Appendixes. 1994. Beach Erosion Control and Hurricane Protection Study, Virginia Beach, Virginia. Norfolk District, Virginia

This results in a \$1,355 per acre per year benefit over common strains.

A variety of approaches could be used to resolve an average value to use in the summary from the three Corps Studies. The benefits per acre increase as the size of the planting decreases. By determining this average per acre variation, which is \$16.39, times the total acres from all three studies gives an objective \$1,211 per acre average benefit. Table 5 shows this summary.

Table 5 - Average values from the three Corps studies for the PMC releases

Plant Releases	Total Commercial Production	Total Acres	Average Value/Year	Average Value Life of Planting
Cape American beachgrass	123,549,048	2,364	\$ 2,861,406	\$ 44,351,800
Emerald Sea shore juniper	3,825,564	565	\$ 683,489	\$ 13,669,774
Atlantic coastal panicgrass	44,126	1,379	\$ 1,669,375	\$ 25,040,621
Atlantic coastal panicgrass	5,977,000	221	\$ 266,968	\$ 4,004,519
Wildwood bayberry	7,600	3.49	\$ 4,224	\$ 84,488
Ocean View beach plum	8,950	4.11	\$ 4,975	\$ 99,496
Sandy rugosa rose	4,700	1.33	\$ 1,608	\$ 32,153
		4,537	\$ 5,492,045	\$ 87,282,851

These benefits the PMC dune are over 12 year PMC to cost ration every reason to coastal shores attract ever of people, and

higher awareness of the value of dunes that anytime in recent history. Should this be the case, the plants needed to stabilize them, and create an attractive and desirable habitat will be available, and at no future development costs.

of \$87,283,000 from stabilization efforts times the total 33-budget, or a benefit of 12.9. There is believe that the will continue to increasing numbers they may have a

CLOSING

From its establishment in 1965, the PMC has addressed many major missions, which included concentrating on stabilizing coastal dunes and developing fringe marshes to stabilize the toe of eroding tidal streambanks. There are many benefits from multiple PMC missions that cannot be measured. Two measurable areas of evaluations have been used to determine the relationship of the benefit of its operations to the cost of establishing and operating the PMC. In other words, the expressed benefits are only for those things that can be measured from two mission areas while the costs are the sum of all funds for the PMC establishment and operation

This Analysis has produced benefits and costs for each evaluation area. Since the entire life of the PMC has been devoted to the development of benefits, the average annual costs and benefits must reflect its 33-year life. Consequently, Table 6 shows the total benefits and costs and an annual benefits and costs which is the total figure divided by 33 years.

Table 6 - Relationship of the value of benefits to the cost of establishing and operating the PMC

	Areas of Evaluation Gross Values	Annual Values
Cost of establishing and operating CMPMC	\$6,758,915	\$204,816
Benefits to the producer of CMPMC released plants	\$12,804,000	\$388,000
Benefits of fringe marsh plants and technique	\$5,492,000	\$166,424
Benefits of sand dune stabilizing plants	\$87,282,851	\$2,644,935
Total costs	\$6,758,915	\$204,816
	Totals benefits	\$105,578,851
		\$3,199,359
	Ratio of benefits to cost	15.62

The Cape May PMC has been successful in producing economic benefits in their assigned area of concentration. Their efforts have produced \$15.62 in benefits for each \$1.00 spent. This ratio would be significantly larger if all benefits from PMC mission activities could have been incorporated.

Appendix I – Estimated Producer Production Costs

	Cost Item	Unit	Amount	Cost/unit	Cost/acre
Land	Rental Value - <u>1/</u>	acre	1	\$ 90.00	\$ 90.00
	Field prep - <u>2/</u>				
	Tractor time @ \$15.00/hr	hr	1	\$ 15.00	\$ 15.00
	Fuel (gal. @ 1.00/gal)	gal	1	\$ 1.00	\$ 1.00
	Labor.	hr	2	\$ 5.25	\$ 10.50
	Planting of culms - <u>2/</u>				\$ -
	Culm cost (@ 0.15/culm once each 3 years, and 9680 culms/ ea.		3227	\$ 0.15	\$ 484.05
	Tractor time @ \$15.00/hr	hr	2	\$ 15.00	\$ 30.00
	Fuel (gal. @ 1.00/gal)	gal	2	\$ 1.00	\$ 2.00
	Labor.	hr	6	\$ 5.25	\$ 31.50
	Growing season maintenance - <u>2/</u>				\$ -
	First weeding, irrigation, fertilizing, etc.				\$ -
	Tractor time @ \$15.00/hr	hr	0.67	\$ 15.00	\$ 10.05
	Fuel (gal. @ 1.00/gal)	gal	0.33	\$ 1.00	\$ 0.33
	Labor.	hr	1	\$ 5.25	\$ 5.25
	Fertilized/herbicide/water cost	acre	1	\$ 60.00	\$ 60.00
	2nd weeding, irrigation, fertilizing.				
	Tractor time @ \$15.00/hr	hr	1	\$ 15.00	\$ 15.00
	Fuel (gal. @ 1.00/gal)	gal	0.33	\$ 1.00	\$ 0.33
	Hours @ \$5.25/hr.	hr	1	\$ 5.25	\$ 5.25
	Fertilized/herbicide/water cost	acre	1	\$ 25.00	\$ 25.00
	3rd weeding, irrigation, fertilizing.				\$ -
	Tractor time @ \$15.00/hr	hr	1	\$ 15.00	\$ 15.00
	Fuel (gal. @ 1.00/gal)	gal	0.33	\$ 1.00	\$ 0.33
	Hours @ \$5.25/hr.	hr	1	\$ 5.25	\$ 5.25
	Fertilized/herbicide/water cost	acre	1	\$ 80.00	\$ 80.00
	Harvesting and processing culms - <u>2/</u>				\$ -
	Tractor time @ \$15.00/hr	hr	1	\$ 15.00	\$ 15.00
	Fuel (gal. @ 1.00/gal)	gal	1	\$ 1.00	\$ 1.00
	Hours @ \$5.25/hr.	hr	378	\$ 5.25	\$ 1,984.50
	Packing Materials	culm	242,000	0.0010	\$ 242.00
	Shipping	mile	150	\$ 0.45	\$ 67.50
	Certification cost	acre	1	\$ 75.00	\$ 75.00
	Management overhead	hr	5	\$ 25.00	\$ 125.00
	Equipment and facilities prorated to this production	acre	1	\$ 1,270.00	\$ 1,270.00
	Total Production Cost per Acre				\$ 4,665.84
	Total Production Cost per 1000 culms				\$ 19.28
	Total cost to produce one culm				0.0193
	Total Cost per planting unit (2 culms)				0.0386

1/ - Rental land values from plant producing areas of NY, NJ, VA and NC.

2/ - Values based on review of growers, actual plant costs, and PMC estimates for their production.

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