

**MICROIRRIGATION FOR SUSTAINABLE VEGETABLE PRODUCTION
IN THE US VIRGIN ISLANDS**



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ABSTRACT

The main water delivery system for crops grown for both research at the University of the Virgin Islands and by many of the territory of the U.S. Virgin Islands farmers is through drip irrigation. During this time there is no water shortage problem; however the US Virgin Islands experiences drought from January through March, normal dry season. Through the use of drip irrigation we have been able to conserve fresh water which is truly a valuable resource.

Chemigation and fertigation through drip irrigation delivers pesticides and fertilizer in the root zone of the plants, respectively. The precision obtained through drip application is safer, more accurate and uses far less material due to the accuracy.

The objectives of the project were to evaluate improved water management practices using microirrigation in selected vegetables and determine varying rates of irrigation on the yield and growth of selected vegetables.

Replicated trials on cucumber, eggplant and tomato were conducted in field plots at the University of the Virgin Islands Agricultural Experiment Station, Albert A. Sheen campus and at the Sejah farm, Kingshill. Water was applied to maintain soil moisture levels equivalent to -0, 40, 60 kPa using tensiometers.

Moisture level -30pka produced highest yield compared to -60pka and -90pka. -90pka moisture level was high and produced low marketable fruits in cucumber. In eggplant, var. 'Hansel' produced highest yield (30.57ton/ha) and lowest in 'Magal' (12.16ton/ha). Spider mites infestation (2-3%) occurred in plots and controlled by miticides. All four varieties of tomato produced marketable fruits. Trial needs to be repeated in order to collect data and results.

The duration of project was short to conduct the detailed research necessary to achieve all the three objectives. Frequent rainfall and insect pests damage was an issue and trial needs to be repeated in order to collect data and results.

Water is a rare commodity on a semiarid island and the Virgin Islands stakeholders are concerned to use this precious resource as efficiently as possible. Drip irrigation has been very beneficial and fertigation and chemigation are new technologies for utilizing a drip irrigation system to apply fertilizer and pesticides. Data being analyzed to determine significance differences among treatments and second trial is planned this year.

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Introduction

The main water delivery system for crops grown for both research at the University of the Virgin Islands and by many of the territory of the U.S. Virgin Islands farmers is through drip irrigation. During this time there is no water shortage problem; however the US Virgin Islands experiences drought from January through March, normal dry season. Through the use of drip irrigation we have been able to conserve fresh water which is truly a valuable resource. Energy required and associated costs to desalinate large quantities of water for farming purposes is truly substantial. Through the use of drip irrigation, researchers and farmers alike have been able to utilize above ground water storage tanks as well as water catchment ponds to store large quantities of rain water in the rainy season.

Problem and Research Objectives

The use of drip irrigation is a great asset when it comes time for the application of fertilizers. Unlike the common local application of granular fertilizer, which is spread around the field or around the base of a sizeable plant, drip irrigation affords the efficiency of applying water soluble fertilizers within inches of a relatively newly planted seedling and throughout the life of the plant. This allows for remediating specific nutrient deficiencies that can occur in local high pH calcareous soils. Chemigation through drip irrigation delivers pesticides in the root zone of the plants. The precision obtained through drip application is safer, more accurate and uses far less material due to the accuracy. Using pesticides such as DuPont Coragen, Venom other commercial pesticides and soluble fertilizers are more efficient use of drip irrigation which saves in labor costs.

Objectives

- a) Develop and evaluate improved water management practices using microirrigation in selected vegetables.
- b) Evaluate the effect of varying rates of irrigation on the yield and growth of selected vegetables.
- c) Determine the minimum water requirements for selected vegetables.

Methodology

- Three experiments were conducted in field plots at the University of the Virgin Islands Agricultural Experiment Station, Albert A. Sheen campus and at the Sejah farm, Kingshill. Cucumber and eggplant trials conducted at the UVI-AES field plot in the growing season of 2012 and tomato trial conducted at Sejah farm, Kingshill in the growing seasons of 2012-2013.
- Seeds, potting trays, potting mix and drip supplies ordered off-island and locally after approval of project and project account establishment.
- An advertisement for the student aid prepared, circulated and applications invited for the position. Interviews conducted and a UVI Undergraduate student Ms. Vernecia Philips was hired. Ms. Philip didn't complete her appointment period, therefore, another student aid Mr. Mark Sinanan of UVI hired.
- Seeds of cucumber var. 'Eureka' planted in 'seedling trays' containing potting mix in the greenhouse. Seedlings were transplanted in the field approximately 10 days after germination.
- An experimental plot (90'x75') selected at the USDA field and cucumber transplants planted in three rows spaced 1.2 m apart, with 12 plants per row spaced at 0.6m along the row. The experimental design was randomized complete blocks, with 3 replications. Standard conventional system applied for the production e.g. fertilizer applications, planting densities and pest control.
Microirrigation: Water was applied to maintain soil moisture levels equivalent to 20, 40, 60 kPa. Tensiometers were placed at a depth of 15 cm, in the middle rows of plots, to monitor soil moisture in the plant root-zone. The irrigation system monitored daily and turned on when tensiometer readings exceed the specified level for each treatment.
- The weather station at the University of the Virgin Islands- Agricultural Experiment Station used to provide the necessary meteorological data for irrigation scheduling.
- Data were collected on rainfall, water used, yield, and other plant characteristics.
- In eggplant, three cultivars ca. 'Nadia', 'Hansel' and 'Magal' were grown in conventional management system at the Agricultural Experiment Station of the University of the

Virgin Islands in St. Croix (Kemble *et.al.*, 1998)

- The experimental design was complete randomized block in three replications. Weed control was done mechanically or with herbicide application.
- Data on plant height, marketable yield and fruit size were recorded.
- At the Sejah farm, field plot (30'x152') selected, cleared and prepared for the tomato experiment. Untreated seeds procured from Harris seeds, NY and planted in compost in the greenhouse and other cultural practices adopted as per National Organic Program (NOP).
- A randomized complete block design with three replication used. Four cultivars of tomato (determinate type) 'Mountain Fresh' (MF), 'Red Defender' (RD), 'Security 28' (SY) and 'Defiant' (DF) used for the experiment. Tomato transplants of all four cultivars (4-5 weeks) planted in the field.
- OMRI listed fertilizers and insecticides ordered and applied. Drip irrigation (low pressure, gravity based) used and water requirement monitored.
- Data on yield (numbers and total weight) and marketable fruits collected from multiple harvests throughout the growing season.

Principal Findings and Significance

- Moisture level -30pka produced highest yield compared to -60pka and -90pka. -90pka moisture level was high and produced low marketable fruits.
- Injecting Malathion, Sevin or Venom on a rotation as needed once the pest reaches levels where they can no longer be controlled using topical application, often bring the situation under control.
- In eggplant, var. 'Hansel' produced highest yield (30.57ton/ha) and lowest in 'Magal' (12.16ton/ha). Average marketable fruits number was higher (14/plant) in 'Hansel'. Spider mites infestation (2-3%) occurred in plots and controlled by miticides.
- All four varieties of tomato produced marketable fruits. Trial needs to be repeated in order to collect data and results.
- In tomato trial, total 18,750 gallon water used in drip irrigation from December 2012 to

March 2013 (Dec. 2012-2400gal, January 2013-4950gal, February 2013-6100gal, March 2013-6300gal).

- Frequent rainfall and insect pests damage was an issue and trial needs to be repeated in order to collect data and results.
- Water is a rare commodity on a semiarid island and the Virgin Islands stakeholders are concerned to use this precious resource as efficiently as possible. Fertigation and chemigation are new technologies for utilizing a drip irrigation system to apply fertilizer and pesticides.

Conclusions

- Drip irrigation has been very beneficial though it has not been easy to get 12 or 15ml drip tape. Regional supplier have only been able to get 8ml and 10 ml low flow drip tape, the 15ml is very difficult to obtain and generally has to be ordered off-island which can be very pricy once shipping to the Virgin Islands is added.
- Frequent rainfall and insect pests damage was an issue in cucumber and trial needs to be repeated in order to collect data and results.
- Water is a rare commodity on a semiarid island and the Virgin Islands stakeholders are concerned to use this precious resource as efficiently as possible. Fertigation and chemigation are new technologies for utilizing a drip irrigation system to apply fertilizer and pesticides.
- The study provided vegetables yield response with respect to irrigation amounts and method of determination of amounts and would be useful to producers for planning purposes and water management of the crops. Data being analyzed to determine significance differences among treatments.

List of Publications and Presentations

1. Nandwani D. Evaluation of sandea for weed control in transplanted eggplant. American Society for Horticultural Science-Southern Region, Orlando, FL, 2013 (poster)

2. A manuscript shall be prepared on tomato after data analysis for submission to peer review journal.

Student Participation

Two student aids worked in the project:

- 1) Vernecia Philips (UVI, Undergraduate)
- 2) Mark Sinanan (UVI, Undergraduate)

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| Soil moisture (pka) | No. of fruits | Total fruit wt. (gm) | Marketable fruits | Marketable fruit wt. (gm) |
|---------------------|---------------|----------------------|-------------------|---------------------------|
| 20 | 126 | 22,016 | 93 | 18701 |
| 40 | 111 | 19,909 | 87 | 17675 |
| 60 | 138 | 26,542 | 111 | 23384 |

| Soil moisture (pka) | Fruit diameter (cm) | Fruit length(cm) |
|---------------------|---------------------|------------------|
| 20 | 3.58 | 11.72 |
| 40 | 3.49 | 12.56 |
| 60 | 3.80 | 12.94 |

Fig.1. Tomato production in drip irrigated plot at the Sejah farm. (Var. MF, 'Mountain Fresh'; RD, 'Red Defender'; SY 'Security 28', DT, 'Defiant')

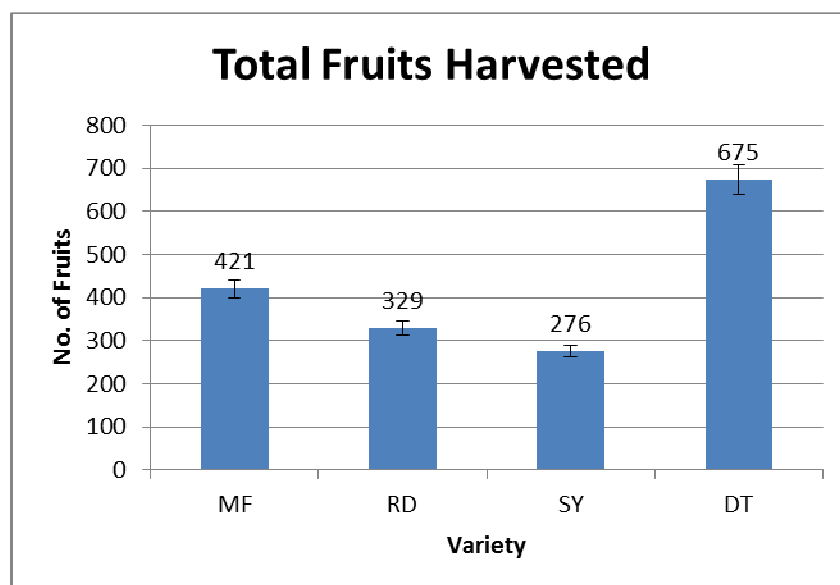


Fig 2. Total fruit weight per plant of four var. of tomato at Sejah farm

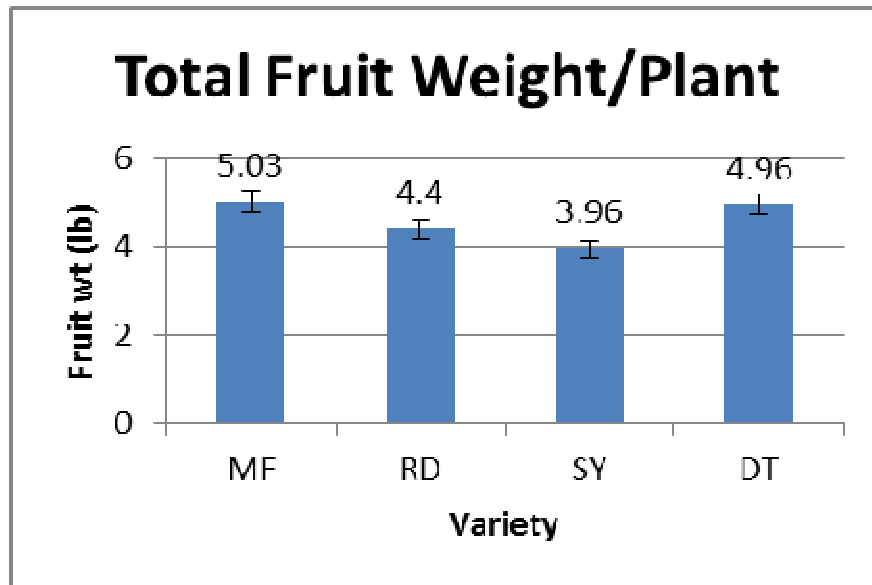
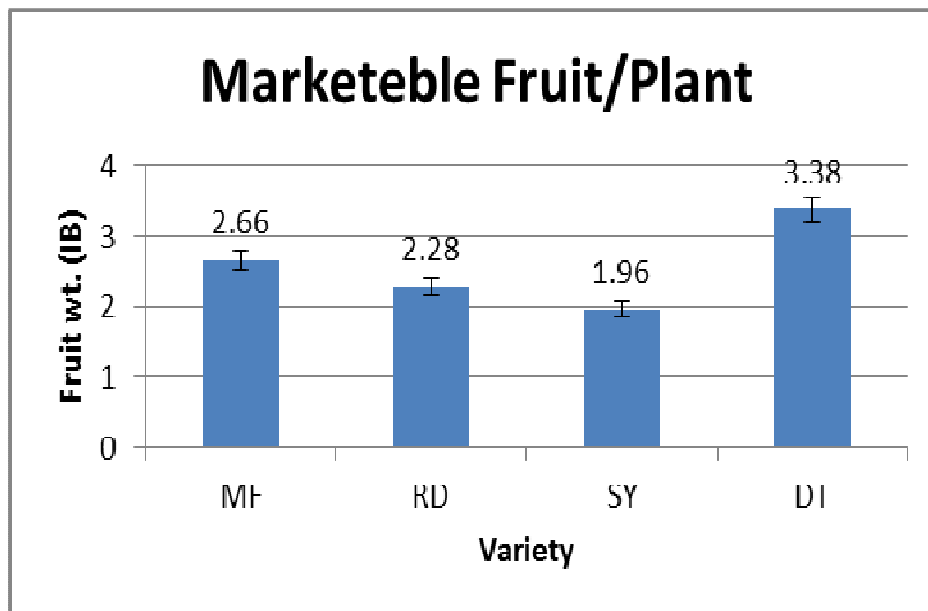
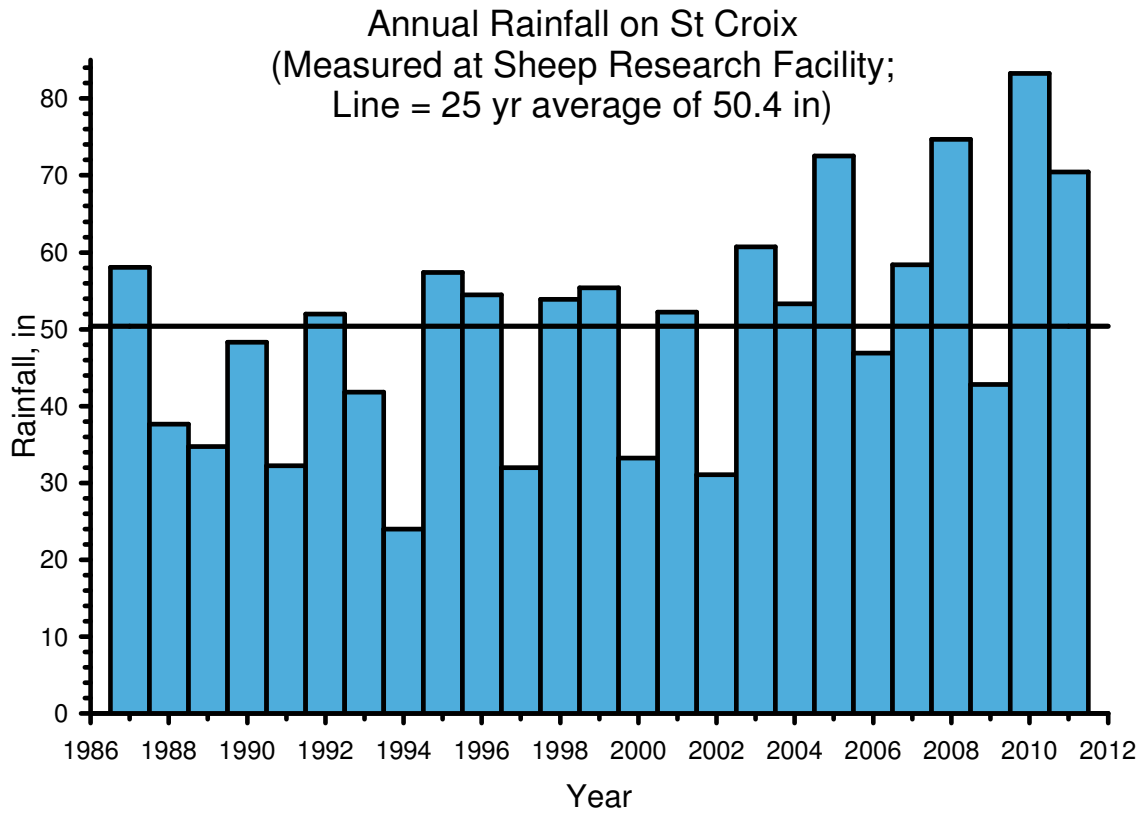


Fig.3. Yield in tomato grown at the Sejah farm







Varying rates of irrigation in cucumber



Soil moisture data (tensiometer) in the field



Eggplant field



Low pressure irrigation in tomato at Sejah farm



Tomato field ready to harvest



Tomato fruit grading and data collection