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Consultancy Report

THE GAZA STRAWBERRY INDUSTRY STUDY

***Cooperative Development Project
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TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

I. MERISTEM PROGRAM 5
Findings
Conclusions
Recommendations

II. FOUNDATION (MOTHER STOCK) PRODUCTION 5
Findings
Conclusions
Recommendation

III. PLANT PRODUCTION IN THE GAZA STRIP 7
Findings
Conclusions
Recommendations

IV. STRAWBERRY PRODUCTION IN GAZA 8
Findings
Conclusions
Recommendations

V. STRAWBERRY MARKETING IN GAZA 9
Finding
Conclusions
Recommendations

**TABLE 1: HEBRON NURSERY PROJECT
FOUNDATION (MOTHER) PLANT PRODUCTION
PROFORMA OPERATING STATEMENT** 12

TABLE 2: GAZA NURSERY PRODUCTION OF DAUGHTER PLANTS 13

TABLE 3: COST PER DUNNUM OF STRAWBERRY PRODUCTION IN GAZA 14

TABLE 4: GAZA STRAWBERRY FRUIT REVENUE PER DUNNUM 15

GLOSSARY OF TERMS 16

APPENDICES:
SCOPE OF WORK
IN-COUNTRY ITINERARY
STRAWBERRY PRODUCTION IN GAZA STRIP
GRAPH OF SWEET CHARLIE AND OSO GRANDE PRODUCTION IN FLORIDA
THE MERISTEM PROCEDURE
STRAWBERRY ROOTSTOCK PRODUCTION CYCLE
PHOTOS OF CALIFORNIA ROOTSTOCK PRODUCTION

EXECUTIVE SUMMARY

GAZA STRAWBERRY INDUSTRY STUDY

The Scope of Work states that the Gaza Strawberry Industry Study will "assess the requirements for the technical and economic feasibility of a strawberry plant nursery which would enable Gaza strawberry farmers to achieve security in a reliable supply of strawberry seedlings". This report addresses these issues and places them within the context of the Gaza strawberry fruit industry. The immediate crisis limiting the growth of the strawberry industry is the inadequate supply of rootstock. The marketing of strawberry fruit, however, poses a more fundamental issue for Gaza's strawberry growers. The supply and origin of rootstock is only one element influencing the immediate and long term future of the Gaza strawberry industry. The scope of this study has been expanded to include fundamental market considerations in addition to the important issue of supplying rootstock to the strawberry industry in Gaza.

A reliable supply of strawberry rootstock comprises one link of a chain of activities driven by the fruit marketing strategy of the strawberry growers in the Gaza Strip. The following table summarizes the integrated chain of plant propagation and fruit production activities.

FIGURE 1:

No.	COMPONENT	YEAR
I	MERISTEM PROGRAM	1
II	FOUNDATION (MOTHER) PRODUCTION	2
III	PLANT (DAUGHTER) PRODUCTION	3
IV	STRAWBERRY (FRUIT) PRODUCTION	3
V	STRAWBERRY (FRUIT) MARKETING	3

The Gaza strawberry growers need to manipulate the plants and the varieties in every phase of this three year process in order to achieve their specific marketing goals. In the multi-year variety program which precedes the Meristem Program of commercial propagation, grower involvement is usually limited to defining the fruiting characteristics demanded by their marketing objectives.

The Gaza strawberry industry depends upon one market outlet. The growers target their most of their resources on the fresh fruit, export window during November and December. They utilize one Israeli company, Agrexco of Tel Aviv. This buyer exports the fresh fruit by air to Northern European markets. About one third of Gaza's strawberry fruit production enters this single export stream. The remaining two thirds is sold in the local market at very little value. For this reason, the export revenues represent about three fourths of the Gaza growers' annual income. The critical problem confronting the Gaza fruit growers is not just a reliable source of planting stock, but the narrow focus of their fruit marketing strategy. Both problems are related in that the nursery decision of plants

selected for propagation will vary according to the timing and fruit production demanded by the marketing strategy (e.g., characteristics such as: earliness, overall yield, taste, firmness, color).

The Gaza fruit marketing strategy presently generates net profit for both the Israeli marketing company and the Gaza producer. However this narrow market strategy carries a high degree of risk and is vulnerable to market and production fluctuations. The practices of plant production increase the economic vulnerability of the entire production chain. Fruit growers have adopted plant propagation practices to achieve specific fruit marketing goals. Expanding and diversifying market alternatives will allow growers to select new varieties and modify their propagation strategies in order to enhance productivity and significantly reduce the risk of doing business.

Gaza can significantly diversify their fruit market in the short term by adopting the following:

- Modify the new Gaza juice factory to include a strawberry freezing capability;
- Develop regional trade of fresh strawberries with Jordan and other neighbors;
- Develop fresh strawberry markets for Gaza production during the months of January, February, and March;
- Capitalize on previous introductory shipments to new markets such as last year's shipments to Russia.

The Gaza growers have about 1,500 dunnums (DU) in strawberry production or about 375 acres (4 dunnums = 1 acre). Export and domestic sales earn about \$4,875,000 (1500 dunnums x \$3,250 P/DU) in annual gross revenue. The long range viability of the Gaza strawberry industry can be maintained and expanded over next three years by modifying, diversifying and expanding rootstock, fruit production and fruit marketing components of the strawberry industry.

The farmers in the Gaza area utilize specific Israeli varieties in a green plant multiplication system. This system is described more fully in the text of this report. The success of the green plant system depends upon the immediate transplanting with proper irrigation of the daughter plants from the nursery field to the farmer's strawberry fruit production field. Farmers produce daughter plants for their own use or for the limited commercial sale to their close neighbors. This system minimizes the handling during the transplanting process. Decentralized plant production reduces the potential danger of plant mortality often experienced by many centralized, commercial nurseries. The existing system of the Gaza growers could be improved significantly with better management control and supervision in the following areas:

- Source and control of foundation (mother) plant production;
- Timing and handling of mother plants at time of planting the nursery fields;
- Time and maturing of daughter plants at the time of harvest (September) as it relates to the time and quality of the fruit harvest beginning in November.
- Size of plants and other selection criteria of daughter plants during nursery harvest as it relates to fruit production.

The farmers in the Gaza area need alternative sources of mother (foundation) rootstock for their green plant multiplication system. At this time, there is only one source of mother plants. The study recommends developing a foundation (mother plant) plantation in Hebron area of the West Bank. A foundation plant nursery in the Hebron area would achieve the following:

- Create an alternative source of mother plants
- Control mother plant production
- Provide the required chill in the field to initiate dormancy
- Facilitate plant handling and maintain optimal vigor
- Provide better isolation to avoid disease contamination from other plants.
- Reduced the price of foundation stock by as much as 50%

The importation of new varieties and the implementation of dormant (frigo) and semi-dormant (high elevation) plants would complement the existing varieties and green plant system presently used by the Gaza growers. Direct importation of plant material would provide additional sources of plants that may extend the fruiting season and improve fruit quality. Unfortunately, foreign plant material entering Israel (and Gaza) must go through a two year quarantine process under an Israeli controlled propagation system. This quarantine system parallels that in the United States. The Gaza farmers should work with authorities to develop phytosanitary agreements with other countries that will enable the direct imports of live plants.

The Sharon variety developed by the Volcani Institute dominates strawberry production in Gaza. The variety is well adapted to the Gaza area. The Volcani Institute has two new varieties that should be tested in the Beit Lahiya and Rafah regions of Gaza. Gaza growers should trial the California developed Oso Grande variety and make efforts to procure and trial the Sweet Charlie (Florida variety). The Volcani Institute already has Oso Grande in its foundation block and is interested in acquiring Sweet Charlie. Even if Gaza growers are not allowed to import root stock for direct planting in the fruiting fields, growers should develop the capability to introduce and trial new varieties through quarantine process of the Government of Israel. Existing variety trials in Gaza should be continued and expanded.

Flower production has the potential to develop into an important industry in Gaza, but the cultural practices and infrastructure required for flower plant and bulb production are different than those of strawberries. The effort to develop the nursery production of ornamental plants should not be confused with efforts to develop a strawberry plant nursery capability.

Gaza farmers have the potential to compete at several levels in the international strawberry market. Presently the growers are physically and technologically isolated. The Gaza farmers should access new technologies and strategies from other countries in the subject areas of nursery stock production, fresh strawberry fruit marketing, and frozen strawberry fruit production.

The study recommends a five year multi-phase market development program that will define the constraints facing the Gaza strawberry farmers and develop a consistent export strategy to create the necessary marketing infrastructure and to open new regional export markets.

The sequential activities noted on page one in this executive summary define the topics and sections of this report.

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

I. MERISTEM PROGRAM

Findings:

The meristem process utilizes well established laboratory procedures and controlled temperatures to eliminate viruses and other pathogens in strawberry plants. Please refer to *Appendix: The Meristem Procedure*, for a description of the meristem process in California. In California, the meristem procedure is used only to clean the mother plant stock of viral pathogens. By utilizing a much debated variation of the process, meristem laboratories are able to micro-propagate strawberry plants. Meristem procedures require strict sanitation and qualified technicians. The fixed cost associated with meristem do not justify the propagation of small volumes of strawberry plants. In Israel, large laboratories such as Rahan Meristem at Ros Nakura produce meristemed plants of many species. They also supply the Gaza strawberry industry with meristemed plant material.

Conclusions:

The meristem procedure and maintenance of nuclear stock should be carried out by an experienced and respected laboratory. The Rahan Meristem or similar laboratories in other countries can provide this service. The small quantities of plant material required by the Gaza growers do not merit an additional investment in a new meristem laboratory.

Recommendations:

- Maintain source of meristem stock through the Rahan Meristem Lab;
- Contract additional sources of meristem planting stock;
- Develop capability to access meristemed plants of new varieties and maintain a base of nuclear planting stock of existing varieties.

II. FOUNDATION (MOTHER STOCK) PRODUCTION

Findings:

Presently, only the Rahan Meristem in Ros Nakura supplies strawberry foundation stock certified by the Government of Israel's Ministry of Agriculture. Other nurseries that previously sold root stock to the Gaza growers have gone out of business or do not provide the varieties required in Gaza.

Rahan Meristem propagates the Israeli strawberry varieties and several of California origin. They maintain nuclear plant material from which they produce meristemed, virus free foundation planting stock. The company propagates the planting stock in green houses from the original meristem. In December, they harvest and pack the foundation level plants. The plants are then stored in refrigeration chambers at +1.0^o centigrade. Removed from cold storage in March, they place the plants in small pots for 45 days. The Gaza farmers buy the potted plant in mid April at a cost of \$.75 to \$1.00 per plant depending on volume and time of purchase.

A crop failure at Rahan in 1993 limited the amount of the Sharon variety offered to Gaza strawberry growers. The lack of foundation planting stock threw the Gaza industry into turmoil. This year Rahan has said that they would reserve up to 60,000 foundation plants for delivery in April of 1995 if the cooperatives representing the growers would sign an agreement and make deposits by September of 1994. This amount covers seventy percent (70%) of the anticipated need.

Conclusions:

The Gaza strawberry growers need at least one alternative source of foundation plants. The growers should continue to purchase the meristem planting stock from Rahan Meristem or another certified source. They should establish a small nursery site in the Hebron area of the West Bank to propagate the foundation planting stock. A site in Hebron would allow the production of the foundation stock under isolated, outside conditions. At an elevation of about 1,000 meters, plants grown in open field conditions would accumulate sufficient chilling hours below 7 degrees Centigrade to approach dormancy in the field prior to harvest. Plants vigor increases and plant storage is facilitated when plants are harvested in this condition.

A high elevation nursery site in the Hebron area should provide the Gaza growers with a more vigorous foundation planting stock at a lower cost than is currently available to them. Such a nursery, however, should remain under the supervision of the Department of Agriculture to assure the production of certified, virus free, true-to-type planting stock.

A mother plant nursery of 2 dunnums in the Hebron can supply all the foundation plants required for 1,500 Du. of fruit production by the Gaza growers. In California, an "inside foundation" or screen house site maintains nuclear plants that protects plants from insect vectors. Plants harvested from the screen house are then planted into an outside foundation field. Outside production develops plant "hardness" or vigor. The Hebron area should provide adequate isolation to avoid the cost and initial investment of a greenhouse. The foundation production should continue to use planting stock from Rahan Meristem or other certified source. An outside foundation field should provide adequate supply of quality rootstock for the Gaza growers. Table 1 summarizes the costs of a Hebron foundation nursery. The development of a foundation plant nursery in Hebron has the following advantages:

- 1) Supplies an alternative source of mother plants;
- 2) Maintains quality and management control with supervision by appropriate agents of the Department of Agriculture and by Palestinian authorities;
- 3) Produces more vigorous dormant planting stock;
- 4) Improves the storage of planting stock;
- 5) Reduces the cost to the Gaza grower.

Recommendations:

Initiate a foundation (mother) plant nursery in the Hebron area. Site selection should take place in September 1994 to prepare for planting in April 1995. The foundation plants would be harvested in January of 1996, held in cold storage at

-1°C. and delivered to the Gaza growers in April of 1996.

III. PLANT PROPAGATION IN THE GAZA STRIP

Findings:

Israeli plant breeders have selected cultivars that require little chilling in the nursery field to initiate fruit buds. These varietal characteristics enable the Gaza growers to utilize the green plant system of strawberry production. The growers propagate their own planting stock from April to September in one dunnun plots at their own farms. They transplant the daughter plants to the fruiting fields in September. These strawberry plants come into fruit production within two months.

The Gaza strawberry growers currently receive their foundation rootstock from Rahan Meristem in Israel. They supplement the supply of foundation stock with mother plants from their own nurseries that they have held over from the previous year's production. The planting stock held over from the growers' nursery plots often carries a disease load. It lacks vigor and is less productive than correctly produced foundation material.

The Gaza growers utilize about 11,718,000 strawberry plants in September of each year. The growers currently multiply about 125 daughter plants from each mother plant. Growers must immediately harvest the plants from one irrigated parcel and transplant into another. Any delays in this process result in a high level of plant mortality. Plant propagation in decentralized micro-nurseries is labor intensive but appears reasonable economical and effective. The growers lack another source of viable planting stock.

Table 2 outlines the costs and returns of plant propagation for the Gaza farmers. Not all farmers have nursery plots. The larger farmers multiply daughter plants to assert some control and to insure an adequate supply of planting stock for their own fruit operations. What they do not utilize on their own farms, they sell to their neighbors. In order to determine the economic viability of plant propagation, this report uses an average sales price of \$.04 per plant to determine the revenue to Gaza farmer if he were to sell all of his plants to neighboring farmers. A Gaza farmer produces enough planting stock from each dunnun of nursery for about 8 dunnuns of fruit production.

With existing acreage, Gaza growers require about 93,750 foundation level plants in order to plant the 375 acres in strawberry fruit production. A profile of the economic return of an average Gaza grower producing daughter plants per dunnun in one season is as follows:

Gross Income	\$2,500
Expenses	<u>\$1,925</u>
Net Revenue	\$ 575

Conclusions:

The decentralized system of farm based, micro-nurseries works well within the context of the green plant system for the production of daughter plants now used by the Gaza strawberry growers. Green plants require significant amounts of hand labor and must be transplanted by hand from one field to another within hours. As currently practiced, the growers report little or no plant mortality during the transplanting process. A centralized, commercial nursery to produce daughter plants in Gaza offers little competitive advantage at this time.

Strawberry plantations established with planting stock propagated in a high elevation area or with "frigo", fully dormant plants may provide a complementary fruit cycle and produce higher quality fruit than plantings based on the current system. Plant import restrictions and lack of cold temperature within Gaza and Israel during the month of September does not allow the Gaza grower this option at this time.

Recommendations:

- Maintain the current system of plant propagation
- Establish trials of imported or chilled plants from a high elevation area
- Develop alternative sources of mother stock.

IV. STRAWBERRY PRODUCTION IN GAZA

Findings:

The strawberry producers in Gaza have adapted the Israeli plant varieties and growing technologies to create an important and viable industry in Gaza. Their comparatively low cost of labor, climate conditions and sandy soil give the growers a competitive advantage in the world market during the production season of November through February.

The strawberry growers have tested several varieties. The principal varieties are the "Sharon" (70%) and the "Smadar" (20%). Other varieties occupy 10 percent of the production. The Sharon variety begins fruiting early in November and December for the export market. The fruit is relatively firm.

The green plant system utilizing the Israeli varieties gives early production for the export market. However the total yield, fruit size, and fruit firmness are usually sacrificed to achieve early fruit production. If alternative markets were available, complementary varieties and planting systems could enhance overall production.

The Oso Grande variety (California) and the Sweet Charlie (Florida) appear suitable to the Gaza area. The production characteristics of these varieties are summarized in *Appendix: Graph of Sweet Charlie and Oso Grande*.

Currently, strawberry production in Gaza is limited to the Beit Lahiya region. The average unit of production is about 6 dunnums (1½ acres). About 175 to 200 farmers

produce strawberries on 375 acres in Beit Lahiya. The Rafah area is reported to have good water and available land. Strawberry fruit production trials should be initiated there.

An economic profile of a typical Gaza strawberry grower can be summarized as follows:

\$3,250	Gross revenue (See Table 4 Gaza Revenues)
<u>\$2,543</u>	Expenses (See Table 3 Gaza Fruit Production)
\$ 707	Net Return per dunnum

Actual family income may be substantially higher if the family does most of the labor.

Among the constraints faced by the Gaza growers is the limited supply of good irrigation water. Strawberries are intolerant of salts. Salt management is the critical factor in improving the cultural practices of the Gaza farmers. Aquifer contamination, ground water contamination and salt intrusion complicate the management of salts at the farm level. These problems threaten the continued viability of strawberry production in the Gaza region. The expansion of the strawberry industry demands remedial measures to confront environmental degradation in the Gaza Strip as well as the development of a sound water policy for the area.

Conclusions:

Strawberry fruit production is a technically and economically viable activity in the Gaza Strip. The major constraints to expansion and the continued viability of the industry are marketing limitations and capabilities, declining water quality, and the lack of reliable sources of mother stock.

Recommendations:

- Develop alternative marketing capabilities
- Expand fruit variety trials to include other sites in Beit Lahiya and Rafah
- Trial new Israeli varieties as well as the Oso Grande and Sweet Charlie varieties
- Develop alternative sources for mother stock
- Monitor water quantity and quality
- Establish appropriate water and land use policies.

V. STRAWBERRY MARKETING IN GAZA

Findings:

Gaza growers utilize especially selected strawberry varieties developed by the Volcani Institute in Israel to produce for a specific export window. Varieties such as the Sharon and Smadar used in a green plant system represent a significant competitive advantage in the fresh fruit, export market during the months of November and December. Unfortunately, the Gaza strawberry growers have not developed the local and regional

fresh fruit markets for their product. In these markets, demand for fresh strawberries remains very shallow. Regional export is limited to a small amount of fruit sent to Jordan. The Gaza growers have no fruit processing capacity at this time. It was reported that a new juice processing facility recently has been completed. It may be possible that this facility could be used to process frozen strawberries.

Strawberries have been grown in Gaza for over twenty-five years. The area of production has increased as well as productivity per unit. (Please see *Appendix: Strawberry Production in the Ghazah Strip*). Profitability and productivity has risen dramatically in the last three years:

	1991-92	1992-93	1993-94
Area in dunnums	373	644	1532
Production Per dunnum	1500	2400	N/A
Volume to Local Market	1337	2000	N/A
Volume to Export Market	163	400	500*

N/A (Not Available)

* Export Data collected through January 1994)

Table translated from the Dept. Agriculture publication STRAWBERRY ROOTSTOCK IN THE GAZA STRIP, By Agricultural Engineer: Mahmoud Hamid Abou Wardah, January 1994.

Interviews with Mr. Mohammed Hamdan of the Palestinian Dept. of Agriculture and several growers provided information to estimate the price structure and revenue structure for the average strawberry grower in Gaza. Their information yields the following calculations:

Estimated production per dunnum(DU)	2,400 kg
Estimated volume for export P/DU	700 kg (29%)
Estimated volume for local market (P/DU)	1700 kg (71%)
Estimated Revenue (P/DU)	\$3,250 (US\$\$)
Estimated Revenue (P/DU) from Export	\$2,400 (74%)
Estimated Revenue (P/DU) from Local	\$ 850 (26%)

The estimate value of entire industry is about \$4,875,000 FOB value Gaza (1500 dunnum x \$3,250 P/DU). Table 4: GAZA REVENUE provides a detailed breakdown of the income stream currently generated by the Gaza strawberry industry.

Conclusions:

The export market is profitable for the grower and is an important source of revenue to the entire Gaza economy. About one third of the production is sold for export, but this percentage accounts for about three quarters of the total revenue. The local market can not absorb the production of strawberries not exported. The Gaza growers are wasting about two-thirds of their production because they have not established alternative markets.

A critical dimension in any strawberry fruit industry is a processing capability. A facility that washes, sorts and freezes strawberries as a whole or sliced product or produces puree or juice would provide an important outlet that would improve the economic viability for the entire industry in Gaza.

Recommendations:

- Maintain current export activities.
- Develop capability for alternative export activities.
- Develop a capacity to process frozen strawberries for export.

This report recommends a multi-phase market development program that will define the constraints facing the Gaza strawberry farmers and develop a consistent strategy to create the necessary marketing infrastructure and to open new regional export markets. In phase 1, the program should analyze the specific constraints limiting the movement of perishable products from the Gaza area. These include the following:

- processing of export permits
- procurement of phytosanitary certificates
- security concerns limiting the movement of product out of Gaza
- availability of infrastructure appropriate for post harvest management of highly perishable products
- limitations of existing transportation infrastructure available for movement of fresh and processed strawberry fruit
- intra-regional trade barriers that limit rapid movement of perishable products to regional markets.

Phase 2 of the marketing program would focus on local capability to produce, harvest and ship fresh and processed strawberries into the local, regional and extra-regional export markets. Specifically, the program would undertake to

- arrange terms and conditions of sale of trial shipments to wholesale buyers in neighboring countries
- establish market specific price information and identify banks and foreign exchange mechanisms that will facilitate the import of inputs and the export of final product
- carry out and evaluate export shipments of fresh market strawberries to two regional markets
- undertake the production of specific frozen strawberry products based on contractual arrangements with foreign buyers.

Phase 3 of the marketing program would focus on developing the business capability of local producers and production cooperatives to maintain the flow of quality product into the distinct market windows defined within the previous activities. Phase 3 will bring the grower on line with multiple market windows and opportunities. It is estimated that such a multi-phase marketing program would take five years to develop effectively.

**TABLE I: HEBRON NURSERY PROJECT
FOUNDATION (MOTHER) PLANT PRODUCTION
PROFORMA OPERATING STATEMENT***

REVENUES	HEBRON NURSERY SITE
TOTAL AREA OF PRODUCTION	2 DUNNUMS
PLANT YIELD (NO. OF PLANTS)	125,000 FOUNDATION PLANTS
SALES PRICE PER PLANT	\$0.50
TOTAL REVENUE	\$62,500
DIRECT PRODUCTION COSTS	
LAND PREPARATION	\$1,000
FUMIGATION	\$500
PLANTS (500 x \$1.00)	\$1,000
FERTILIZER	\$500
WATER (1,000 X .15)	\$300
LAND RENT (ANNUAL LEASE)	\$240
IRRIGATION SYSTEM (ESTABLISHMENT)	\$1,000
HAND LABOR (300 X \$20)	\$12,000
MISC. EXPENSE (10% OF TOTAL)	\$1,654
TOTAL PRODUCTION EXPENSES	\$18,194
HARVEST COST	
LABOR 5 DAYS X 20 PERSONS \$20	\$2,000
PACKING MATERIALS (250 CARTONS \$2/CTN)	\$500
COLD STORAGE \$5 X 250	\$1,250
TRANSPORT HEBRON TO GAZA	\$500
TOTAL HARVEST EXPENSE	\$4,250
ADMINISTRATION	
GAZA /WEST BANK AG. AUTHORITIES ESTIMATE: TESTING AND INSPECTING	\$5,000
TOTAL EXPENSES	\$27,444
NET RETURN FROM OPERATIONS	\$35,056

*COST DATA SUPPLIED BY
RESOURCE PEOPLE IN GAZA.

TABLE 2 : GAZA NURSERY PRODUCTION OF DAUGHTER PLANTS

PLANTING STOCK REQUIREMENTS FOR GAZA	PER DUNNUM	TOTAL FOR GAZA
FRUIT PRODUCTION		
PLANTING DENSITY IN FRUITING FIELD	7,812	
TOTAL AREA IN FRUIT PRODUCTION		1,500
TOTAL PLANTS REQUIRED FOR GAZA		11,718,000
PLANT PRODUCTION		
FOUNDATION PLANTS REQUIRED PER DUNNUM	500	
YIELD OF PLANTS PER DUNNUM OF NURSERY	62,500	
TOTAL NUMBER OF DUNNUMS OF NURSERY		187.5
TOTAL FOUNDATION PLANTS REQUIRED		93,744
INCOME ANALYSIS OF NURSERY PRODUCTION OF DAUGHTER PLANTS IN GAZA		
	PER DUNNUM	TOTAL FOR GAZA
INCOME		
GROSS INCOME FROM NURSERY PRODUCTION: (62,500 PLANTS X \$.04)	\$2,500.00	\$468,720.00
COSTS		
LAND PREPARATION	\$80	\$14,999.04
FUMIGATION	\$250	\$46,872.00
PLANTS (500X \$.90)	\$450	\$84,369.60
FERTILIZER	\$250	\$46,872.00
WATER (1,000 X .15)	\$150	\$20,123.20
LAND RENT(ANNUAL LEASE)	\$120	\$22,498.56
IRRIGATION SYSTEM (ANNUAL EXPENSE)	\$150	\$20,123.20
HAND LABOR (30 DAYS A \$10/DAY)	\$300	\$56,248.40
MISC. EXPENSE(10% OF TOTAL)	\$175	\$32,810.40
TOTAL PRODUCTION EXPENSES	\$1,925	\$360,914
NET REVENUE FROM NURSERY PRODUCTION	\$575	\$107,806

TABLE 3: COST PER DUNNUM OF STRAWBERRY PRODUCTION IN GAZA

GAZA STRAWBERRY PRODUCTION: COSTS		PER DUNNUM	PER ACRE*
LAND PREPARATION	\$80	\$320	
FUMIGATION	\$250	\$1,000	
PLANTS (7,812 X .04)	\$312	\$1,248	
FERTILIZER	\$250	\$1,000	
WATER (1,000 X .15)	\$150	\$600	
LAND RENT(ANNUAL LEASE)	\$120	\$480	
IRRIGATION SYSTEM (ANNUAL EXPENSE)	\$150	\$600	
HAND LABOR (100 DAYS A \$10/DAY)	\$1,000	\$4,000	
MISC. EXPENSE(10% OF TOTAL)	\$231	\$925	
TOTAL PRODUCTION EXPENSES	\$2,543	\$10,173	
* 1ACRE= 4 DUNNUMS			

TABLE 4: GAZA STRAWBERRY FRUIT REVENUE PER DUNNUM

ANALYSIS OF REVENUES	EXPORT KGS/DH	EXPORT PRICE/KG	EXPORT REVENUE	LOCAL KGS/DH	LOCAL PRICE/KG	LOCAL REVENUE
PRODUCTION SEASON						
NOVEMBER	100	\$4.00	\$400	50	\$0.50	\$25
DECEMBER	200	\$4.00	\$800	150	\$0.50	\$75
JANUARY	300	\$3.50	\$1,050	800	\$0.50	\$400
FEBRUARY	100	\$1.50	\$150	700	\$0.50	\$350
MARCH	0		\$0	0		\$0
TOTAL	700		\$2,400	1700		\$850
AVERAGE EXPORT PRICE P/KG		\$3.43				
AVERAGE LOCAL PRICE P/KG					\$0.50	
		PERCENT				
TOTAL EXPORT VOLUME	700	29%				
TOTAL LOCAL MARKET VOLUME	1700	71%				
TOTAL KILOS/DUNNUM	2400	100%				
		PERCENT				
TOTAL EXPORT REVENUE	\$2,400	74%				
TOTAL LOCAL MARKET VOLUME	\$850	26%				
TOTAL REVENUE/DUNNUM	\$3,250	100%				
TOTAL REVENUE/DUNNUM	\$3,250					
TOTAL COSTS/DUNNUM	\$2,543	*1				
EST. NET PROFIT PER DH	\$707	*2				
*1. COST DATA ASSUMES ALL LABOR AS A CASH EXPENSE. IN GAZA MOST LABOR IS FROM THE FARMER FAMILY. AN ESTIMATED \$1000 OF THE COST PER DUNNUM IS RELATED TO LABOR.						
*2 NET PROFIT PER FAMILY COULD INCREASE AS HIGH AS \$1000 PER DUNNUM DEPENDING ON THE COST OF FAMILY LABOR.						

GLOSSARY OF TERMS

CHILLING: In strawberries, exposure to temperatures low enough to induce the production of starch reserves in the root system needed to support vigorous vegetative growth.*

DAUGHTER PLANTS: Vegetative progeny or strawberry plants; plants that develop along the runners produced by another strawberry plant called the mother plant.*

DORMANCY: A physical or physiological state in which a plant is not actively growing.*

FRIGO PLANTS: A term applied to dormant rootstock maintained in cold storage at 27 degrees F for up to nine months prior to planting.

GREEN PLANTS: A term applied to rootstock that is harvested from the nursery and transplanted without acquiring chilling prior to harvest.

MERISTEM: A collection of cells at the apical growing point of a plant that are capable of cell division and differentiation.*

MERISTEM PLANT: Plants grown from the meristem of another plant.*

RUNNER: The stolon of a strawberry plant on which a daughter plant may develop.*

VEGETATIVE: Plant parts or plant growth not involved in the production of seed or fruit, such as roots, stems, and leaves.*

VIGOR: The capacity of a strawberry plant for active vegetative growth*

MOTHER PLANT: A strawberry plant from a nursery which is used to vegetatively produce runners or daughter plants.

ROOTSTOCK: A trade name that for strawberry plants. The term usually refers to a trimmed bare root plant.

FOUNDATION STOCK: Initial nursery rootstock used as mother plants to produce several generations of daughter plants. Foundation plants in the text refer to meristemed plants that will be used as the mother plants for the Gaza growers.

*Items defined herein are taken from the following publication:

INTEGRATED PEST MANAGEMENT FOR STRAWBERRIES, UNIVERSITY OF CALIFORNIA STATEWIDE INTEGRATED PEST MANAGEMENT PROJECT, DIVISION OF AGRICULTURE AND NATURAL RESOURCES, PUBLICATION 3351, 1994.

**SCOPE OF WORK
GAZA STRAWBERRY PLANT NURSERY STUDY**

Evaluate the nursery business potential for the strawberry industry of Gaza Strip. The purpose of the study is to assess the requirements for technical and economic feasibility of a strawberry plant nursery which would enable Gaza strawberry farmers to achieve security in a reliable supply of strawberry seedlings. Specific issues to be addressed:

1. Document farmers actual practices of seedling procurement and nursery propagation, addressing such issues as, sources, availability, quality, planting system, handling procedures, cultural practices and cost.
2. Assess the state of current practices, technology, and farmer understanding of the strawberry plant business.
3. Document the current sources of strawberry seedlings for Gaza farmers as to foundation stock supply availability and quality, nursery propagation procedures, expertise, technology, plant system, handling procedures and cost.
4. Assess the current source of strawberry seedlings for the Gaza strawberry industry.
5. Review the strawberry varieties and planting systems available as to frigo versus green plant system taking into account the current breeding program and variety trials underway in Gaza, the role of a variety development program in the world strawberry industry, and how such programs are financed.
6. Review the prospective sources of foundation stock for a Gaza-based nursery, evaluating local and foreign sources from the standpoint of genetic quality and phytosanitary condition, tissue culture versus micro-culture material, import procedures and permits, and cost effectiveness.
7. Consider the viability of including other plants, specifically flower seedlings, as a product for the strawberry nursery.
8. The final report should include recommendations for the start-up of a strawberry nursery business considering time frame, location(s), ongoing sourcing of foundation stock, cultural practices, facilities, financing, feasibility, and technical assistance needed.

MARK MATZE STRAWBERRY NURSERY CONSULTANCY SCHEDULE

DATE	TIME	PLACE	ACTIVITY	CONTACT
Sat. 25 June	13:30	Airport	Arrive	Bill
	14:30	Jerusalem	Hotel Check-in	ACH
Sun. 26 June	8:00	Jerusalem	Depart ACH	Bill, Rex
	9:30	Erez	Car transfer	Ali, Aown
	10:00	CDP/Gaza	Meet farmer liaison	Saad Tarazi
		Beit Lahia	Field Visits	Ayesh Alian & Rezik Abu Halimeh
	15:00	CDP/Gaza Gaza City	Return to CDP Hotel Check-in Palestine Hotel	Ali/Aown
Mon. 27 June	9:00	CDP/Gaza	Palestinian Dept. of Agriculture	Mohammed Hamdan
	12:00	Lunch	(Poss. meet USAID)	
	13:15	CDP/Gaza	Depart for Rafah	Bill, Ali
	14:00	Rafah	Rafah Ag Co-op	Chairman Suliman Zo'urab
	16:30	Erez	Car transfer Drive to Jerusalem	Ali, Bill
	18:00	Jerusalem	ACH	
Tue. 28 June	6:00	Jerusalem	Depart for nursery	Bill, Aown
	10:00	Ros Nakura	Visit Rosh Haniqra Nursery	Daniel Halevi
	14:00		Return to Jerusalem	
	17:30	Jerusalem	ACH	
Wed. 29 June	9:00	Jerusalem	Depart for Hebron	Bill, Younis
	10:00	Hebron	Arrive Department of Agriculture Field visits	Fawsy Khaissi
	13:00		Return to Jerusalem Report writing	
Thu. 30 June	8:00	CDP/Jeru	Status check	
	10:00	"	Depart to Tel Aviv	Bill
	11:00	Bet Dagan	Meet with Volcani	Hillel Adiri Shamay Izhar
	13:30	Tel Aviv		
	14:30	"	Return to Jerusalem	
	15:30	CDP/Jeru	Report writing	
Fri. 1 July	8:00	CDP/Jeru	Report writing	
	13:00		Consultancy Report Debriefing	Rex, Bill, Joseph
Sat. 2 July	6:00	Jerusalem	Hotel Check-out	ACH Taxi
	9:15	Airport	Departure	

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Page 7 - 9.

Strawberry Production in the Ghazah Strip.

Sub-titles:

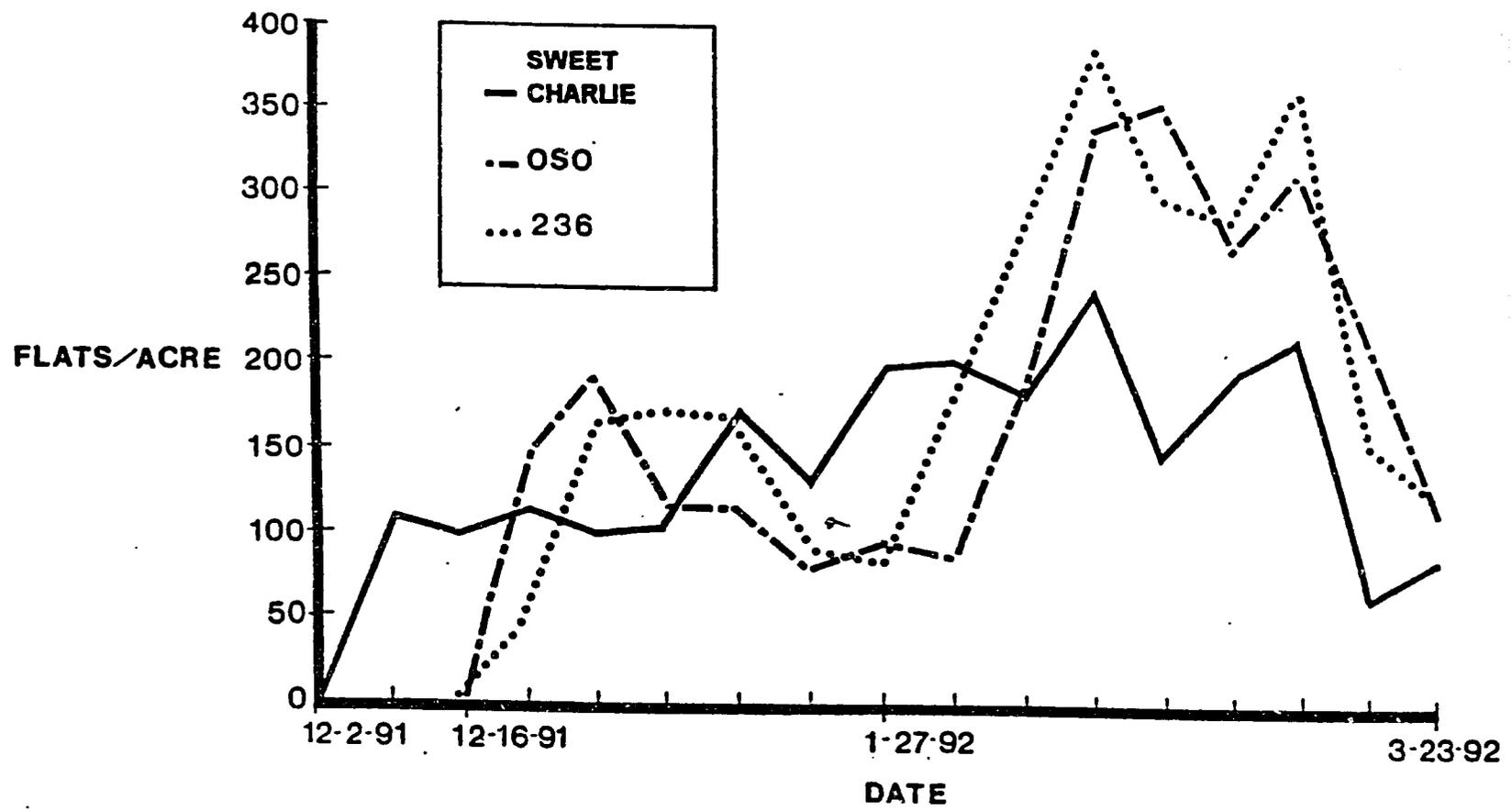
- environmental production needs.
- Strawberry history in the Ghaza strip.

Page 8: a table designed to give a quick perspective of the strawberry crop's development from '967 - '994

YEAR	AREA (IN DONAMS)	TOTAL PRODUCTION (TON PER DONAM)	FOR LOCAL MARKETS	FOR EXPORT
1967-68	1	1.5	.5	1
1968-69	6	9	5	4
1969-70	2	3	2	1
1970-71	3	4	4	0
1971-72	12	12	4	8
1972-73	18	20	12	8
1973-74	36	60	20	40
1974-75	49	100	63	37
1975-76	25	50	29	21
1976-77	130	260	131	129
1977-78	210	420	251	160
1978-79	300	750	524	226
1979-80	300	900	700	200
1980-81	230	690	529	161
1981-82	400	1200	840	360
1982-83	427	1000	710	290
1983-84	327	1300	899	401
1984-85	480	1920	1520	400
1985-86	528	1584	1234	350
1986-87	369	1000	792	208
1987-88	358	1400	1235	165
1988-89	240	840	717	123
1989-90	254.5	1000	867	133
1990-91	289.5	1150	966	184
1991-92	373	1500	1337	163
1992-93	644	2400	2000	400
1993-94	1532			500

(THRU JAN94)

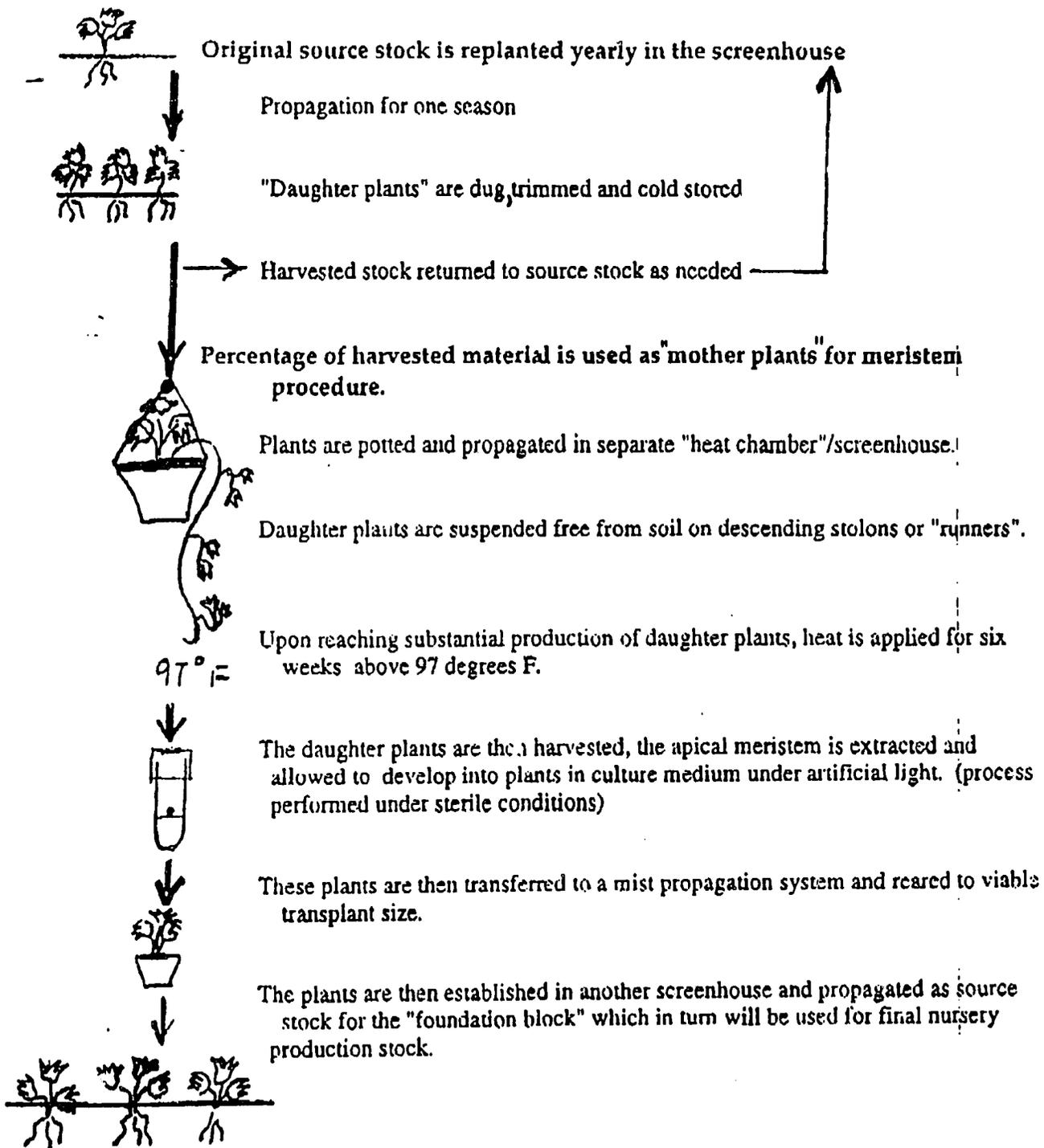
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Marketable yield of Sweet Charlie, Oso Grande, and FL 87-236 over the 1991-92 season, Agricultural Research & Education Center, Dover, Florida. (one flat = 10.25 lbs.)

THE MERISTEM PROCEDURE

The meristem method of tissue culture is employed at the nursery level to remove deleterious viroids from strawberry plants and is one of several steps taken to insure clean planting stock. The process is performed as follows:



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STRAWBERRY ROOTSTOCK PRODUCTION CYCLE

Strawberry plant nurseries in California undertake the vegetative reproduction of strawberry rootstock through a sequence of interrelated activities over a four year period. This page of the narrative and the following three pages of diagrams compare and contrast the current production of strawberry rootstock in California with the proposed production of rootstock in Gaza.

CALIFORNIA

The figure on the following page, the California Production Diagram of certified strawberry rootstock visualizes the four year propagation cycle of strawberry plants. Photographs of the actual production of rootstock during each phase are attached to this study (See photographs)

PROPOSED ROOTSTOCK PRODUCTION CYCLE FOR GAZA

I. Meristem procedure and first generation plants produced by Rahan Meristem at Ros Nakura corresponds to the meristem process and "first generation plants" in the California diagram.

II. Foundation(mother stock) production in the high elevation area of Hebron corresponds to the "Foundation" plants of the California diagram.

III. Nursery (Daughter plant) production in Gaza corresponds to the "Registered" plants of the California diagram.

IV. The "certified" plants of the California diagram are eliminated from the Gaza model. The proposed production of rootstock cycle for Gaza requires only three generations. Registered planting stock will be planted by the Gaza growers for the strawberry fruit production.

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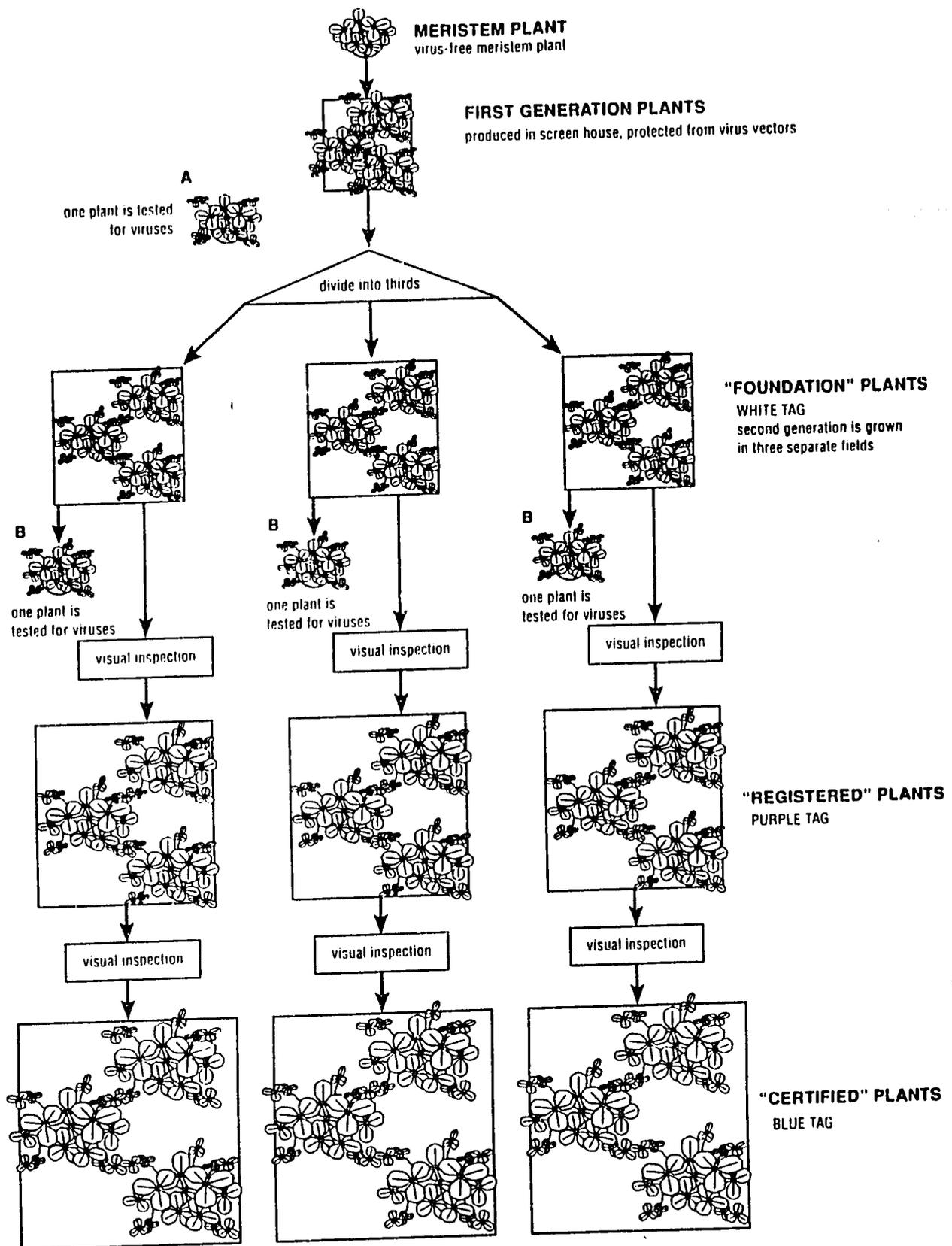
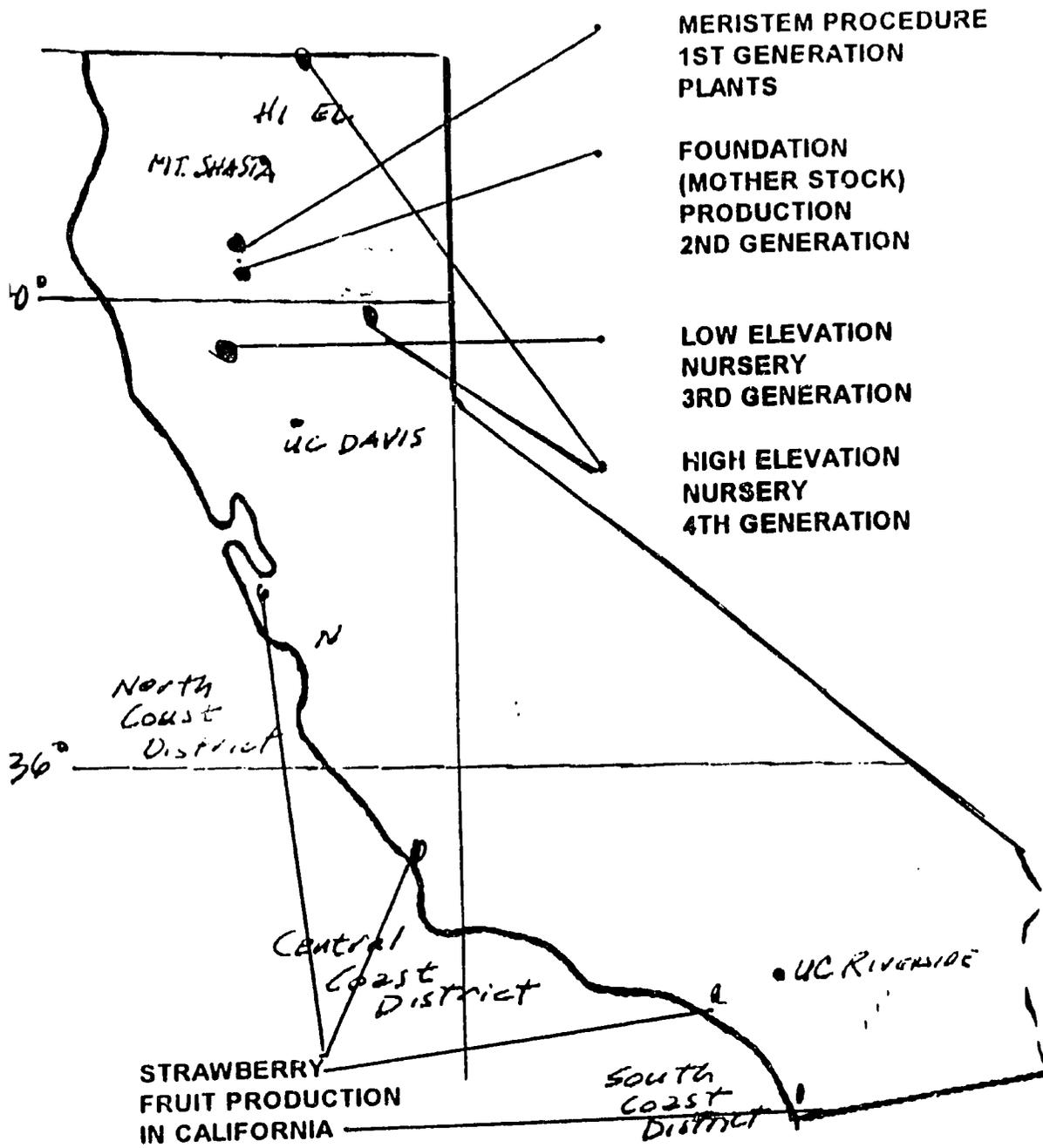


Figure 9. Production of certified strawberry planting stock in California.
 A. ("100% testing"): One daughter plant from each meristem plant is tested for viruses. Because virus infections are systemic throughout all daughter plants of a single mother plant, testing one plant is considered equivalent to testing all daughter plants for viruses.
 B. ("3% testing"): One daughter is tested from each block of plants descended from a single meristem plant. This is considered equivalent to testing 3% of all the plants of this generation.

CALIFORNIA STRAWBERRY ROOTSTOCK PRODUCTION CYCLE



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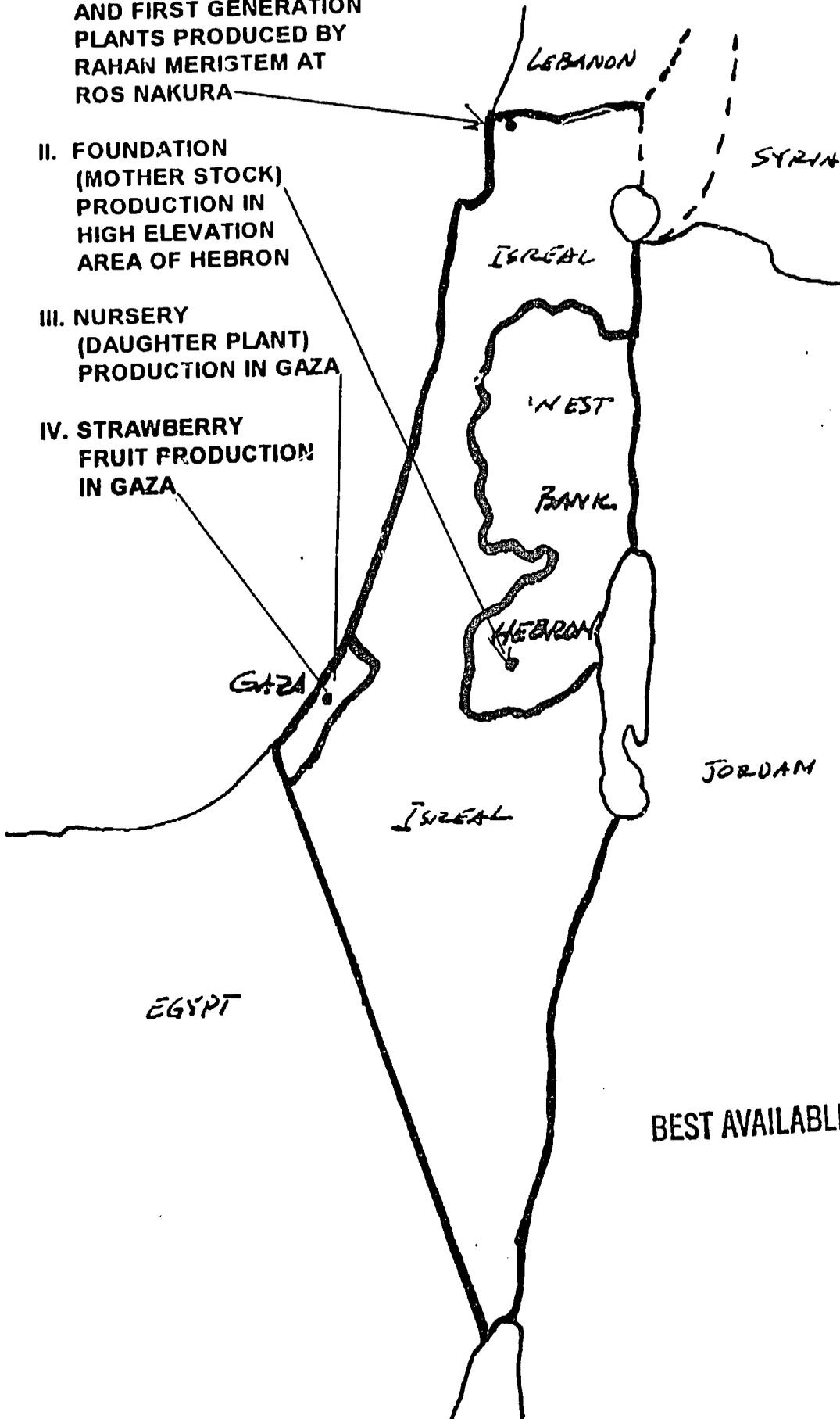
PROPOSED ROOTSTOCK PRODUCTION CYCLE FOR GAZA

I. MERISTEM PROCEDURE AND FIRST GENERATION PLANTS PRODUCED BY RAHAN MERISTEM AT ROS NAKURA

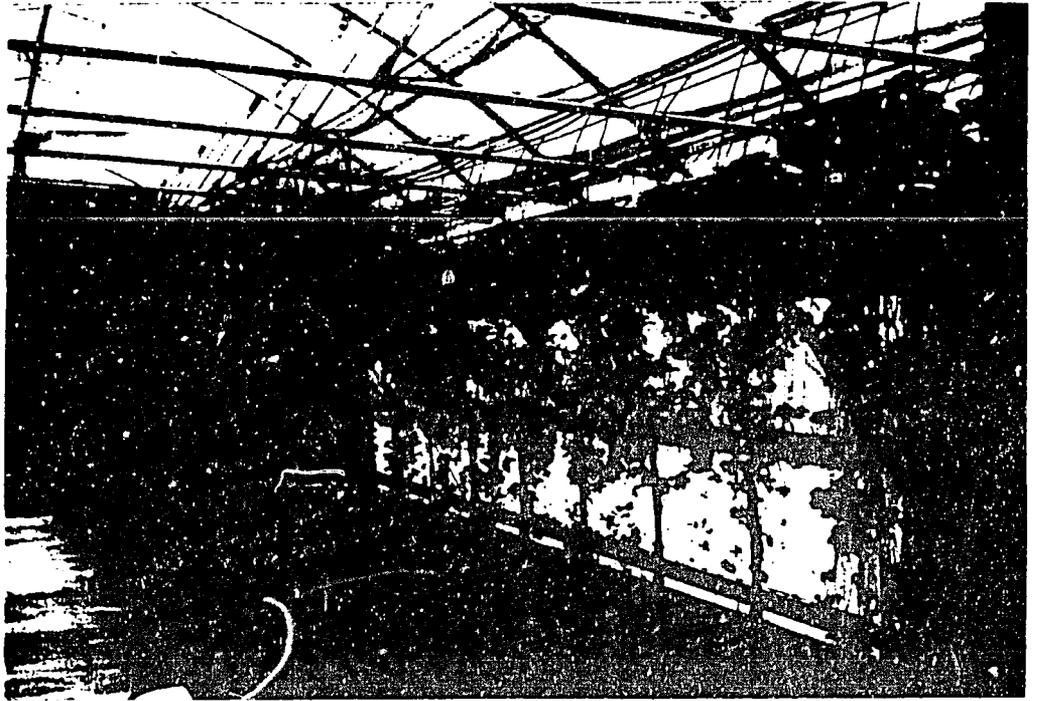
II. FOUNDATION (MOTHER STOCK) PRODUCTION IN HIGH ELEVATION AREA OF HEBRON

III. NURSERY (DAUGHTER PLANT) PRODUCTION IN GAZA

IV. STRAWBERRY FRUIT PRODUCTION IN GAZA



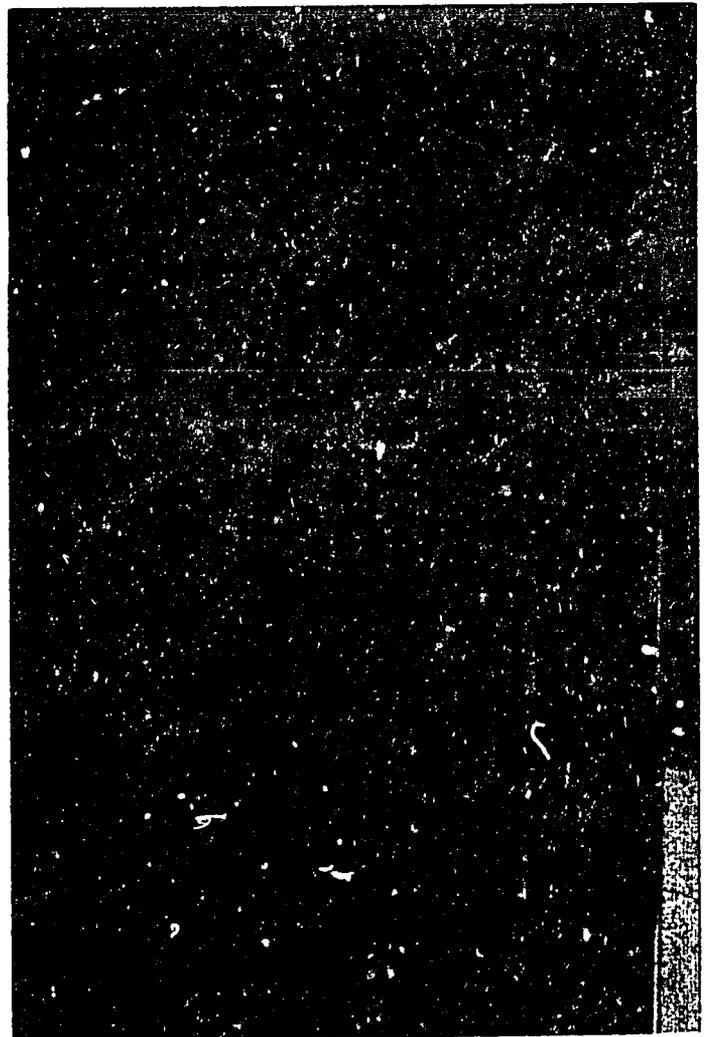
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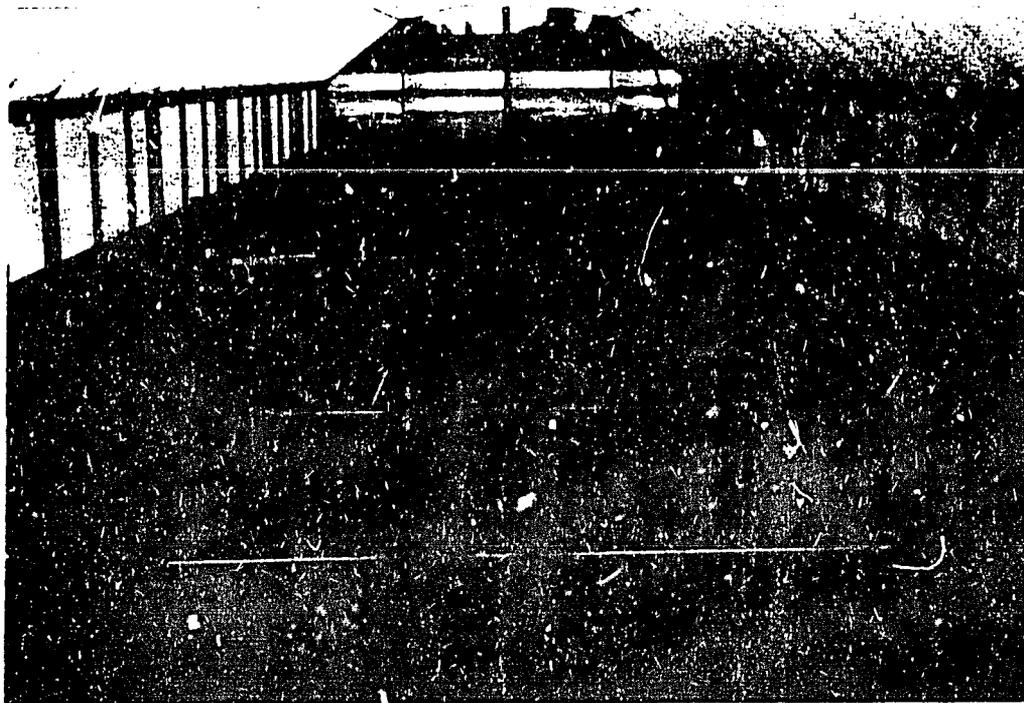


Plants are potted and propagated in a separate *heat chamber/screenhouse*. Heat treatment limits the movement of virus from entering the tips of the plant. The apical meristem is then extracted from heat treated plants.

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Original source stock is replanted yearly in screenhouse to protect plant from virus vectors.



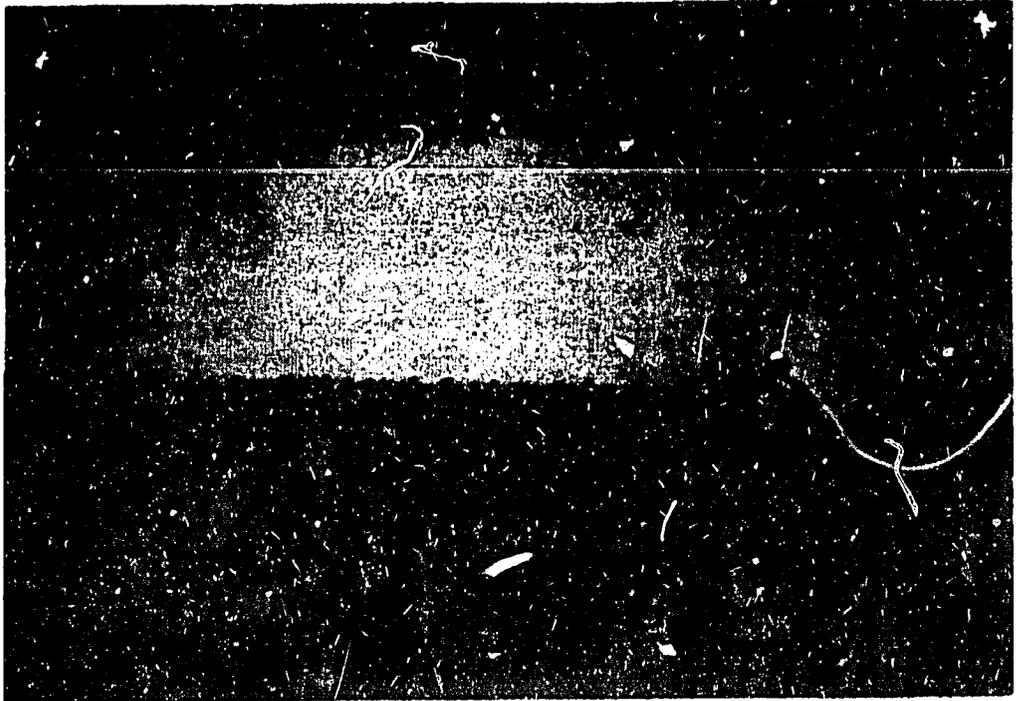


First generation plants planted in screenhouse. (Inside view lengthwise).



First generation plants planted in screenhouse. (View from outside).

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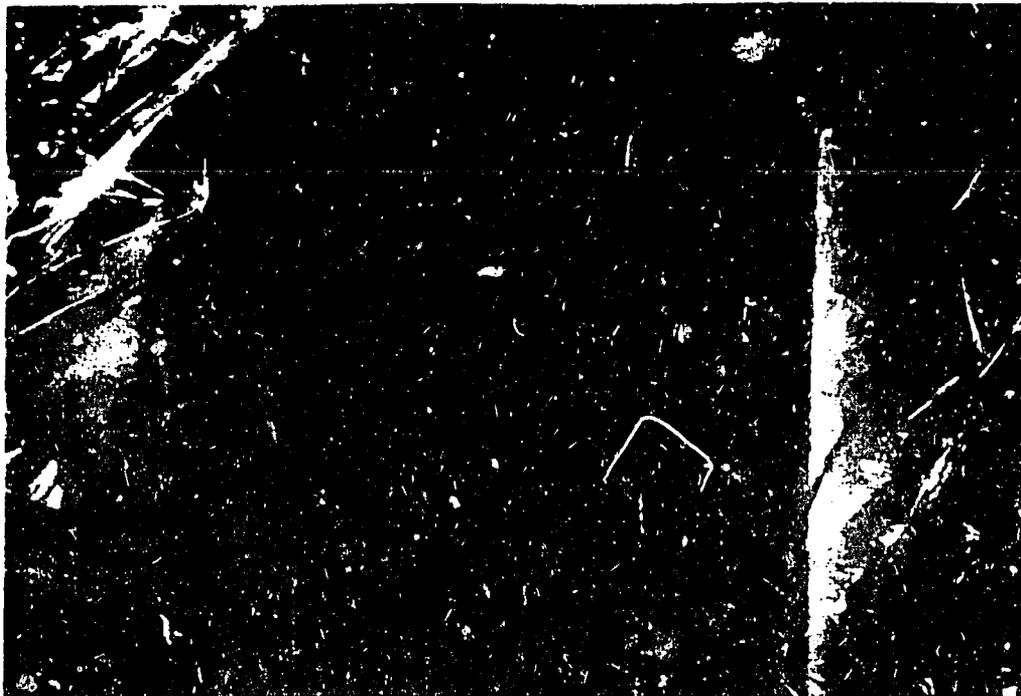


Foundation plants in open field production.



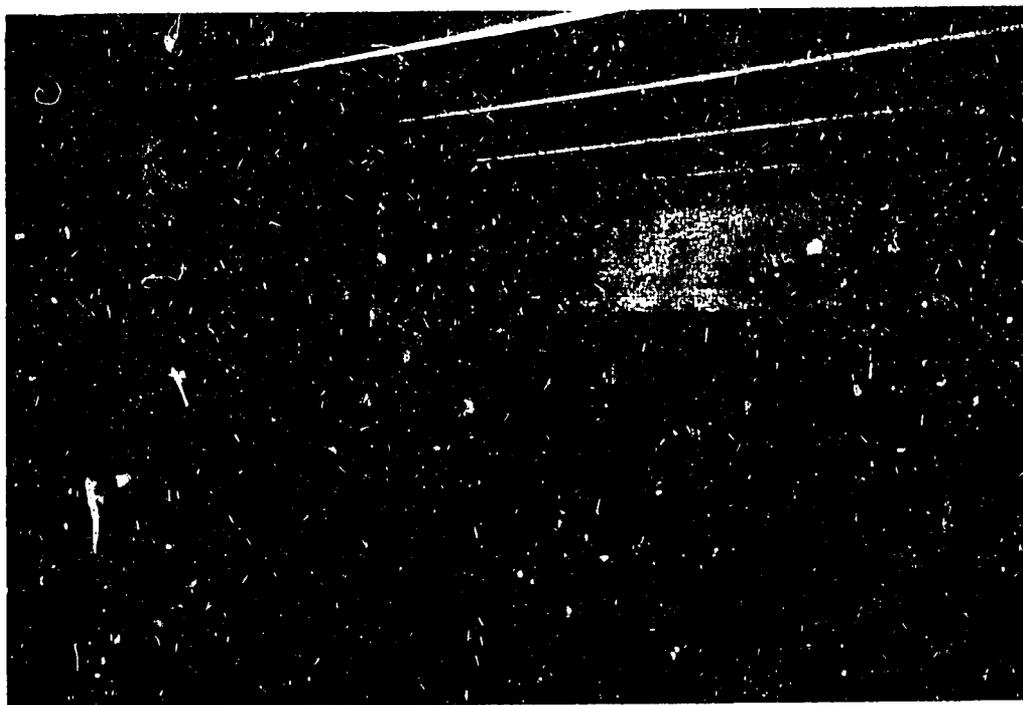
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Mother plant and
first daughter plants
of nursery field.

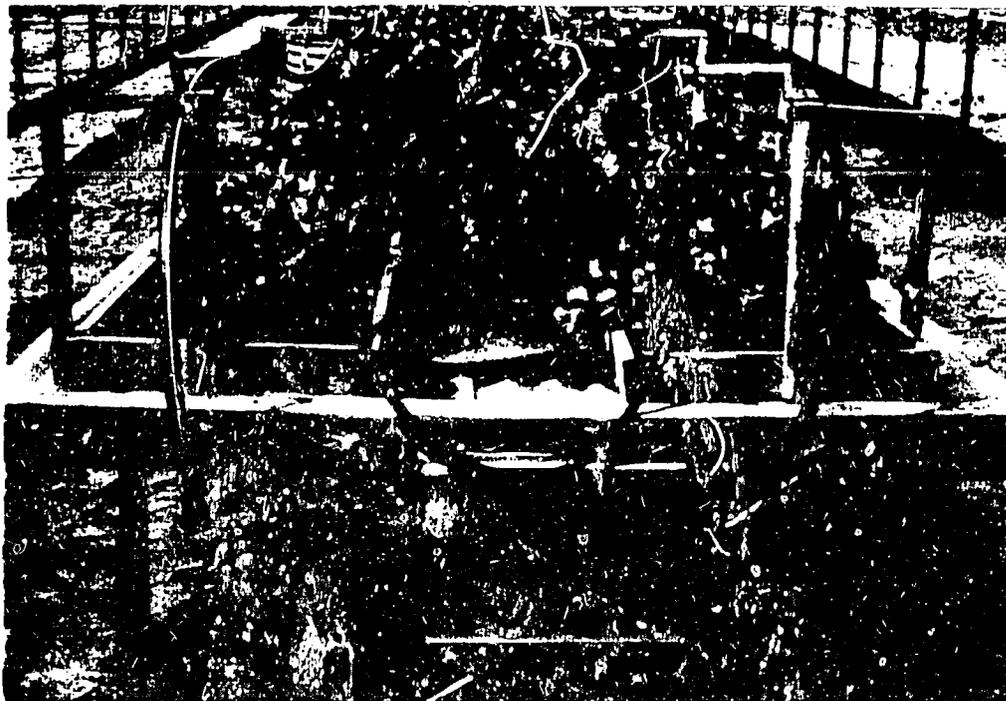


Harvested, dormant plants trimmed, packed, and stored at -2 degrees C.

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Cartons of plants properly air stacked in cold storage at -2 degrees C.



Plants of new varieties maintained under four month quarantine for entry into the United States. The water is collected and sterilized. The potting soil and the original mother plants are destroyed at harvest time. The daughter plants are rooted in separate containers and are used for propagation.



Side view of Quarantine plant bed showing slope to facilitate water collection.

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