LOAN STATUS REVIEW REPORT

A. Identification

A.I.D. Loan Number:	278-K-018	
Name of Project	Sprinkler Irrigation Equipment	
Original Loan Amount:	$8,000,000.00	
Deobligations: (See Section C.2)	$3,500,000.00	09/06/77
	$ 10,076.51	03/80
	$ 494.69	Pending
Final Loan Amount:	$4,489,428.80	
Date of Authorization:	September 27, 1976	
Date of Obligation:	September 30, 1976	
Terminal Date for Disbursement:	November 30, 1980	
Total Disbursements (as of 4/10/81):	$4,489,428.80 (See Section I.)	

Report prepared by:

		Initials	Date
Aied Sweis	CD/E		
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B. Summary

This loan was intended to finance the procurment of sprinkler irrigation equipment in support of four Jordan Valley irrigation construction projects and has been fully disbursed. The purpose of improving agricultural yields in the Jordan Valley can not be shown to have been achieved by this project because of equipment under-utilization. Reasons for this underutilization are suggested herein.

C. Background

1. Project Description

The East Jordan River Valley (hereinafter the "Jordan Valley") is the western-most part of the Hashemite Kingdom of Jordan. It extends from the Yarmouk River to the Dead Sea. The Jordan Valley contains approximately 420,000 dunums of arable land capable of supporting a program of sustained irrigated agriculture.

The Government of Jordan (GOJ) decided in the early 1970's to encourage the use of sprinkler irrigation in certain areas of the Jordan Valley where other irrigation methods were believed to be less efficient and more costly. These areas encompassed 93,100 dunums, including

33,100 dunums being irrigated by the open watercourse method. Four separate construction projects were designed and implemented to develop these areas:

(a) The East Ghor Canal Extension (A.I.D. Loan 278-H-009);
(b) The Zarqa Triangle Project (A.I.D. Loan 278-T-011);
(c) The North East Ghor Irrigation Project (International Development Association); and
(d) The Hisban-Kafrein Irrigation Project (KFW).

During the development and design of these projects, cost escalation for equipment was underestimated resulting in insufficient funds being available to procure the sprinkler irrigation equipment for these projects.

The Sprinkler Irrigation Equipment Loan (278-K-018), the subject loan, was to procure portable on-farm sprinkler irrigation equipment to meet the expected requirements to irrigate the 93,100 dunums of land included under the four abovementioned projects. The GOJ's Land Redistribution Program was to create about 2,327 40-dunum farm units in these areas. A minimum of one portable sprinkler unit comprised of two flylines was expected to be provided to each farm unit.

The materials to be procured under the subject loan included portable pipes, filters, pressure gauges, couplers, valves, fittings and sprinkler heads. The Natural Resources Authority (NRA) was to store, manage and distribute the equipment to farm owners approved by the Jordan Valley Commission (JVC) as eligible recipients following the execution of credit or cash sale agreements between the Agricultural Credit Corporation (ACC) and the eligible recipient. Funds realized from the sales were to be maintained in a separate account by the ACC for relending to Jordan Valley farmers for procurement of additional and/or replacement sprinkler equipment.

Concurrent with the abovementioned irrigation projects and this sprinkler equipment project is USAID's Water Management Technology (WMT) Project (Grant 278-0192). All are intended to complement each other. The WMT project was to provide technical assistance to Jordan Valley farmers in the proper utilization of sprinkler irrigation equipment and to conduct the research required to optimize crop production under a sprinkler regime.

2. Significant Project Events

Equipment for the project was estimated to cost $8.0 million at the time of Project Paper development. Primarily as the result of two events, project costs to A.I.D. were significantly reduced resulting in the deobligation of $3.5 million on September 6, 1977. These events were:

(a) The decision by the GOJ to purchase the sprinkler irrigation equipment completely disassembled and to acquire the necessary equipment and training to assemble it in Jordan. This resulted in savings in the purchase price due to less U.S. labor costs, savings in freight charges due to more compact packing and savings to A.I.D. because the GOJ would provide the personnel to assemble the equipment in Jordan.

(b) The GOJ and USAID endeavored to issue invitations for bids at a time when demand was low in the U.S. for similar equipment; and succeeded.

Total savings at the time of project completion have amounted to $3,510,571.20.

On May 16, 1977, Temporary Law No. (18) was enacted changing the JVC to the JVA (Jordan Valley Authority) and transferring the authority and responsibilities of the NRA (as well as most other agencies in the Jordan Valley) to the JVA. This resulted in the JVA, as the implementing agency, having all authority necessary for implementing the project.

On December 8, 1980, the JVA requested USAID to include within the Annex I to the Loan Agreement the additional irrigation project areas associated with the East Ghor Canal and 8 km Extension projects. Farmers in these areas have indicated an interest in purchasing a portion of the available sprinkler irrigation equipment even though they will be required to provide their own pressurization system. USAID issued Implementation Letter No. 14 on December 24, 1980 including these two project areas.

This project was included in the Memorandum Audit Report No. 5-278-81-3 dated October 27, 1980. This report made no recommendations concerning this project.

3. Project Purpose

The purpose of this project was to improve the yields of agricultural crops in the project areas. This was to be accomplished by making sprinkler irrigation equipment available to Jordan Valley Farmers with the assumption that related technical advice would be made available.

4. Covenants

The GOJ covenanted "that all the irrigation systems for which the sprinkler equipment will be used will be completed in a timely manner so as to assure effective utilization of the Eligible Items financed", in addition to the standard general covenants and warranties.

D. Achievements

All equipment to be provided under this loan has been purchased, delivered and is available for purchase by the Jordan Valley farmers. Those spare parts considered essential for the equipment provided have been ordered and have either been received or are in transit. Adequate covered storage areas have been constructed to protect those equipment items which could be damaged by exposure to the elements.

E. Future Monitoring Needs

In the course of conducting other agriculture sector activities, USAID/J will continue to be cognizant of the ultimate disposition of the equipment provided under this loan.

F. Organization and Management

The JVA is responsible for all GOJ development projects in the Jordan Valley including the subject project. The Irrigation and Drainage Division of JVA, headed by Dr. Fahed Natour, V.P., is responsible for the supervision and coordination of activities relating to design, construction, operation and maintenance of irrigation and drainage projects. The equipment design and tender documents were prepared by the firm of Dar-Al-Handasah. The equipment was procured from the following U.S. firms: (1) Bush Hog/ Redi Rain; 2) Rainbow Manufacturing; and 3) Rain Bird International.

The various procurement aspects of this project were efficiently and competently administered. The failure to contribute to the project purpose on schedule is the result of few purchases of the equipment by farmers. This may be attributed, in part, to a lack of personnel qualified to demonstrate the long-term benefits of sprinkler irrigation relative to other irrigation schemes. And, in part, to delays in the implementation of the Land Redistribution Program (See C. above and G. below).

G. Status of Completion of Project Elements

All 2,785 portable sprinkler units, including pipes, filters, pressure guages, couplers, valves, fittings and sprinkler heads, have been delivered to the three designated storage and distribution centers in the Jordan Valley. Essential spare parts have been ordered and most delivered. The final spare parts order is in-transit but has been delayed due to strikes in the U.S.

All unsold equipment (approximately 2,564 units) is being stored in protected and guarded areas. Soft rubber gaskets which are intended for use inside the pipes of the sprinkler units are subject to deterioration if exposed to sunlight for an extended period. These gaskets have been stored in buildings at the storage and distribution centers and are inserted in the pipes only at the time of delivery to the purchaser.

As mentioned in Section B.2. above, the JVA undertook to assemble the portable sprinkler units in Jordan to reduce purchase and freight costs. Each of the three storage and distribution centers are staffed with personnel trained in the assembly, installation, operation and maintenance of these units. In addition, each center is equipped with all necessary tools and equipment for assembly including relatively sophisticated machinery used for pressing fittings onto the pipes.

Procedures have been developed and implemented which have permitted same-day delivery of ordered equipment. Equipment is usually delivered to the farm within 24 hours. Actions included within this timeframe are: actual writing and pricing of the order; submission of the order to JVA for approval; review and approval of the order by JVA; submission of the approved order to the ACC; issuance of ACC's sales agreement; delivery and installation of the equipment at the purchaser's farm; and initial instruction for the purchaser in the installation, operation and maintenance of the equipment.

As of April 30, 1981, 221 portable sprinkler units had been sold (i.e., 8% of the total available). Over 40% of these (96 units) were sold during the preceding two months supporting the belief that sales will increase now that most constraints have been removed. It is probable that more units will be ordered soon by farmers who were ineligible purchasers prior to the revision of Annex 1 to the Loan Agreement. These orders will be placed at the appropriate time in the growing season.

The lack of sales has been a serious concern of the JVA and USAID and has been investigated by various consultants including specialists provided under the WMT project. There have been as many opinions on the "why" as there have been "investigators". USAID believes the answer to be a combination of effects which are expressed in the many opinions.

Investigations conducted by the Ministry of Agriculture (MOA), JVA and USAID under the WMT project and other activities show that cropping patterns in the Jordan Valley have changed somewhat from baseline information used in the early 1970's for designing and developing irrigation programs. Crop choices by farmers have been influenced by domestic and international market conditions. Changes in certain market conditions were unforeseen and unpredictable by development planners. The result has been that nearly one-half of the Jordan Valley's developed irrigated land is devoted to crops most suitably irrigated by the drip irrigation method. These crops include tomatoes, cucumbers, peppers and other vine-type vegetables.1/

1/ See: Environmental Assessment, Jordan Valley Irrigation Project - Stage II, November 1980.

The value of drip irrigation was recognized by JVA planners at the outset of this project. The JVA made the determination not to promote drip irrigation equipment because of its high capital cost (up to three times the cost of portable sprinkler equipment) and because sufficient research was lacking to permit adequate technical guidance for the farmers.

The private sector, through intense promotional activities, successfully demonstrated the merits and efficiencies of the drip irrigation method to the Jordan Valley vegetable growers. As a result, over 10% of the Jordan Valley's developed irrigated land is being irrigated by the drip method[1/], in spite of the high capital cost.

The potential for further sales of the sprinkler irrigation equipment remains excellent, however. The other one-half of the Jordan Valley's developed irrigated land not devoted to crops most suitably irrigated by the drip method either must be irrigated by the open watercourse method or sprinklers. The JVA is continuing to encourage the use of sprinkler irrigation over open watercourse irrigation through demonstration, raising the price of water to encourage efficiency and by redistributing lands configured specifically for the use of sprinkler irrigation equipment. The 2,785 portable sprinkler units made available by this loan will provide irrigation to less than 30% of the Jordan Valley's developed irrigated lands. Therefore, once other constraints (discussed below) are removed, the portable sprinkler units available under this project should be distributed completely with a potential demand remaining for more sprinkler equipment for the 20% of irrigated lands devoted to crops suitable for sprinkler irrigation for which there are insufficient supplies under this loan (some portion of this 20% will undoubtedly continue to be irrigated by the open watercourse method).

One of the constraints mentioned above has been the fact that the land areas included within the original four projects areas were where land redistribution was required. Land redistribution procedures were not finalized by the JVA until mid-1980 and, as of February 28, 1981, not all titling had been completed. As farm ownership is a necessary prerequisite, with one exception[2/], for the purchase of the sprinkler equipment provided under this loan, it follows that purchase could not take place until after redistribution was finalized. Now that this situation is being resolved, sales should favorably progress.

1/ Same as footnote No. 1 on previous page.
2/ The exception is documentation approved by the JVA evidencing a tenure arrangement of not less than 10 years duration. Even this requires an approved landowner.

Another constraint has been that farmers (certified farmer-owners) growing crops more suitably irrigated by the sprinkler method were exlcuded from purchasing the equipment made available by this loan because they were not located in one of the four project areas. This constraint was reduced on December 24, 1980, when USAID revised Annex 1 to the Loan Agreement to include two additional Jordan Valley irrigation areas. It should be noted that the areas of developed irrigated lands devoted to crops suitable for sprinkler irrigation are distributed throughout the Jordan Valley and not spatially confined.

An additional technical aspect should also lead to sprinkler equipment sales. Depending principally upon soil and water characteristics, drip irrigation generally leads to increased soil salinity. The ultimate result is decreasing yields. To alleviate this problem, leaching is necessary which, in most of the Jordan Valley, would have to be accomplished with sprinkler irrigation equipment. This is because the predominately undulating terrain renders field flooding an impractical alternative.

The JVA is continuing to demonstrate sprinkler irrigation technology where appropriate.

H. Training

Rainbow Manufacturing provided the services of two technicians for one week each to train JVA personnel in the installation, operation, maintenance and use of the portable sprinkler irrigation equipment and associated assembly machinery. In addition, one technician was provided for a week to train JVA employees in the construction of a warehouse and in its proper utilization.

Bush Hog/Redi-Rain also provided the services of one technician to train JVA personnel in the installation, operation and maintenance of their sprinkler irrigation equipment.

I. Financial Status: (As of April 10, 1981)

Number	Expires	For	Amount Committed $	Amount Disbursed $	Balance of Commitments $
L/Comm 018 001	9/30/80	Bush Hog/Redi-Rain Mfg. Co.	1,605,959.36	1,605,959.36	-0-
L/Comm 018 002	9/30/80	Rainbow Mfg. Co.	2,421,235.37	2,421,235.37	-0-
D.R.A. 018 003	9/30/80	Air Shipment Costs (FM/BFD)	89,387.40	89,387.40	-0-
L/Comm 018 004	11/30/80	Rainbow Mfg. Co.	99,984.34	99,984.34	-0-
L/Comm 018 005	11/30/80	Bush Hog/Redi-Rain Mfg. Co.	134,357.57	134,357.57	-0-
L/Comm 018 006	11/30/80	Rain Bird Int. Inc.	138,999.45	138,504,76	494.69 3/
		TOTAL	4,489,923.49	4,489,428.80	494.69

1) No difficulties were faced in requesting, obtaining or disbursing funds.

2) The TDD extensions granted beyond the period stated in the Loan Agreement were from June 30, 1979 to November 30, 1980.

3) USAID has not yet received confirmation from AID/W that this sum has been deobligated.

J. Conclusions and Recommendations

1. Conclusion

USAID concludes that, while the purpose of the loan has not been achieved within the originally conceived timeframe, progress is being made that will result in distribution and utilization of the sprinkler irrigation equipment and will contribute to agricultural yields. We refer primarily to the progress being made in the distribution of land in the four areas being irrigated by pressurized systems. USAID also believes, as has been the case in other JVA activities, that as a few farmers begin to utilize the sprinkler equipment, demand will accelerate rapidly.

2. Recommended Action

Having reviewed the status of the Sprinkler Irrigation Equipment Loan (278-K-018), the Project Committee recommends that the USAID Director be requested to approve the negotiation of a Project Implementation Letter which will establish a date by which all loan-financed equipment will be distributed in accordance with the Agreement. It is suggested that up to five years from the date of the Implementation Letter be permitted. Throughout this time period the JVA should be required to submit semi-annual (January 31 - June 30) distribution status reports to USAID. If there is any undistributed equipment at the end of this time period, USAID may request accelerated repayment of the loan for the estimated value of such equipment.

attachment 2

End of Tour Report
Water Management Technology Project
Jordan Valley Authority
Amman - Jordan

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Contents of Report

A. Introduction
B. Assessment of Problems
C. Development of Program
D. Accomplishments
E. Associated Contributions
F. Appendix

Respectfully submitted

Date 14 January 1981

Place Amman- Jordan

George A. Marlowe, Jr.

George A. Marlowe, Jr.

A. Introduction

This end of tour report covers the orientation, program development, and program accomplishments of one member of a team whose goal was to assist the vegetable growers in the Jordan Valley increase their production efficiency through improved technology. How well this team performed and succeeded may become more evident with time. We would like to feel that we made a contribution.

It has been a rare opportunity to work with vegetable growers as eager to try new practices, to take risks on behalf of improvement, and to be so appreciative of efforts to help them.

These two years have provided a great deal of challenge, some successes, some frustration, some saddness, and a great deal of warmth from Arab hospitality. We were deeply saddened by the untimely death of the Project Director, Dr. Karim Husseini. This kind man held the welfare of the Jordan Valley farmers with great concern, and was held in high regard by them.

The very capable administrative support from His Excellency, JVA President Omar Abdullah Dokhgan and Vice President Munther Haddadin, and Frederiksen, Kamine and Associates stateside back-up were of great help in program implementation.

The encouragement and concern expressed by AID Director Ed Harrell and Technical Project Directors Dr. Frank Denton and currently Dr. James Turman was always positive and optimistic. Of special and sustained help, both direct and indirect, WMT would like to express our appreciation to AID Agricultural Officer Charles Jenkins and Program Specialist Fu'ad Qushair. Mr. Jenkins and Mr. Qushair made frequent visits to WMT operations in the Valley, and were knowledgeable and supportive of the program. Of the seven foreign countries in which I have worked, Mr. Charles Jenkins is the most competent and helpful AID Agricultural Officer I have encountered. All of us in the field were greatly encouraged by their interest.

I am glad I had the opportunity to work with the fine young staff of JVA/WMT engineers. To those with whom I worked most closely I am grateful for their assistance and indulgence. Their names are listed with projects results in the appendix of this report. Mr. Duane Lindgren EK-JVA/WMT was of great value on all of our water distribution planning and implementation. Miss Arkaid Abdel Nour Admin Assistant and Mrs Yana Mbaidin provided excellent office support for the program.

If I leave with one regret it is that I wish we could have done even more for the very deserving farmers in the Jordan Valley.

B. Assessment of Problems

The first five weeks in-country were spent in assessing the production patterns, methods, and problems of vegetable crops in the Jordan Valley. Visits were made to 42 farms in the southern, middle and northern areas of the Ghor. During the visits standardized, pre-determined questions were asked about each crop grown; problems the farmer felt were limiting his production and profit potential; and observations on practices which our interview team felt were likely to become problems,or practices which were currently inadequate.

On return from the Valley interviews, available written information generated by other sources was reviewed, conferences were held with JVA Ministry of Agriculture, University of Jordan College og Agriculture faculty, and about 10 commercial companies who supply seed, fertilizer, or pesticides to the farmers in the Valley.

It became obvious, less than half way through the assessment period, that the major problems of the Valley farmers were crop management rather than water management problems.

The farmers expressed problems related to water, but these were policy problems, such as uncertain delivery times, and uncertain quantity. These expressed needs were transmitted to the JVA. The farmers did not feel that sprinkler irrigation

would be valuable to them for certain vegetable crops but felt that it would be good for citrus, bananas, cabbage, and lettuce.

The team noted that the zig-zag surface irrigation method, placement of fertilizer on top of the soil, high incidence of foliar and fruit rotting diseases, and improper use of mulch on drip irrigated rows could be replaced by better practices.

The farmers registered strong complaints about the cost of pesticides, fertilizers, and selling their produce. These problems were transmitted to the farm management section of the Jordan Valley Farmer's Association, as these were problems in their area of responsibility.

Serious soil borne diseases, high weed populations, guesswork in fertilizer rate determination, poor quality seedlings of tomato, pepper, and eggplant (when not direct-seeded), were also problems in crop management which the team felt deserved research attention.

In general, farmers were satisfied with the varieties of cucumber, eggplant, and pepper being used in the field, but felt that better greenhouse cucumbers and field tomatoes varieties should be made available which were more disease resistant, higher yielding, and with firm fruit suitable for shipping.

The disease problems of greenhouse and row covered cucumbers were strongly expressed. Poor coverage of spray, poor ventilation, the free-water method of irrigation were actually bigger problems than change of variety as felt by the farmers.

Another problem that surfaced was the lack of technical assistance for the farmers in routine problem solving. When asked what they were presently doing about getting information they said from other farmers, the commission men, and commercial sales people. It was obvious that the Ministry Extension Service was not reaching very many Valley farmers, at least

4/...

not the 42 we interviewed.

Labor problems were pointed out by 64 % of the farmers interviewed. Weeding is a high labor, high cost input in the Valley, but not one of the farmer's had or intended to use, herbicides. Spraying labor costs are also high because most of the operations are semi-manual. The manual methods used require approximately three times more labor and five times more hours than is required by tractor drawn or selfpropelled sprayers. Because of small size of farm, high efficiency sprayers may not be justified but cooperative ownership or contract application could be helpful.

The farmers felt that grading and sizing were not justified, as higher prices were not given for graded tomatoes, peppers, or eggplant. The new marketing oenter at Arda will help growers to get better prices for sorted, sized, and graded products.

A final, and very important problem expressed was the tomato virus disease. The farmers said that this is one of their biggest problems with tomatoes. The virus diseases of cucumber, squash, and melons will be equally devastating unless strong measures are taken to curb their spread. Both diseases are spread by insect vectors, both have a wide range of weed hosts, and both seriously reduce yield and quality.

Another research area requested, from the JVA administration was the need for determination of water requirement for the various vegetable crops grown in the Jordan Valley. This information is to be used in water allocation in the future. His Excellency, Omar Abdullah Dokhgan also requested the development of a best practices package for each method of irrigation used in the Valley.

C. Program Development

After the survey results were digested and reduced, a research and demonstration program based on vegetable industry needs and JVA requests was outlined. It was suggested that some of the minimum stress technology from the USA be considered. During the following 4 weeks, seminars were presented to the JVA, USAID, Ministry of

Agriculture, and University. We were most fortunate to have someone from the AID show such interest in the new technology as Agricultural Officer Charles Jenkins. Mr. Jenkins visualized an on-farm demonstration program using these new technics. In a very short time, AID provided very strong moral and financial assistance to a Tomato Better Practices Program. Without Mr. Jenkins encouragement and help I doubt if we could have developed a program of such magnitude in that first year.

The demonstration program fitted in very well with the research program outlined. As tomatoes represent 40 % of the agricultural income from the Jordan Valley we made this crop our priority test crop in 1979. Decisions were made:

1. To study seedling production methods which would provide virus-free transplants for field research and demonstration plots.

2. To compare furrow, sprinkler, and drip irrigation methods for water-use efficiency, effectiveness with various practices, and influence on yield and quality of the five major vegetable crops.

3. To study the value of the full bed mulch system with drip and traditional furrow irrigation.

4. To test varieties of tomatoes for resistance to the major diseases in the Jordan Valley, for earliness and large fruit size, and yield.

5. To study fertilizer rate and placement methods with current and improved practices.

6. To compare and demonstrate various aspects of the new technology with practices used in the Valley and their influence on labor use, fruit yield and quality, and plant health.

7. To assess the value of systemic insecticides, anti-feedant oil films, and contact insecticides on the virus disease incidence of tomatoes and cucumbers.

8. To compare various row-cover management systems (tunnels) on the growth, yield, and disease incidence of cucumbers.

(Systems compared: Kentucky, French, and San Diego).

9. To initiate studies which could help validate known water consumptive use figures for the major vegetable crops grown in the Jordan Valley.

10. To initiate an irrigation better practices body of information upon which could be used in future educational programs.

D. Program Accomplishments

1. Three greenhouses were constructed for containerized plant production. These structures were built by the JVA/WMT group with materials to exclude insect vectors of the Tomato Yellow Leaf Curl Virus (TYLCV) and Cucurbit Mosaic, (CMV). Integrity of the greenhouses was maintained with cloth or screening having openings of 0.2 mm or less the size of the first infective-stage of the TYLCV vector, Bemesia tobaci, the sweet potato whitefly.

Seedlings were grown in the patented trays of Speedling, Incorporated USA using a vermiculite-peat soil-less media. The technology of controlled seedling production was demonstrated and has been successfuly transferred to three competent Jordanian agricultural engineers.

The methods of sanitation to reduce insect and disease entrance to the seedling production area have been demonstrated and transferred. Studies were conducted on soil-less media which could be made from local materials; a formula of peat (purchased) sand (local), micro-nutrients (purchased) lime (local) and wetting agent has been developed, tested, and transferred.

Greenhouse construction, ventilation, and evaporative cooling methods were designed, constructed and transferred.

The superiority of containerized, disease-free vigorous seedlings has met with marked interest among growers and business persons in Jordan.

The Todd Planter Flat has been modified slightly, is

now being manufactured, and is being sold in large quantities to growers in the Jordan Valley. It is hoped that growers will incorporate the entire disease-free system (media, sanitation, air-pruning, demand watering and fertilizer, roguing, etc.) as the tray is but one segment of the system.

The importance of cotyledon retention, maintenance of seedling vigor, transfer technics, soil moisture control, seedling fertilization, and pesticide application were demonstrated and transferred.

A two-stage program to insure the production of virus-free seedlings has been initiated. An high-integrity (0.2 mm) greenhouse for growing the seedlings, and another for growing to fruiting stage was designed and constructed at Pump 16, Karameh. The proposal is to have a 4 to 5 % sample of each lot released from the Seedling house to be grown in the Validation house. If the plants grown to fruiting in the Validation house remain free of the TYLCV, one could assume that the seedlings left the Production house of the virus. This program could be used for the cucurbit virus program, too.

2. In order to start a field research program it was necessary to add a field station in Wadi Yabis to serve farmers in the northern Ghor, establish activity on JVA land in Deir Alla for farmers in the Middle Ghor, and Karameh for farmers in the Southern Ghor (down to Ghor Safi). The demonstration area at Kafrein was already available, and for this reason plant production house number one was constructed on that site.

At Kafrein, tomato variety trials, irrigation methods studies, and cultural practices comparisons were made in the fall of 1979 and spring of 1980. The Wadi Yabis station was ready for limited testing in the fall of 1979, and by spring 1980, 16 plots were established, Plots at Wadi Yabis included irrigation methods, water use efficiency studies, best practices studies, 3 different tomato variety trials, fertilizer rate and placement studies, and several variety trials on melons, cucumbers, and beans.

8/...

The irrigation methods studies showed that drip and furrow not zig-zag) yielded approximately the same (Drip 5.6, Furrow .2 MTD) whereas, sprinkler yielded 4.1 MTD. The farmer yield f 1.4 MTD was used in comparison. In early season yields, urrow was better than drip, as follows: furrow 2.6 drip 2.5 nd sprinkler 0.7 MTD. Sprinkler plots developed later yields ut fruit quality was also less than the surface methods. This ame pattern held for tomatoes, cucumbers, muskmelons, okra, weet corn and watermelon as shown in the Appendix of this eport.

3. In addition to the preparation of the field stations, quipment procurement was initiated. In order to demonstrate nd evaluate the full bed mulch system equipment to form and irm an elevated bed was needed. Ordering from the US was unortunately delayed, thus it was decided to manufacture a bed ress in-country. From slides and drawings WMT provided, the oyal Scientific Society fabricated two bed presses which were sed extensively for research and demonstrations. Lacking other eeded equipment it was necessary to improvise or do many of he operations manually.

The raised beds were 90 cm across 15 cm high. Before the lastic film (mulch) covered the bed, a band of fertilizer was laced on the outer edge of each side of the bed refered to as houlder placement. A center band of superphosphate was applied. he drip tube was placed off-center about 5 to 8 cms. Fumigation as a manual operation, thus a 450 gram can of methyl bromide as placed in an open top oil can over a nail block for puncturing. The fumigation can was removed from beneath the plastic fter 48 hours.

The film was placed firmly over the bed and soil was used o lock the film to the base of the bed. These operations are ll machine operations. An equipment order was placed in the pring of 1980 but has not arrived as yet, due to the Gulf as and restrictions on shipments from the Port of Aqaba.

The full bed mulch system (FBM System) was demonstrated n the Better Practices Demonstration Program (BPD Program) on

20 different farms and at all field stations in 1979-1980. Farmer interest in this practice was very high. At this date the former Prime Minister, Said Al Rifai has set up a 80 dunum model farm in Karameh in which the entire FBM system is being used. The farmers immediately grasped that better growth, less loss of fruit due to ground rot, ease of spraying, harvesting, and great reduction in weed growth was associated with the system. Many of the plots included staking and tying, a further improvement on the FBM System.

The BPD Program was very successful and most of the credit goes to Mr. Jenkins and Mr. Fu'ad Qushair af AID Jordan who helped to obtain funds and supplied such interest and moral support for the Program, and to the American coordinator Mr. Robert T. Montgomery an Extension Agent, Univ. Florida who coordinated the program so effectively with the help of various Jordanian engineers.

The best tomato yields from the BPD program in the Southern Ghor were 4.6 metric tons/dunum (MT/D), the farmer average was 1.4 and the average for all BPD farms was 2.4 MTD. In the 10 farms in the North the farm average is 2.6 MTD, and the BPD farms 4.2 MTD.

The research studies on the FBM system compared to farmer's average yields showed that fumigation doubted yield (2.6 to 6.4 for fumigation; raised beds 6.3 versus farmer's flat mulch method 2.6 MTD; and mulched versus non-mulched 6.3 versus 2.4 MTD. There is little doubt that this technology has been successfully transferred. The current limitation is availability of equipment.

The FBM system uses approximately the same amount of plastic per dunum, the same fertilizer amounts, and the same amount of drip tubing. The increase in efficiency of these inputs is obvious. The advantage of staking was felt in crop earliness, reduction in cracking, larger size fruit, easier spraying and easier harvesting. An increase in marketable yield (from farmer average 1.4 to staked plots 5.4 MTD) was achieved.

The FBM system was transferred in detail to 9 Jordanian engineers working for JVA/WMT.

4. Tomato varieties were tested at Wadi Yabis, Kafrein, and at Karameh. Fifty varieties were assembled for replicated and observational trials. The cultivars were obtained from USA, Europe, Japan, USSR, and local sources. Twelve varieties were screened for adaptability to sprinkler irrigation. A summary of these trials is presented in the Appendix.

The methods of evaluation of varieties in the field and for consumer acceptance (taste panel, and a 5-point organoleptic procedure) was demonstrated and transferred. Another value of our variety studies was to increase an awareness of yield potential and yield assessment. Farmer samples showed that the average tomato grower in the Southern Ghor produces about 17 to 20 fruits per plant. In our variety trials many varieties exceeded 30 without mulch, and more than 50 with mulch. In Florida, an average of 87 (very carefully graded) marketable fruit per plant is achieved. In studies Mr. Montgomery and I conducted in Florida the average total fruit per plant is 124, marketable 87. Jordan can be expected to increase yields significantly as cultural practices improve and the virus is better controlled.

5. Fertilizer application for most vegetables in the Valley is a manual, high labor and high materials, high cost practice. Most farmers pay a great deal for chicken manure and medium analysis fertilizer. The Univ. of Jordan admits that most rates of application are guesswork.

WMT studied the influence of complete fertilizer in bands under mulch with drip irrigation, and another trial on the value of supplemental nitrogen. It was faund that there was no significant yield increase above the 150 Kg/Dunum rate of complete fertilizer with the high use-efficiency of the FBM system. There was no significant increase in marketable yield beyond 100 Kg/Dunum of supplementary nitrogen with the FBM system. The farmer average of 2.6 MT/D was almost tripled (7.0 MT/D) in these fertilizer tests, most of which was attributed to better placement and the

increased efficiency due to the full bed mulch system.

6. Some of the pessimists feel that tomato production in the Jordan Valley may be economically unfeasible in 10 years unless The TYLC virus is checked. Optimists feel that 15 years is realistic. It was hoped that JVA could bring together the resources and talents of the Min. of Agri. Faculty of Agric., and the JVA into an intensive team effort, but such has not materialized. WMT accomplishments include creating an awareness of the possibility of growing virus-free transplants; providing these seedlings with a systemic insecticide before leaving the safety of the greenhouse; covering the field set plants with an anti-feedant oil; and following with effectively applied contact insecticides. WMT put out 2 trials with these variables, and we have shared our thinking and stylet-oil with U.J. Fac, of Agric. who have new initiated research along these lines. We have promissing leads, hope and enthusiasm but the answer is still in the distance.

7. Three methods of applying clear plastic over rows of cucumbers were developed and demonstrated (tunnels or row covers). Four Agric. Engineers for the JVA have seen and worked with these technics. It was hoped that on-farm demonstrations could have been established but WMT has not given this effort much priority. The French method (in use in Jordan involves a half circle wire hoop covered on both bottom edges with soil. The low labor, easy ventilation method used in San Diego (USA) involves a post and wire holding 2 strips of film over the plants, like an inverted V. Edges of the two strips of plastic are buried at the ground level and held at the top of the wire by clothes pins. To ventilate, one or both sides can be unpinned and the film drops to the ground. The labor saving, disease reduction, and greater yield should be a very quickly adopted practice in the Valley.

8. Facilities for the validation or determination of the evapotranspiration figure for the various crops were not available; but WMT has been provided with complete project information, plot design, data input and output suggestions for three approaches to this problem. One approach covers crop efficiency per unit

of water supplied, another measures delivery system efficiency by crop response, and the third is the development of low-cost volumetric lysimeters for hillside construction. The hillside construction would save costs of excavation by one-half, and the gravity flow collection facility would eliminate the need for out-flow pumps and measuring pits.

9. The development of an irrigation better practices package is now in its second phase. WMT should feel confident that the FBM system is highly applicable to drip irrigation at bed widths up to 90 cm, and for furrow irrigation one side watered up to 60 cm wide. For furrow irrigation side holes need to be made in the bed wall on which the furrow water is being applied.

With the FBM system fertilizer, water, and labor efficiency can be increased between 50 and 60 % according to our preliminary results. This work should be continued, so that a reliable, highly visualized, educational publication in simple language and line drawings could be available for distribution to farmers, allied industry personnel (fertilizer, pesticide salesman), and commission merchants.

10. His Excellency, President Omar Abdullah Dokhgan, requested a five year plan for research based on the priorities I felt should be addressed for the Jordan Valley.

A 5 year Plan for Research, and a 5 year Plan for Demonstration needs was prepared and presented. Each element of the Research Program Proposal was organized in the following manner:

1. Title
2. Objectives
3. Duration of Investigation
4. Suggested methods of Investigation
    a. Variables
    b. Constants
    c. Treatment
    d. Experimental Design
    e. Data to be Taken
    b. Information to be Expected

5. Field Layout, Equipment Needs, etc.

Each element of the Demonstration Program Proposal was organized in the following manner:

1. Title
2. Objectives
3. Duration of Demonstration
4. Size and Location of Demonstration
5. Methods of Approach
6. JVA Inputs
7. Farmer Inputs
8. Care of the Demonstration
9. Expected Value of the Demonstration

The Research Program Proposal included the following:

A. Plant Protection: Incidence and Control

1. Influence of Date of Planting on Virus Incidence and cost benefit ration of Tomato Production

2. Influence of Virus-free Seedlings, Systemic and contact insecticides and anti-feedant oils on the Virus Incidence of Tomatoes.

B. Water Management

1. Influence of Method of Irrigation on the Growth Development, and Economics of Production on the 5 Major Vegetable Crops in the Jordan Valley.

2. Determination of Water Requirement of the 5 Major Vegetable Crops in the Jordan Valley.

3. Determination of an Irrigation Best Practices program for each method of Irrigation for the 5 Major Vegetable Crops in the Jordan Valley.

4. Evaluation of the Minimum Stress High Efficiency Semi-Closed System of Irrigation.

C. Cultural Practices

1. Evaluation of Varieties of the 5 Major Vegetable Crops

under the Full Bed Mulch and Open Systems of Culture.

2. Evaluation of Fertilizer Rate, Kind, and Method of Placement under Strip, Full Bed Mulch, and Open System of Culture.

3. Evaluation of Major Components of the Minimum Stress Full Bed Mulch System on the 5 Major Vegetable Crops.

D. Seedling Plant Production

1. Assess Plant Production Technics as to Improvement of Plant Quality, Labor Efficiency, and Field Performance.

2. Evaluation of Virus-Free Status of Seedlings Produced in the 2-Stage System.

3. Assess Factors Influencing Summer Dormany Problems of Tomatoes.

The Demonstration Program Proposal included the following:

A. Field Demonstrations

1. Best Practices Program 5 Crops

a. Fumigation
b. Raised Beds
c. Disease-Free Seedlings
d. Full Bed Mulch
e. Full Coverage Pest Control
d. Band Placement Fertilizer
f. Irrigation Method Used in Area

2. Farmer Adoption Program

a. Farmer supplies inputs
b. JVA provides technical assistance

B. Greenhouse Demonstrations

1. Best Practices Program (Cuke, Beans, Tomato)

a. Screening
b. Fumigation
c. Ventilation
d. Drip irrigation
e. Mulching
f. Variety trials
g. Controlled pollination
h. Growth regulations: Fruit set

C. Modified Hydroponics System: High Tolerance Crops

1. Sandwich Technic: High Salt Areas
2. Nutrient Film Technics
3. Semi-Closed System

D. Plastic Row Cover Systems (Cuc.,Tom.,Pep.,Egg.)

1. Systems

   a. Kentucky Hoop and Hook System

   b. French System

   c. San Diego System

2. Practices

   a. Mulching

   b. Ventilation

   c. Disease Control

   d. Staged Fertilization

   e. Pollination

   f. Labor Efficiency

   g. Cost Effectiveness

Both Program Proposals were submitted with equipment needs, personnel needs and capital outlay for each of the five years. Copies of this entire package were given to His Excellency the President; the new Agricultural Director of JVA,WMT Mr. Labadi the assistant to the Director, Mr. Anwar Haddad, and one for the WMT file.

E. Associated Contributions

1. Assisted in the selection and evaluation of preliminary, intermediate, and final design proposals of the JVA-JVFA Plant Propagation Facility. Three units of 20 Seedling Nursery Greenhouses for the Jordan Valley.

2. Assisted Government of Jordan in development of grade standards for pepper and tomatoes.

3. Assisted in the selection and procurement of US machinery, equipment, and supplies to implement the research and demonstration programs.

4. Presented fifteen seminars on various topics related to the new technology for vegetable crops in Jordan. These presentations were for three different audiences: academic, extension-research, and private industry.

5. Instructed JVA/WMT engineers in functional field plot design, data collection, data analysis and reduction, and data interpretation.

6. Assisted in the organization of a training tour of vegetable production systems in Florida for 4 JVA/WMT engineers.

7. Provided technical assistance to the demonstration programs, and to the water management training advisor.

8. Provided technical assistance to the allied industry and commercial firms on selection, procurement, and operation of equipment, supplies and methods related to seedling plant production, fertilizer, fumigation, and cultural practices related to the new technology.

9. Assisted in the orientation and technical assistance to more than 20 visiting individuals or groups (such as World Bank, FAO, etc.).

Attachment 3

APPENDIX

End of Tour Report JVA/WMT
Water Management Technology Project
George A. Marlowe, Jr.
Research Advisor

The results of experiments are herein recorded in brief, should one want more details the original, derived, and reduced data is filed with the JVA. Each experimental unit is reported by place, period, method, and personnel involved.

The administration and staff of JVA/WMT was basically as follows for the period of this tour of duty 8 February 1979 to 5 February 1981.

Program Director:	Dr. Karim Husseini, Deceased 13 July 1980, Mr. Moh'd Said Labadi, July 80 to present
Program Assistance:	Mr. Anwar Haddad Mr. Ghaleb Haddadin
FK(USA) Advisors:	Mr. Duane C. Lindgren Dr. George A. Marlowe, Jr.
USAID-BPD Advisor:	Mr. Robert T. Montgomery
Staff Engineers BSA	(EIC) Engineer in Chargo
Miss Laila Sarraf	Kafrein Station
Mr. Ali D'Moor	BPD program South
Mr. Imad Khyatt	BPD program South, and Investigations Kafrein and Wadi Yabis
Mr. Najuib Assi	Karameh Station
Mr. Ali Hamadneh	Dier Alla Station
Mr. Adnan Qutob	Wadi Yabis Station
Mr. Moh'd Kannaker	BPD program North and Investigations Wadi Yabis Station

The results are grouped into four units.

A. Water and Irrigation Studies

B. Cultural Practices Studies

C. Variety Trials

D. Plant Production Studies

A.1.

Title: The Influence of Drip Furrow and Sprinkler irrigation on the yield and quality of tomatoes, Kafrain S 1980.

Pers: Laila Sarraf, Imad Khyatt, G. A. Marlowe, Jr.

Methods: Raf variety tomatoes were grown in rand. complete blocks replicated 4 times, Rept'd on per plant basis.

Treat-ments	MKTBL				Total	
	1st 3 Harv		8 Harvests		8 Harvests	
	No	Wt	No	Wt	No	Wt
Drip	18	2.2	40	5.1	47	5.7
Furrow	21	2.6	41	4.7	47	5.1
Sprinkler	4	0.5	27	3.7	32	4.2
Farmer Average: Kafrein area 1.4 MT/D					17	1.3

A.2.

Title: Irrigation Methods Comparisons, Wadi Yabis, S-1980

Pers: Adnan Qutob, Mohd Kannaker, Ghaleb Haddadin, Duane C. Lindgren, G.A. Marlowe, Jr.

Methods: Six crops were grown in three replicates each under drip, furrow, and sprinkler irrigation. All had the same length of watering time, but run-off was not recorded.

Vegetable Crop	Irrig. Method	Kg per Plot, 0.07 D		Yield, MKT, MT/D
		MKT	Total	
Tomato	D	413	441	5.9
	F	362	391	5.2
	S	217	245	3.1
Cucumber	D	103	109	1.5
	F	73	84	1.0
	S	49	69	0.7
Muskmelon	D	72	73	1.0
	F	51	67	0.7
	S	40	54	0.6
Watermelon	D	90	94	1.3
	F	58	65	0.8
	S	38	45	0.5
Okra	D	92	106	1.3
	F	62	75	0.9
	S	33	40	0.5
Sw. Corn	D	96	104	1.3
	F	89	99	1.2
	S	68	73	0.9

E.1.

Title: Influence of Pruning and Staking on the Yield of total and marketable yield of mulched tomatoes Kafrein, S-1980.

Pers: Laila Sarraf, Imad Khyatt, G.A.Marlow Jr.

Methods: Pruned, Pruned-Staked, Control Raf tomatoes were grown on rand. complete blocks replicated, [illegible]. Reported on per plant average. Kg/plt.

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Results: Variable	MKT 1st 3 Harv.		MKT 8 Harv.		Total 8 Harv.	
	No	Wt	No	Wt	No	Wt
Pruned	13	1.6	32	4.1	42	5.0
Pruned-Stk.	15	1.9	39	4.9	46	5.2
Staked	16	1.8	36	4.4	39	4.7
Control	14	1.7	36	4.4	45	5.1

The advantage of pruning and staking for early production is well established. A cost-benefit analysis should accompany follow-up studies on these practices.

B.2.

Title: The Influence of Full bed mulch on the yield and fruit size of drip irrigated tomatoes, Kafrein, 1980-S.

Pers: Laila Sarraf, Imad Khyatt, G.A. Marlowe, Jr.

Methods: 30 varieties were grown with mulched-drip irrigation; 20 varieties drip non-mulched, in inform plots.

Results	Gms/Frt.	No Frt. Plt	Kg Frt. Plt	MT/Dunum
Drip Mulched	91.3	58	5.3	5.8
Drip Non-Mulched	108.6	34	3.7	4.1
Farm Yields				
RAF Drip NM	133.4	27	3.5	3.8
RAF Zig-Zag	76.4	17	1.3	1.4

B.3.

Title: Influence of Varying Rates of Banded Fertilizer on the Yield of Drip Irrigated, Mulched Tomatoes. Wadi Yabis, S - 1980.

Pers: Adnan Qutob, Mohd Kannaker, G.A. Marlowe, Jr. Anwar Haddad

5/...

Methods: Four rates of complete fertilizer were assessed as shoulder-placed bands, Special Pak variety, full bed mulch, drip irrigated, RCB, replicated 4 times.

Results

15-15-15	No Frt/Plant		Yield MT/D	
Rate Kg/D	Early	Total	Early	Total
0	11.2*	38.1	3.2*	6.9
150	20.5	40.0	4.3	7.3
200	20.8	41.4	4.2	7.2
300	19.4	41.7	4.0	7.4
Signif	.05	NS	.05	NS
Farmer	---	15.0	---	2.6

B.4.

Title: Influence of Varying Rates of Supplemental N Fertilizer on the Yield of Drip Irrigated, Mulched Tomatoes Wadi Yabis S - 1980.

Pers: Adnan Qutob, Anwar Haddad, Mohd Kannaker, G.A. Marlowe, Jr.

Methods: Five rates suplemental nitrogen (Ammonium Sulfate) were assessed as off center bands, Special Pak variety, Full bed mulch, Drip irrigated Rand. Comp. Blocks, 4 replicates.

Results

Amm. Sulf.	No Frt/Plant		Yield MT/D	
Kg/D	Early	Total	Early	Total
0	11.2 a	38.1	3.2 a	6.9
100	21.8 c	41.7	4.3 b	7.2
150	19.8 b	42.5	4.2 b	7.3
200	17.9 b	39.1	3.7 a	7.0
300	22.9 c	42.9	4.8 b	7.5
Sig.	.05	NS	.05	NS
Farmer	---	2.6	---	2.6

B.5.

B.5.

Title: Tomato Best Practices Research Study, WY80S.

Pers: Adnan Qutob, Anwar Haddad, Mohd Kannaker, G.A. Marlowe, Jr.

Methods: Four components of the BPD program were partitioned in a randomized complete block, factorial design with 4 replicates; using the FBM system, drip irrigation, intensive pest control program, staking and tying.

Components Compared	Number Plant	Kg Plant	Fr. Size cms	Yield MT/D
Fumigation	36	5.8 b	163 c	6.4 b
Non-Fumig.	34	5.0 a	149 a	5.5 a
Raised bed	36	5.7 b	160 b	6.3 b
Flat row	33	5.2 a	152 a	5.7 a
Mulched	34	5.7 b	165 c	6.3 b
Non-Mulched	34	5.3 a	150 a	5.7 a
Stake-Ty	33*	5.3 a	159 b	5.8 a
Non-Staked	36	5.6 b	156 b	6.2 b
Sig. Diff.	NS	.05	.05	.05
Farmer Ave.	15	2.4	160	2.6

* Plots were over-pruned.

B.6.

Title: Tomato Best Practices Demonstration Program.

Pers: R.T. Montgomery, Anwar Haddad, Ali D'Moor, Imad Khyatt (S). Mohd Kannaker, Anwar Haddad, R.T. Montgomery (N).

Methods: Farmer cooperators provided the land (3 rows, 50-100 meters long, the water, and daily monitoring). JVA-WMI provided the Speedling transplants fertilizer pesticides, plastic, planting, harvesting, and maintenance labor). Plots demonstrated fumigation, band-fertilizer raised, full bed mulch, staking tying, and full coverage intensive pest control.

Results: Records showed that the improved practices produced higher yields of better quality fruit than traditional plastices for very little extra cost of the improved technology. Yields would have been significantly higher had it not been for the TYLC virus

Southern Ghor RAF Variety	Per Plant		Yield
	No	Wt/Kg	MT/D
Best BPD	17	4.2	4.6
Ave BPD	15	2.2	2.4
Farmer Ave.	17	1.3	1.4

Northern Ghor	Per Plant		Yield
	No	Wt/Kg	MT/D
Special Pak Var.	40	6.1	4.0
Select Var.	43	6.2	4.2
Ave. BPD	42	6.1	4.1
Farmer Ave.	15	2.4	2.6

C.1

Table: Tomato Variety Screening Trials, Kafrein 1980 (Yield Potential).

Pers: Laila Sarraf Imad Khyatt, G.A. Marlowe, Jr.

Methods: 30 cultivars were grown in replicated, drip irrigated, fumigated full bed mulch beds, 20 other varieties were grown in drip irrigated observational trials.

Results: The top ten varieties of each group are listed by ave. number fruit and Wt. per Plant.

8/...

Drip Non-Mulched			Drip Mulched		
Name of Cultivar	No Frt Plt	Wt Frt Plt	Name of Cultivar	No Frt Plt	Wt Frt Plt
UC 82	50	3.1	NOVA	113	5.6
Floradade	43	4.5	Early Girl	72	6.6
Terrific VFN	36	5.1	VEE MORE	65	6.0
MH-1	36	4.9	VEE PRO	64	5.3
Supersonic	31	3.8	Earlirouge	53	5.8
Spring Set	31	3.5	Early Summer	53	5.3
CAL ACE 55	30	3.0	Star Shot	46	4.6
Marmande VF	30	2.9	UHN 65	42	4.6
Jack Pot	29	3.2	Superfantastic	38	5.7
VFN 8	28	2.9	Master No. 2	35	4.0
Ave.	34	3.7	Ave.	58	5.3
			RAF Exper	27	3.5
			RAF Farmer	17	1.3

C.2.

Title: Tomato Variety Screening Trials Kafrein 1980 -Fall (for Large Fruit Size).

Pers: Laila Sarraf, Imad Khyatt, G.A. Marlowe, Jr.

Methods: 50 cultivars were grown in drip irrigated, observational plots. The top ten varieties compared to experimental plot and farmer Raf are reported. Minimum fruit size 130 grams.

Results Cultivae	Per Plant Marketable		Season Yield
Name	Number	Kilograms	MT/D
1. Earlirouge	53	5.8	6.4
2. Floradade	43	4.5	4.9
3. UHN 65	42	4.6	5.1
4. Superfantastic	38	5.6	6.2
5. Terrific VFN	36	5.1	5.6
6. MH-1	36	4.9	5.4
7. Orient	35	3.8	4.2
8. Master No.2	35	4.0	4.4
9. UF 145	35	3.7	4.1
10. Supersonic	31	3.8	4.2
Raf, Plot, ave.	27	3.5	3.8
Raf, Farmer ave.	17	1.3	1.4

C.3.

Title: Tomato Variety Trials, WY, S-1980.

Pers: Adnan Qutob, Moh'd Kannaker, Anwar Haddad, G.A. Marlowe, Jr.

Methods: 50 cultivars were grown in observational trials, sprinkler irrigated, non-mulched. Yield ranking of the top 15 are reported herein.

Results:	Per Plant Performance			Yield
	No	Kg	Fruit Size, gms	MT/D
Early Girl	68	5.7	83	6.2
UHN-65	41	4.8	117	5.3
Terrefic VFN	39	4.5	115	4.9
Early Summer	40	4.4	110	4.8
Supersonic	32	4.3	81	4.7
Superfantastic	42	4.1	110	4.5
Jet Star	34	3.9	113	4.3
Juice	33	3.3	100	3.6
Floramerica	23	3.1	133	3.4
Marmande VF	28	2.9	102	3.2
RAF	25	2.8	112	3.1
Moira	28	2.7	96	3.0
Jack Pot	20	2.6	130	2.9
Select	23	2.5	109	2.7
Floradade	32	2.4	75	2.6
Ave WY Var	34	3.6	106	4.0
Ave KAF Var(DM)	58	5.3	91	5.5
Ave Farm area	15	2.4	160	2.6

Comparison of same 50 varieties on sprinkler vs. drip with mulch same season at different locations Wadi Yabis and Kafrein.

D.1.

Title: Media Sources Studies, I. Kafrein, 1979-S

Pers: Laila Sarraf, G.A.Marlowe, Jr., R.T. Montgomery

Methods: Twelve combinations involving native volcanic ash, sand imported peat, imported sawdust. Compared to peat-lite imported mix.

10/...

Results: With peat lite mix as 100 % good seedlings, peat 50-sand 50 %; and peat 100 %; and peat 75 % sand 25 % were rated at 87 % good seedlings. Volcanic ash 25 peat 75, volcanic ash 50 and peat 50 produced 70 % as well as the peat-lite mix. Sawdust combinations were very poor in performance.

D.2.

Title: Media Sources Studies II., 1980 F,S.

Pers: Laila Sarraf, G.A. Marlowe,Jr., Kafrein

Methods: Sand local and imported peat combinations were made. The following combinations are presented for final evaluation based on 3 previous studies:

Results:

Per cent Peat-Sand		Peat Liters	Sand Liters	Superphosphate gms	Lime gms	Micr. gms
25	75	6.0	17.0	28	57	2.4
50	50	11.5	11.5	28	57	2.4
75	25	17.0	6.0	28	57	2.4

This provides the basic ingredients for a 25 liter batch. All three give almost the same plant production potential as the imported peat-vermiculite mix. but are slightly heavier in handling weight.

D.3.

Title: Plant Production Source Comparisons, Kafrein 79 F.

Pers: Ali H'modna, G.A.Marlowe,Jr.

Methods: Seedlings grown by the farmer,(bare-rooted) seedlings grown in sterile, soil-less media with and without containerization were grown until the first fruit cluster was set.

Results: The containerized seedlings had higher survival rates (93 %), bare-rooted media 84 %, and farmer grown 66 %. The growth of both media grown seedlings was more uniform and vigorous than the bare rooted plants.

11/...

D.4.

Title: Plant Production Fertilizer Study, Kafrein, 79-F.

Pers: Ali D'Moor, G.A. Marlowe, Jr.

Methods: Four soluble fertilizer combinations at three rates were tested on fall grown containerized tomato seedlings.

Results: Imported calcium nitrate at 53 gms and potassium nitrate at 106 grams per meter of water was superior to eleven other rate and material combinations for stem strength and firmness of root ball, when applied 3x per week. Next best solution was the locally prepared liquid concentrate which should be adequate until high volume production develops. For fairly constant feeding 3-4 per week concentration of solution should not exceed 75 ppm.

D.5.

Title: Plant Production Studies : Time-Labor Requirements, Kafrein 1980 F,S.

Pers: Laila Sarraf, G.A. Marlowe, Jr. R.T. Montgomery, Kafrein 1979.

Methods: Comparisons between Direct Seeded and Seedling Transfer Methods broken down into 3 operations, 8 functions per operations, means 7 worker.

Results: Manual seeding, which could be replaced by mechanical methods, required 4 min 37 sec average per 72 cell flat; whereas, the transfer method required 5 min 30 seconds. The transfer method produced the most uniform seedlings, with fewer blank cells.