



# UDC - CAUSES

## Muirkirk Agricultural Experiment Station

### - 2014 Report -

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## Introduction

This report covers the activities carried out on the farm in 2014. The University of the District of Columbia’s Muirkirk Agricultural Research and Demonstration Station has a 143 acres of land of which 12-acres of land are used for various grant projects, educational classes and demonstrations, and soon, commercial production. The grant projects include a Specialty Crop Project from the USDA, which entails vegetable production, hydroponics production, and community outreach. The Ethnic Crops grant from SARE, funds the production and marketing of various West African native crops. This report includes yields of specialty and ethnic crops grown on the farm that includes yield data.

The Aquaponic and Hydroponics systems are the new projects launched this year and they are installed by different companies. The Aquaponic system was installed by the Burdette industries Inc., while the Hydroponics system is installed by Mr. Peter Forbes - a private entrepreneur. The trials of both systems is underway at the farm and in progress though there are constraints The .fish smoke house installation has also started in the administration building that is not completed.

The electric systems connection to the solar well and heating systems to the buildings on the farm has started by contractors and started working effectively this year. However, connection of the power to the Aquaponic trail and newly constructed Aquaponic hoop houses is underway. The contractors installed two generators on the farm site in order to solve problems of power outage.

Purple Mount Organics contracted to try rice production funded by USDA on the farm this year and implemented the project. Please contact Purple Mount for more information.

In an open space in the Orchard site a Pavilion was constructed on the farm to be used by visitors, students, guests and Bread for the City Staffs, and UDC staffs.

The urban forestry trial is also one of the new projects that has started at the farm this year too. This was started by Mr. Peter where different tree species were planted as stated in the report.

Constructions were performed where three additional hoop houses are constructed this year of which one is for hydroponics system demonstration and the other two for Aquaponic systems demonstration purposes. A Trailer for the third Aquaponic structure was installed around the administration building . Two additional hoop houses were constructed adjacent to the Aquaponic trailer. For power emergency situations two generators were installed on the research farm to avoid discrepancies in power utilization on the facility. Solar well started full operations this year in the fields as well as in the hoop houses by using drip irrigation systems and found effective. The two refrigerators installed

in the administration building were used to store harvested vegetables and fruits effectively this year.



**Figure 1. Approximate layout of Muirkirk Agricultural Experiment Station**

The above picture is a satellite image superimposed with color-coded shapes representing the various structures on the property. The yellow shapes indicate production areas (fields); the green shapes are growing enclosures, such as the hydroponics greenhouse. The red shapes are buildings such as the classroom, Administration building and sheds. Not shown are three new hoop houses, two for Aquaponic systems and one for a new hydroponics system.

Some of the key areas of the farm are labeled.

1. Rice Fields (managed by Purple Mountain Organics)
2. Hoop Houses
3. Training Trailer
4. Micro greens Hoop House
5. Seedling Hoop House
6. Aquaponic Hoop House
7. Hydroponics Greenhouse
8. Bio-intensive Demonstration Boxes
9. Fenced Area (managed by Purple Mountain Organics)
10. USDA Fields (managed by Purple Mountain Organics)
11. Ethnic Crops Field

- 12. Urban Forestry Area
- 13. Orchard
- 14. Administration Building

## 1: New Additions and Improvements

In 2014 calendar year, several new facilities were constructed on the farm. During this year, the two Aquaponic facilities installed in the small hoop house and in Green house last year became functional, with a total combined water volume of 1,200 gallons in 4 Tanks. The Solar Well also became operational this year, supplying drip irrigation lines in the hoop houses and fields.

### 1.1 Additional Aquaponic and Hydroponics Hoop Houses

Three new hoop houses were constructed this year. Two of the new hoop houses are for Aquaponic system while the other one is for a new hydroponics production system. In addition one trailer with a new Aquaponic production system is installed around the administration building along with two new hoop house for Aquaponic system demonstration purposes as shown below in figures 2 and 3.



**Figure 2. New Aquaponic Facilities**



**Figure 3. Aquaponic Production System**



**Figure 4. New Hydroponics System Facility**

## **1.2 New Equipment**

A new bedder and potato harvester were also purchased for use on the farm.

## **1.3 Additions and Improvements to Administration Building**

Improvements were also made to the Administration Building. Two new refrigeration rooms were installed to store harvested vegetables and fruits, and a Soil Sample Preparation Lab is currently being added to the building as shown in figures 5 and 6. Installation of fish smoke house is underway in the administration building.



**Figure 5. Refrigeration Rooms**



**Figure 6. Soil Sample Preparation Lab**

The office space of the building was also improved with a new floor and renovated bathrooms as shown in figure 7 below.



**Figure 7. Improved Office Area**

## **1.4 Generators**

Two generators were purchased and installed at the farm for emergency power outages. One was installed between the Micro greens and Seedling hoop houses as shown in figure 8 below. The second one is installed behind the administration building for the refrigerators and Aquaponic system operation around it.



**Figure 8. Back Up Generator**

## 1.5 Pavilion

A new pavilion for events was also erected within the fenced area near the orchard as shown in figure 9 below.



Figure 9. New Pavilion

## 2: Crop Production

### 2.1 Seedling Production

As many of the crops, particularly in the hoop houses, are hand-transplanted, seedling production is an important function of the farm. The table 1 below lists the information available of the crops started on the farm in the seedling hoop house.

Table 1. Seedling Production

| Date Seeded | Crop                  | Variety         | Number of Trays | Number of Seedlings |
|-------------|-----------------------|-----------------|-----------------|---------------------|
| 3/14/11     | Mini Broccoli         |                 | 11              | 550                 |
| 3/10/14     | Hybrid White Eggplant | Gretel F1       | 5               | 250                 |
| 3/10/14     | Hybrid Bell Peppers   | Ace F1          | 5               | 250                 |
| 3/10/14     | Hybrid Hot Peppers    | Havasus F1      | 5               | 250                 |
| 3/11/14     | Red Romaine Lettuce   | Red Rosie       | 4               | 200                 |
|             | Green & Brown Bell    |                 |                 |                     |
| 3/11/14     | Pepper                | Sweet Chocolate | 9               | 450                 |
| 3/11/14     | Bunching Onions       | Deep Purple     | 2               | 100                 |
| 3/11/14     | Bunching Onions       | White Spear     | 1               | 50                  |

|         |                        |                    |    |      |
|---------|------------------------|--------------------|----|------|
| 3/11/14 | Hybrid Eggplant, Pink  | Orient Charm F1    | 5  | 250  |
|         | Hybrid Eggplant, Dark  |                    |    |      |
| 3/11/14 | Purple/Black           | Hansel F1          | 4  | 200  |
| 3/11/14 | Red Leaf Lettuce       | Ruby Sky           | 7  | 350  |
| 3/11/14 | Sweet Peppers          | Antohi Romania     | 11 | 550  |
| 3/11/14 | Collards               | Champion           | 6  | 300  |
| 3/12/14 | Hybrid Pac Choi        | Black Summer F1    | 3  | 150  |
| 3/12/14 | Hybrid Eggplant, Pink  | Orient Charm F1    | 4  | 200  |
| 3/13/14 | Sweet Basil            |                    | 8  | 400  |
| 3/13/14 | Artichoke              | Imperial Star      | 9  | 450  |
| 3/13/14 | Bunching Onions        | Deep Purple        | 6  | 300  |
| 3/14/14 | Bunching Onions        | Deep Purple        | 4  | 200  |
| 3/18/14 | Sweet Pimento Pepper   | Lipstick           | 2  | 100  |
| 3/18/14 | Bunching Onions        | Deep Purple        | 1  | 50   |
| 3/18/14 | Hybrid Hot Peppers     | Havasu F1          | 5  | 250  |
| 3/18/14 | Sweet Peppers          | Antohi Romania     | 8  | 400  |
| 3/21/14 | Rue                    |                    | 1  | 50   |
|         | Green & Brown Bell     |                    |    |      |
| 4/8/14  | Pepper                 | Sweet Chocolate    | 7  | 350  |
| 4/8/14  | Red Romaine Lettuce    | Red Rosie          | 3  | 150  |
| 4/8/14  | Hybrid Bell Peppers    | Ace F1             | 13 | 650  |
| 4/8/14  | Holy Basil             |                    | 1  | 50   |
| 4/8/14  | Sweet Pimento Pepper   | Lipstick           | 5  | 250  |
| 4/15/14 | Edamame                |                    | 1  | 50   |
| 4/22/14 | Salsa Pepper           |                    | 2  | 100  |
| 4/22/14 | Peruvian Banana Pepper |                    | 10 | 500  |
| 4/22/14 | Hot Pepper             | Chinese Five Color | 13 | 650  |
|         |                        | Bloomsdale         |    |      |
| 8/14/14 | Spinach                | Longstanding       | 9  | 450  |
|         |                        | Bloomsdale         |    |      |
| 8/15/14 | Spinach                | Longstanding       | 11 | 550  |
| 8/15/14 | Kale                   | Siberian Dwarf     | 20 | 1000 |
| 8/15/14 | Collards               | Morris Heading     | 20 | 1000 |
| 8/20/14 | Kale                   | Toscana            | 20 | 1000 |
| 8/20/14 | Asian Greens           | Tatsoi             | 10 | 500  |
| 8/21/14 | Asian Greens           | Tatsoi             | 10 | 500  |
| 8/25/14 | Mustard Greens         | Red Giant          | 20 | 1000 |
| 8/25/14 | Collards               | Morris Heading     | 1  | 50   |
| 9/8/14  | Kale                   | Toscana            | 10 | 500  |
| 9/8/14  | Mustard Greens         | Red Giant          | 10 | 500  |
| 9/8/14  | Asian Greens           | Tatsoi             | 5  | 250  |
| 9/9/14  | Asian Greens           | Tatsoi             | 5  | 250  |
| 9/15/14 | Collards               | Morris Heading     | 4  | 200  |

## 2.2 Actual crop harvest data

All crop information for this year was compiled through a web database AgSquared. The following table is a compilation of all the crop and harvest data recorded in AgSquared.

Table 2. Harvest Amounts for All Crops

| <b>Crop</b>  | <b>Variety</b>         | <b>Actual Harvest to Date (lbs)</b> |
|--------------|------------------------|-------------------------------------|
| Acorn Squash | Tiptop                 | 183                                 |
| Apple        | Gold Rush              | 0                                   |
| Apple        | Enterprise             | 19                                  |
| Apple        | Crimson Topaz          | 0                                   |
| Apple        | Crimson Gold           | 1621                                |
| Artichoke    | Imperial star          | 18.5                                |
| Asian Greens | Tatsoi                 | 3.25                                |
| Asian Pears  | Unknown                | 1529                                |
| Asparagus    |                        |                                     |
| Bean         | Green                  | 18.48                               |
| Asparagus    |                        |                                     |
| Bean         | Red                    | 27.03                               |
| Basil        | Holy Basil             | 10                                  |
| Basil        | Sweet Basil            | 46                                  |
| Basil        | Purple Basil           | 8                                   |
| Basil        | Hydroponic - Float 7/4 | 38.6 kg                             |
| Basil        | Hydroponic - NFT 6/30  | 15 kg                               |
| Beans        | Yellow String Beans    | 0                                   |
| Beans        | Black Garbanzo         | 0                                   |
| Beans        | Purple Field Peas      | 13                                  |
| Beans        | Lima                   | 0                                   |
| Beans        | Black eyed peas        | 15                                  |
| Beans        | Bush Beans             | 91.5                                |
| Beets        | Unknown                | 0                                   |
| Bell Pepper  | Star Sweet             | 0                                   |
| Bell Pepper  | Sweet Chocolate        | 428.25                              |
| Bell Pepper  | Lafayette Golden       | 63.5                                |
| Bell Pepper  | California Wonder 2    | 0                                   |
| Bell Pepper  | Ace                    | 400.03                              |
| Bell Pepper  | Antohi Romanian        | 0                                   |
| Bell Pepper  | California Wonder      | 124                                 |
| Bhut Jolokia | Ghost Pepper           | 0                                   |
| Blackberries | Unknown                | 379.25                              |
| Blueberry    | Blue Ray               | 8.5                                 |
| Blueberry    | Jersey                 | 0                                   |
| Blueberry    | Blueridge              | 0                                   |
| Broccoli     | Belstar                | 409.75                              |
| Broccoli     | Packman                | 6                                   |
| Broccoli     | Purple peacock         | 187                                 |
| Bunching     |                        |                                     |
| Onion        | Deep Purple            | 8                                   |
| Cabbage      | Napa                   | 42.75                               |
| Cantaloupe   | Unknown                | 0                                   |

|                     |                                  |         |
|---------------------|----------------------------------|---------|
| Carrot              | Unknown                          | 0       |
| Carrot              | Purple                           | 2.5     |
| Cayenne<br>Pepper   | Red Rocket                       | 72.95   |
| Collards            | Champion                         | 0       |
| Collards            | Hydroponic - Float<br>(Champion) | 6 kg    |
| Collards            | Morris Heading                   | 297.25  |
| Corn                | Sweet Corn                       | 35      |
| Cucumber            | Hydroponic - Bucket 8/15         | 27 kg   |
| Cucumber            | Marketmore                       | 455.25  |
| Cucumber            | Hydroponic - Bucket 6/15         | 7.5 kg  |
| Denya               | Orange                           | 0       |
| Eggplant            | Galine (bell)                    | 99      |
| Eggplant            | Japanese Long                    | 411.75  |
| Eggplant            | Burkina Faso                     | 20      |
| Eggplant            | Rosa Bianca                      | 56      |
| Garden Egg          | Garden Egg                       | 237     |
| Gboma               | Gboma                            | 149     |
| Hibiscus            | Sawa Sawa                        | 5       |
| Hot Pepper          | Pimento                          | 0       |
| Hot Pepper          | Havasu                           | 527.4   |
| Hot Pepper          | Peruvian Banana                  | 0       |
| Hot Pepper          | Chinese Five Color               | 159.06  |
| Jalapeño            | Early                            | 176.5   |
| Jute                | Hydroponic - Ebb 8/25            | 4 kg    |
| Jute                | Hydroponic - Ebb 6/15            | 7 kg    |
| Kale                | Siberian Dwarf                   | 0.75    |
| Kale                | Red Russian                      | 0       |
| Kale                | Toscana                          | 0       |
| Kitely              | Kitely                           | 0       |
| Lettuce             | Hydroponic - Float 9/15          | 12 kg   |
| Lettuce             | Hydroponic - NFT 9/20            | 0       |
| Lettuce             | Hydroponic - NFT 6/15            | 12 kg   |
| Lettuce             | Hydroponic - Float 7/4           | 38.6 kg |
| Lettuce             | Hydroponic - NFT 7/22            | 14 kg   |
| Mustard<br>Greens   | Red Giant                        | 0       |
| Okra                | Corozal                          | 0       |
| Okra                | Clemson spineless                | 467.5   |
| Okra                | Cameroon                         | 5       |
| Onion               | Hydroponic - Bucket 6/1          | 5.55 kg |
| Pac Choi            | Black Summer                     | 0       |
| Parsley             | Flatleaf                         | 4       |
| Pumpkin             | Roy's Pumpkins                   | 0       |
| Red Leaf<br>Lettuce | Ruby Sky                         | 0       |
| Red Romaine         | Red Rosie                        | 0       |

|              |                            |        |
|--------------|----------------------------|--------|
| Rice         | Koshihikari 1              | 0      |
| Rice         | Koshihikari 2              | 0      |
| Rice         | Duborskian 1               | 0      |
| Rice         | Duborskian 2               | 0      |
| Spinach      | Bloomsdale Longstanding    | 0      |
| Squash       | Sweet Dumpling             | 134    |
| Strawberry   | Everbearing                | 350.05 |
| Suhum Sweet  | Suhum Sweet                | 0      |
| Sweet Pepper | Lunchbox                   | 271    |
| Sweet Pepper | Carmen                     | 161    |
| Sweet Pepper | Sweet Sunrise              | 123.5  |
| Sweet Pepper | Antohi Romania             | 164.06 |
| Sweet Potato | PMO B                      | 607    |
| Sweet Potato | Beauregard                 | 376    |
| Sweet Potato | PMO D                      | 418    |
| Sweet Potato | Porto Rico (Xavier)        | 548    |
| Sweet Potato | Porto Rico B               | 0      |
| Sweet Potato | Ginseng                    | 211    |
| Sweet Potato | Unknown B                  | 144.5  |
| Sweet Potato | PMO C                      | 872    |
| Sweet Potato | Jersey White               | 149    |
| Sweet Potato | Hernandez                  | 322    |
| Sweet Potato | Carolina Nugget            | 166    |
| Sweet Potato | Porto Rico C               | 29     |
| Sweet White  | Sweet White                | 0      |
| Swiss Chard  | Hydroponic - Bright Lights | 3 kg   |
| Swiss Chard  | Green                      | 18.48  |
| Swiss Chard  | Bright Lights              | 53.75  |
| Tilapia      | Tilapia                    | 501    |
| Togovi       | Choco                      | 0      |
| Tomato       | Unknown                    | 0      |
| Tomato       | Jet Star                   | 0      |
| Tomato       | BHN 589                    | 14     |
| Tomato       | Big Beef                   | 0      |
| Tomato       | Yellow Plum                | 143.35 |
| Tomato       | Hydroponic - Bucket 8/15   | 27 kg  |
| Tomato       | Green Zebra                | 13.75  |
| Tomato       | Roma                       | 0      |
| Tomato       | Early Girl                 | 0      |
| Tomato       | Super Sweet 100            | 42     |
| Tomato       | Plum Dandy                 | 100.16 |
| Tomato       | Celebrity                  | 35.3   |
| Tomato       | Great White                | 102    |
| Tomato       | Mixed                      | 6.25   |
| Tomato       | Beefmaster                 | 0      |
| Tomato       | Better Boy                 | 0      |
| Tomato       | Yellow Grape               | 116.75 |

|            |                         |         |
|------------|-------------------------|---------|
| Tomato     | Primo Red               | 229.25  |
| Tomato     | Mariana                 | 797.39  |
| Tomato     | BHN 268                 | 159.95  |
| Tomato     | Hydroponic - Bucket 6/1 | 5.55 kg |
| Water Leaf | Hydroponic - Ebb 9/25   | 0       |
| Water Leaf | Waterleaf               | 59      |
| Water Leaf | Hydroponic - Ebb 6/15   | 7 kg    |
| Watermelon | Early Moonbeam          | 2054    |
| Watermelon | Sugar baby              | 869     |
| Zucchini   | Costata Romanesco       | 673     |

The zero values in the table indicate that no harvest records are available. In some cases people come in for tour or visit and pick crops and leave without giving the information. At times crops are picked on weekends and no record for that. The harvest values represent only those documented; actual harvests may have been higher than recorded in the table. Also, if the variety of a crop was not indicated on a harvest form and multiple varieties are available, the harvest information was recorded under the variety that appears first in AgSquared. For example, not all of the apples were identified by variety and thus the harvests were logged under Crimson Gold.

## 2.3 Specialty Crops Grant

This is a grant offered by USDA in order to grow different vegetable crops on the farm.

### 2.3.a Crop Catalogue - Summer 2014 Season

Several types of peppers were grown for the Specialty Crops grant. Some were planted in the hoop houses while others were planted in the fields. Different crops Grown in the summer of 2014 are shown below.

- *Bell Peppers*

Two varieties of bell peppers were grown in the hoop houses under the Specialty Crop grant: Ace F1 and Sweet Chocolate. Of the two, Sweet Chocolate produced larger yields and larger fruits. Purple Mountain also grew Sweet Sunrise, Lafayette Golden, California Wonder and North Star Sweet in the field as shown in fig. 10 -15.



Figure 10. Ace F1

Figure 11. Sweet Chocolate



Figure 12. Sweet Sunrise (image from johnnyseeds.com)



Figure 13. Lafayette Golden (image from syngenta.com)



Figure 14. California Wonder (image from burpee.com)



Figure 15. North Star Sweet (image from seminis.com)

- *Hot Peppers*

The Havasu F1 hot peppers were grown in the hoop houses and were very high yielding. The fruit's "spiciness" is comparable to that of a jalapeño. The cayenne and

jalapeños were grown in the field by Purple Mountain Organics. It performed very well in the hoop houses. See fig. 16-18.



**Figure 16. Havasu F1**

**Figure 17. Cayenne (Red Rocket)**



**Figure 18. Jalapeño**

- *Sweet Peppers*

Antohti Romania sweet peppers look very much like the hot Havasu peppers, though their taste is very different. These peppers were produced in the hoop houses while the Lunchbox and Carmen peppers were grown in the field. See figures 19-21 .



**Figure 19. Antohi Romania**

**Figure 20. Lunchbox**



**Figure 21. Carmen (image from johnnyseeds.com)**

- *Tomatoes*

All of the tomatoes were grown in the hoop houses. Due to confusion in labeling, not all of the variety types were identified. Those that were identified are shown below on fig. 22 to fig.31.



**Figure 22. BHN 268**

**Figure 23. Celebrity Supreme**



**Figure 24. Great White**

**Figure 25. Green Zebra**



**Figure 26. Mariana**

**Figure 27. Plum Dandy**



Figure 28. Primo Red

Figure 29. Super Sweet 100



Figure 30. Yellow Grape

Figure 31. Yellow Plum

- *Eggplant*

Several types of eggplants were grown at the farm. The Gretel and Orient Charm varieties were grown in the Biointensive demonstration area produced well. The Japanese Long and Rosa Bianca varieties were grown in the fields. See figures 32-36.



Figure 32. Gretel F1

Figure 33. Japanese Long



Figure 34. Orient Charm



Figure 35. Rosa Bianca (image from johnnyseeds.com)



Figure 36. Galine (image from johnnyseeds.com)

- *Squash*

Purple Mountain Organics produced two varieties of Acorn squashes in the field: Sweet Dumpling and Tip Top, see figures 37 and 38



Figure 37. Sweet Dumpling

Figure 38. Tip Top

- *Okra*

Purple Mountain Organics grew Clemson Spineless Okra in the field. See figure 39 below.



Figure 39. Clemson Spineless

- *Basil*

Basil was produced at various locations around the farm, including the hoop houses, the Biointensive demonstration box area and in the fields. Purple Basil and Sweet Basil are the two varieties grown on the farm as shown in fig. 40 and 41 below.



Figure 40. Purple Basil

Figure 41. Sweet Basil

- *Watermelon*

The two watermelon varieties grown by Purple Mountain Organics in the field were Sugar Baby and Early Moonbeam as shown in fig. 42 and 43 below.



Figure 42. Sugar Baby (image from johnnyseeds.com)



Figure 43. Early Moonbeam (image from rareseeds.com)

- *Zucchini*

The zucchini variety grown in the field was Costata Romanesco as shown in fig.44 below.



**Figure 44. Costata Romanesco**

- *Broccoli*

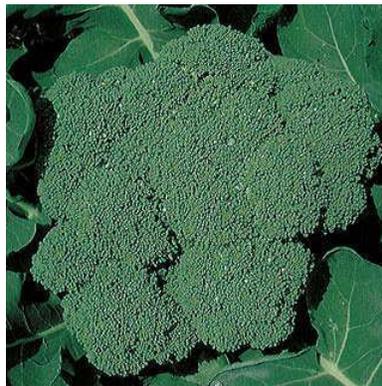
Three different varieties of broccoli were grown in the fields: Belstar, Purple Peacock, and Packman as shown in fig. 45 to 47



**Figure 45. Belstar** (image from johnnyseeds.com)



**Figure 46. Purple Peacock** (image from superseeds.com)



**Figure 47. Packman** (image from parkseed.com)

- *Cucumber*

The only variety of cucumber produced in the field was Marketmore, see figure 48.



**Figure 48. Marketmore** (image from johnnyseeds.com)

- *Chinese Cabbage*

Chinese cabbage was also grown in the field though the variety is not known. See figure 49.



**Figure 49. Chinese Cabbage (Rubicon variety shown)** (image from johnnyseeds.com)

### **2.3.b Crop Catalogue - Fall 2014 Season**

All of the Fall crops under the Specialty Crop grant were grown in the hoop houses. Crops grown in the hoop houses in Fall season are Mustard Greens, Collard Greens, Tatsoi, Kale, and Spinach.

- *Mustard Greens*

Mustard Greens performed very well in the hoop houses. The variety is red giant. It is a spicy leafy vegetable that will add a kick to your salad. See figure 50 below.



**Figure 50. Red Giant**

- *Kale*

Two different types of Kale were grown in the hoop houses under the USDA grant this Fall Season. Siberian dwarf and Toscano are the two varieties grown. See figures 51-52.



**Figure 51. Siberian**

**Figure 52. Toscano**

- *Collard Greens*

Collard Green (Morris Head Long) was the variety chosen for this year.



**Figure 53. Morris Heading**

- *Tatsoi*

Tatsoi (Asian Greens) is a favorite amongst volunteers and staff. Leafy Asian Greens is a variety. It performed very well in the hoop houses. See figure 54.



**Figure 54. Tatsoi - Asian Greens**

- *Spinach*

Spinach (Bloomsdale) did not perform well in the hoop house as well as in the biointensive boxes. . Bloomsdale Longstanding is the variety grown in the hoop house in Fall. See figure 55 below.



Figure 55. Bloomsdale Longstanding

### 2.3.c Yield and Harvest Estimates/ Actual Harvests

Several plants of each variety grown in the hoop houses were designated as sample plants. These plants were harvested several times during the season and their yields recorded. Harvest and yield estimates were calculated using the information from these plants. The following table lists the harvest estimates in pounds and the yield estimate in pounds/acre.

| <b>Crop - Variety</b>           | <b>Harvest estimate (lbs)</b> | <b>Yield Estimate (lbs/ac)</b> |
|---------------------------------|-------------------------------|--------------------------------|
| Bell Pepper - Ace               | 556                           | 93929                          |
| Bell Pepper - Sweet Chocolate   | 565                           | 197447                         |
| Hot Pepper - Chinese Five Color | 208                           | 5980                           |
| Hot Pepper - Havasu             | 2910                          | 148156                         |
| Sweet Pepper - Antohi Romania   | 688                           | 159586                         |
| Tomato - BHN 268                | 374                           | 197472                         |
| Tomato - Celebrity              | 68                            | 98954                          |
| Tomato - Great White            | 706                           | 163979                         |
| Tomato - Mariana                | 1347                          | 90341                          |
| Tomato - Plum Dandy             | 346                           | 279161                         |
| Tomato - Primo Red              | 542                           | 155743                         |
| Tomato - Super sweet 100        | 55                            | 33275                          |
| Tomato - Yellow Grape           | 175                           | 74735                          |
| Tomato - Yellow Plum            | 93                            | 71072                          |

Table 3. Harvest and Yield Estimates

- *Peppers*

By graphing the yield estimates of the peppers, we see that the Sweet Chocolate Bell Peppers had the highest yield estimate of almost 200,000 lbs/ac. See figure 56 below.

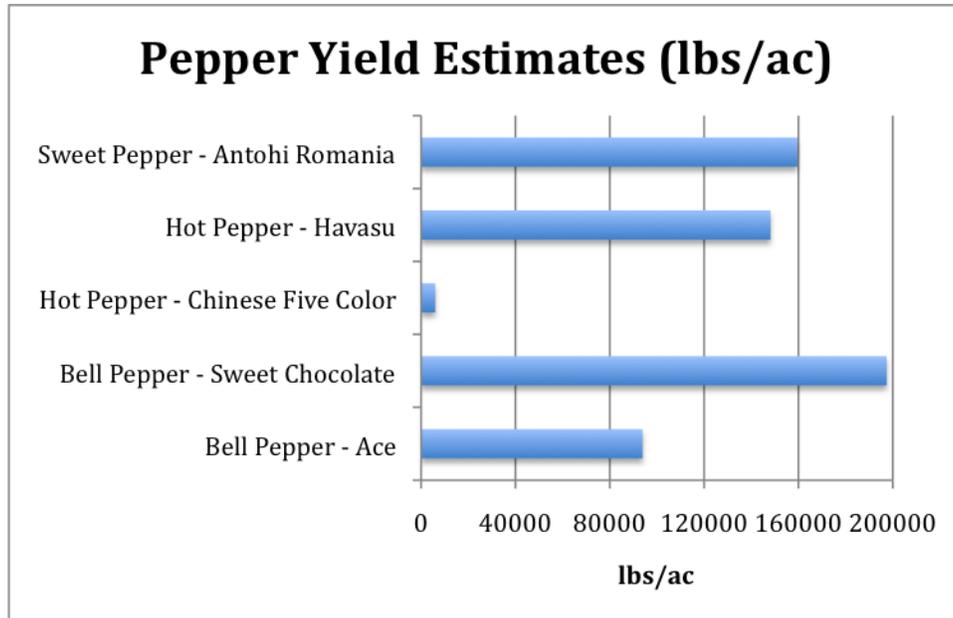


Figure 56. Pepper Yield Estimates

Note that the figure 56 peppers yield estimate unit is pounds/acre and not fruits/acre, meaning that even though bell peppers may give fewer fruits, they are often larger and heavier than those given by say, Havasu plants. Figure 57 below shows the estimated number of fruits on each plant.

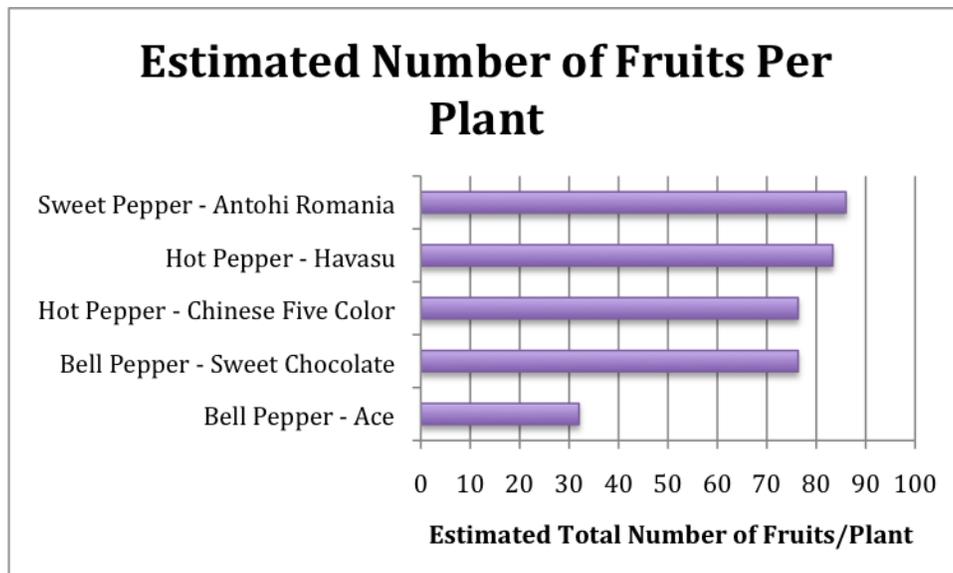


Figure 57. Estimated Number of Fruits Per Plant

The estimated harvest is number of pounds that could have been produced here on the farm. The following table shows the estimates in comparison with the documented total harvests.

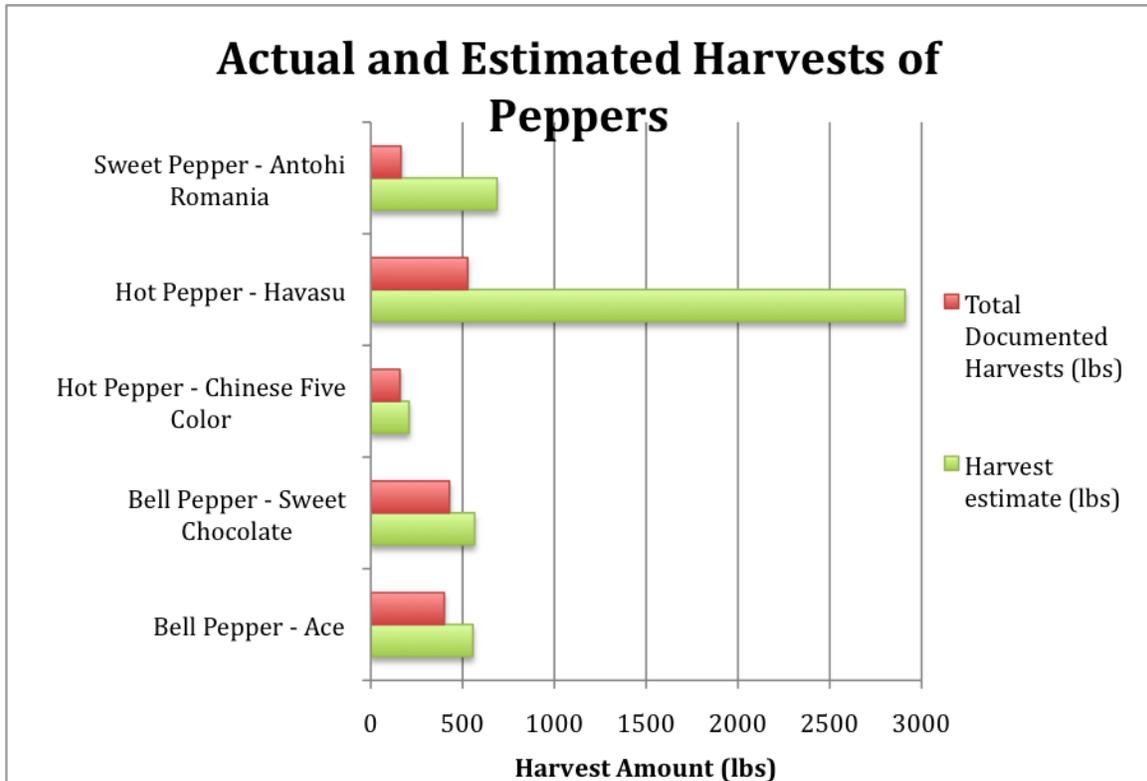


Figure 58. Actual versus Estimated Harvests

For each of the varieties the actual amount harvested is lower than the estimated amount, particularly with the Havasu peppers. This could be for several reasons:

1. Not all harvests were documented.
2. Most of the plants were not harvested on a regular basis, which caused some fruits to rot and some plants to tip.
3. For the Antohi Romania and Havasu peppers, which are very similar in appearance, the plants may have been misidentified on labels and documented harvests.

The Chinese Five Color plants were harvested all at once, which is why its actual harvest is close to the estimated harvest.

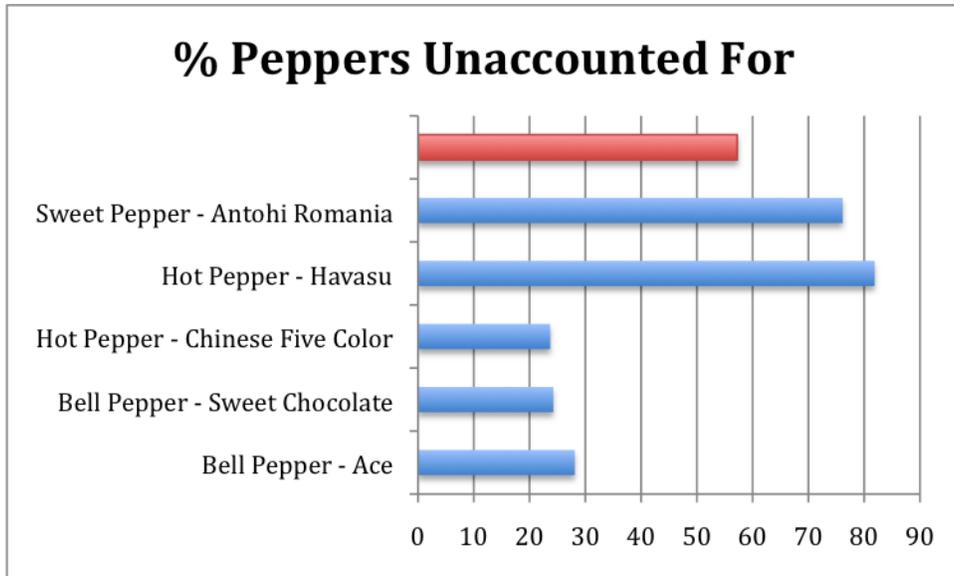


Figure 59. Percent of Pepper Harvest Estimate Unaccounted For

On average for the peppers, 47% of the harvest estimates were unaccounted for. This high percentage indicates a strong need for better data management methods and crop management practices; including labeling, record keeping, and timely harvests.

- *Tomatoes*

The number of fruits were not counted for some of the tomato varieties, particularly those with large amounts of small fruits like Yellow Grape, thus weight is the only parameter used for comparison.

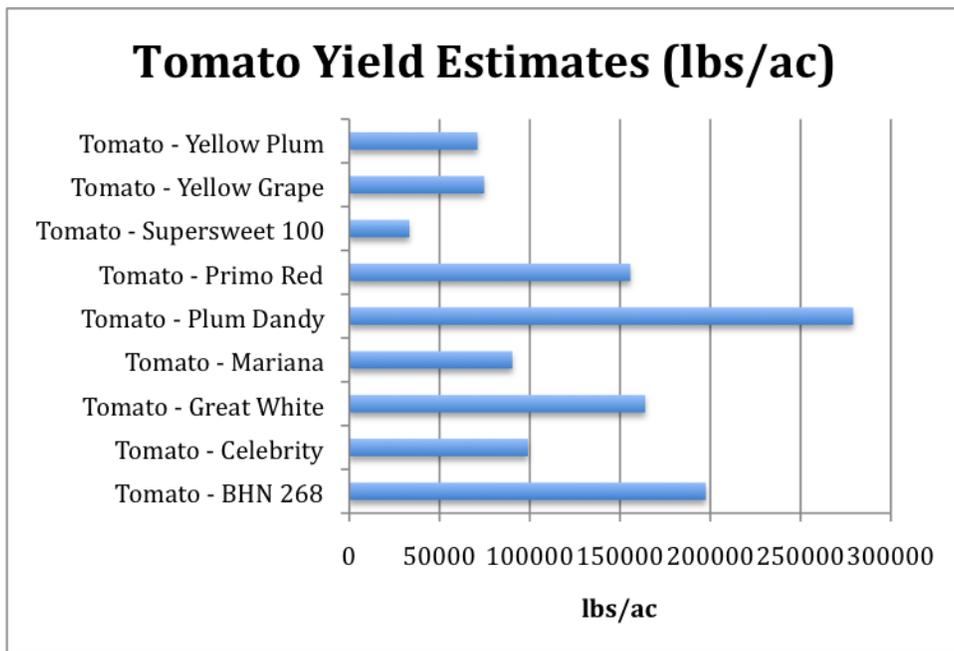


Figure 60. Tomato Yield Estimates

Of the varieties, Great White produces the largest sized fruit, yet it does not have the highest yield estimate. Some of the yield estimates may actually be low because improper spacing affected crop performance.

The harvest estimate is the estimated amount of pounds of fruit the farm could have produced. Involved in this estimate are the:

1. Number of plants of each variety
2. Average harvest in pounds per plant
3. Estimated number of harvests per season (five).

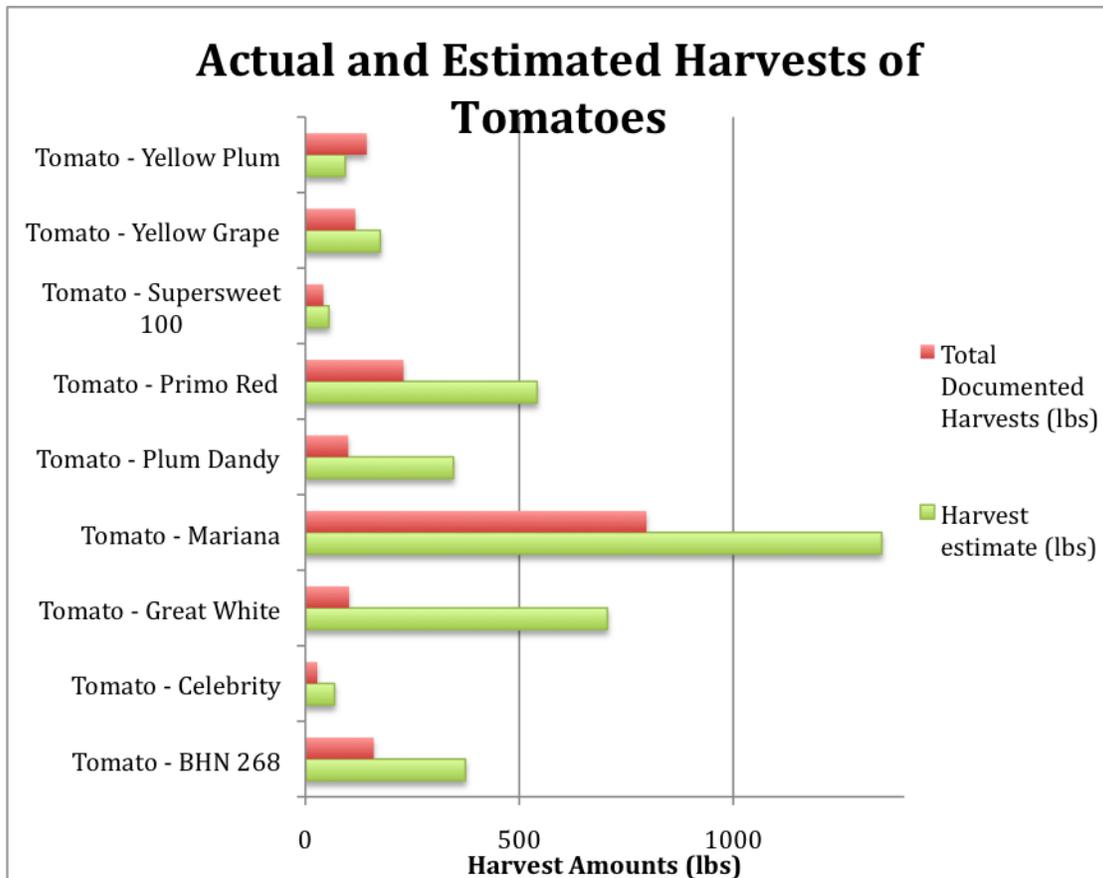


Figure 61. Actual versus Estimated Harvests of Tomatoes

Once again as with the peppers, the documented harvest amounts were less than the expected amounts as shown above.

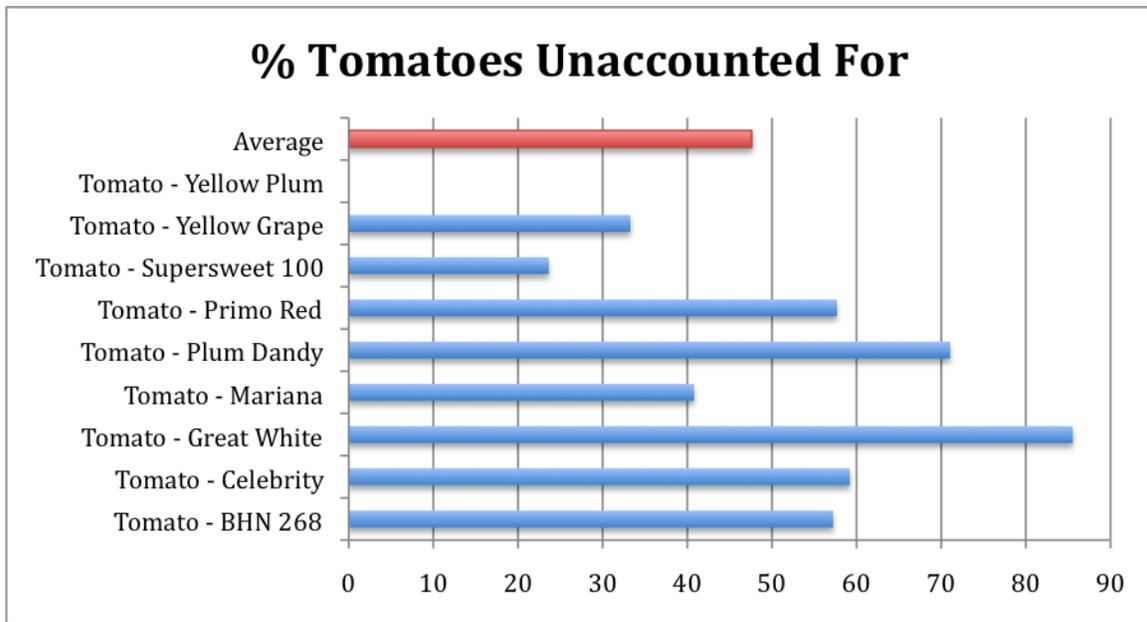


Figure 62. Percent of Tomato Harvest Estimate Unaccounted For

One of the varieties, Yellow Plum, actually performed better than estimated, though the average of the possible tomato harvest was unaccounted for was 48%. Again, there may be several reasons why the plants did not perform as well as estimated:

1. Not all harvests were documented.
2. The plants were not harvested regularly and some of the fruit rotted.
3. Some of the varieties did not mature as expected, possibly due to lack of pollination and too-tight spacing.

### *Discussion on Methodology*

There are two approaches to estimating harvests and yields, by using either individual sample plants or sample areas. Each has benefits and drawbacks.

### *Sample Plants*

This method bases estimations on harvests taken from specific, individual sample plants. On the farm, sample plants were marked with flags and, in the hoop houses, three plants per variety per row were designated as sample plants.

Using this method worked in the hoop houses because all of the plants were hand-transplanted and the number of plants planted was known. Designating sample plants at different locations along each row also helps account for differences in the soil (particularly compost content) in the estimates. There are however, several difficulties with this approach.

Depending on the number of different varieties, the number of rows, and the number of different varieties within a row, this method can be fairly labor intensive and tedious. Samples have to be kept in different containers and carefully labeled. Data can also

be misleading if one of the sample plants dies, or if unauthorized people harvest from the sample plants.

### *Sample Areas*

Using sample areas is another way to calculate yield and harvest estimates. Instead of marking individual plants as samples, spaces of a row area designated, all with same area. For example, one row may have three spaces of three square feet each marked off for sampling. This method works well in rows where the crop is direct seeded or broadcast. A benefit of this method is that you can get a direct yield estimate in pounds per unit area. For the harvest estimation, you'd have to know the total area planted, which can sometimes be harder to measure than counting the number of plants. For the sake of accounting for variations in soil in a row or field, the larger the planting area, the more sample areas needed to get more accurate estimations.

Again, unauthorized harvesting of plants within the sample area is a problem. Close attention has to be paid to the spacing of each crop. For example, in one row the spacing may be 18 inches, while in the next row of the same crop, the spacing is 24 inches. Data from these two rows cannot be used together to calculate estimates; they must be used separately to calculate two different estimates. In other words, the results from such sampling are dependent on plant spacing. For increased ease in using this method, plant spacing should be consistent per crop.

### **2.3.d Hydroponics Production**

Hydroponics is described as growing plants with nutrients and water and without soil. It is a way of growing plants with their roots directly in water. Hence, plants more directly feed on food being introduced directly to the roots with out soil. The root system is hanged directly in the nutrient solution. It can be enclosed within a container or trough which is filled with a substrate (a replacement of soil). The substrate may consist of many different types of materials such us pebble, sand, sawdust or rock wool. All substrates must provide good water holding capacity to be porous for gas exchange. The roots grow within the substrates to secure the plant within the container or trough. The required nutrients mixed with water is delivered to the plant root. In this system of production there is no weeding, soil and compost work. It is part of the Specialty Crops grant provided for the establishment of hydroponics crop production systems. The different techniques used to grow plants in the hydroponics system are described below.

- *Nutrient Film Technique*

The Nutrient Film Technique (NFT) system uses multiple pipes inclined at a small angle to provide a continuous flow of nutrient rich water to the roots of the plants. A large reservoir contains the water while a pump sends the water to the high end of the system. By gravity the water moves along the pipes into an end pipe, which leads back into the reservoir. This

system is useful for growing lettuces and herbs, and other crops with relatively small root systems. See figure 63.



**Figure 63. Nutrient Film Technique (NFT) System**

- *Bato (Drip) Buckets*

This method uses buckets and a series of “injectors” or drip lines, to water each bucket individually, allowing for the production of tall crops with large root systems. Tomatoes and cucumbers were grown using this method. See figure 64 below.



**Figure 64. Bato Bucket System**

- *Float Pool*

A float pool is essentially a large basin of water. The water inside the basin is circulated using submersible pumps to evenly distribute the nutrients in the water. Large pieces of foam with holes cut into them hold the crops and float on top of the water. The roots then extend into the pool and receive nutrients via the water. This method was mainly used to produce leafy green vegetables.



**Figure 65. Float Pool System**

- *Ebb and Flow Pool*

The ebb and flow pool periodically waters the crops by flooding the basin then allowing it to drain. A pump pulls water from the reservoir into the basin, and the water exits the basin and back into the reservoir through drain holes at the bottom. Many different crops can be grown using this system, though care must be taken to use only crops with similar water needs at one time. A timer controls the ebb and flow schedule.



**Figure 66. Ebb and Flow System**

- *Nursery*

The nursery is used to start seeds and works like the ebb and flow system. Once the seedlings have true leaves they are transferred to one of the other systems.



**Figure 67. Nursery System**

## 2.4 Ethnic Crops

This year one large plot with sixteen beds was set aside for the Ethnic Crops project. Mr. Yao Afantchao produced the following crops:

- Bhut jolokia
- Denya Hot Peppers
- Burkina Faso Eggplant (Aubergine)
- Togo White Garden Egg
- Gboma
- Hibiscus (Sawa Sawa)
- Kiteley
- Cameroon Okra
- Corozal Okra
- Suhum Sweet
- Sweet White
- Togovi
- Waterleaf
- Jute Leaf
- Avuvo
- Huckleberry (Jamma Jamma)
- Choco Bonnet Peppers

For more information about this project, contact Yao Afantchao.

### 2.4.a Yield and Harvest Estimates

Some of the crops were sampled using a 2.58ft (31 in) x 3ft sample area. The following table shows the yield and harvest estimates of the fruiting plants.

Table 4. Fruit Yield and Harvest Estimates

| <b>Crop</b>      | <b>Yield Estimate (lbs/ac)</b> | <b>Estimated Harvest (lbs)</b> |
|------------------|--------------------------------|--------------------------------|
| Denya Hot Pepper | 14070                          | 375                            |
| Garden Egg       | 8911                           | 119                            |
| Gboma            | 24388                          | 813                            |
| Bhut             | 12663                          | 338                            |
| Kiteley          | 11256                          | 150                            |
| Hibiscus         | 23919                          | 319                            |

Some of the plants are also desired for their leaves. The yield and harvest estimates for these plants are shown below.

Table 5. Leaf Yield and Harvest Estimates

| <b>Crop</b> | <b>Yield Estimate (lbs/ac)</b> | <b>Estimated Harvest (lbs)</b> |
|-------------|--------------------------------|--------------------------------|
| Gboma       | 7387                           | 246                            |
| Waterleaf   | 8442                           | 113                            |
| Hibiscus    | 35174                          | 469                            |

## 2.5 Bread for the City Orchard

Bread for the City funds the orchard at the farm. On this space apples, Asian pears, various berries, and other crops are produced. The area is managed by Purple Mountain Organics.

There are currently 12 rows of apple trees of the varieties: Crimson Gold, Enterprise, Gold Rush, and Crimson Topaz. In total there are 364 apple trees. Volunteers with Bread for the City pick most of the fruit and the fruit is donated to the organization. In total this year, 1,640 pounds of apples were produced for Bread for the City. The following table lists the documented harvests of several crops grown in the orchard.

Table 6. Harvests from Orchard

| <b>Crop</b>  | <b>Harvested Amount (lbs)</b> |
|--------------|-------------------------------|
| Apples       | 1640                          |
| Asian Pears  | 1529                          |
| Blackberries | 379                           |
| Blueberries  | 8.5                           |
| Strawberries | 350                           |

## 2.6 Sweet Potatoes

Purple Mountain Organics also investigated the effect of different types of mulches on sweet potatoes. In total, they produced 3,842 lbs of sweet potatoes, the largest harvest for any crop on the farm. Volunteers from Bread for the City helped to harvest the potatoes. Most of the production was given to Bread for the City and some are taken by the community.

## 3: Aquaponic system and Crop Production

Aquaponic system is a process of growing fish in a tank. Aquaculture is known as fish or shellfish farming that refers to breeding, rearing and harvesting of plants and animals in all types of water environment including ponds, rivers, lakes and ocean. Aquaculture includes the production of seafood from hatchery fish to shellfish which are grown to

market size in tanks, ponds, cages and raceways. It also includes productions of ornamental fish for the Aquarian trade and growing plant species used in range of food, and pharmaceutical, nutritional,, and biotechnology products. If you connect the fish tank water (fish waste) to water hydroponics system plants get an automatic food supply of almost everything they need to grow from the fish water and in turn the plants filter the water for the fish. The fish waste from the tank helps to grow different vegetables and/or crops organically. Plants grow fast because they get rich alive nutrients.

The Big Green House and the Small Hoop House are used for the Aquaponic system demonstration activities on the farm. There are two water tanks in each house that contains 500 gallons of water. The farm grows Tilapia species. In tanks located in the Green house, there were 330 fishes in Tank #1 and 125 fishes in Tank #2. The 125 fishes in Tank #2 in the Big Green House were harvested for a crop harvest festival day of the farm. The average weight of 10 samples of the harvested fishes was 2.5 lbs. Therefore, the total harvest was  $125 \times 2.5 = 312.5$  lbs.



**Figure 68. Young Tilapia at Feeding Time**

There were 330 fishes in each of the two tanks in the Small Hoop House. When the temperature dropped on November 21st, all fishes in both Tanks of the Small Hoop House were affected and almost all died except the few that were transferred to Tank #2 in the Big Green House. Among the dead fishes in the Small Hoop House due to temperature fall (freeze) ten samples of the dead fishes were taken and weighed. The average weight of the 10 was 1.3 Lbs. The total number of dead fishes counted was 182, with a total weight of 236.6 lbs. Therefore, the Small Hoop House Aquaponic system is not currently working, while there are fishes in the Big green House and is still functioning. There is a lack of technical knowledge to handle the problems that were frequently occurring. As the system was implemented this year, the farm faced problems when the system fails like the heating and water flows.

- Crop production in Aquaponic system

Raised beds and pots with rocks/pebbles were prepared in the Aquaponic system in the Small hoop house. Different crops were planted in raised beds and in pots filled with rocks for demonstration. Fish waste was used to water and grow the crops. Vegetable seedlings planted in the raised bed (soil) performed much better than the vegetables planted in the pots filled with small rock/pebbles. Tomatoes, peppers, huckleberries, and water leaf were planted during the summer season and Mustard Greens, Tatsoi, and collard Greens were planted in Fall season. See figure 69 below.



Figure 69. Aquaponic Production System

#### 4: Urban Forestry

Urban forestry is the art, science and technology of managing trees, forests and natural systems in and around cities, suburbs, and towns for the health and well-being of all people. It is a careful care and management of urban forests , i.e., tree populations in urban settings for the purpose of improving the urban environment. Grey and Deneke describe urban forestry that it is the management of trees for their contributions to the physiological, sociological, and economical well-being of the urban society. It was further stated that urban forestry deals with woodlands, groups of trees, individual trees and where people live. Currently on the farm is an on-going project concerning urban forestry management established for the purpose training and education. Specifically, the project compares various watering methods and their ability to encourage deep taproot growth.

The watering methods tested include the Grouses Waterbucks, Gator Bags, and manual watering with a water hose.



**Figure 70. Urban Forestry Experiment**

For more information on this project, contact Mr. Peter Forbes or Mr. Ambroise Agosse.

## **5: Micro greens**

Micro greens are leafy vegetables that are harvested and consumed before they are fully grown. A micro greens production system was installed at the farm in 2013, and production continued in 2014. Crops grown include Radish greens, Collards, and Kale.



**Figure 71. Micro greens Production**

## 6: Biointensive Demonstration Boxes

The biointensive demonstration boxes were used this year to teach participants of the Urban Agriculture Certificate Program the basics of biointensive agriculture. One demonstration was of “double digging” and another of planting on the diagonal. Various crop were grown in the boxes including basil, onions, Jerusalem artichoke, corn, peppers, ginger, and various leafy vegetables.



**Figure 72. Biointensive Demonstration Boxes**

## 7. Rice Production Trial

Purple Mountain Organics completed a rice trial investigating the effect of different watering tape depths and variety on yield. The two varieties used were Duborskian and Koshihikari.



Figure 73. Duborskian Rice

For more information on this project, contact Mr. Nazirahk Amen of Purple Mount Organics

## 8: Beekeeping Trial

Six beehives were installed for demonstration and research at the farm this year. Among six hives three of them are large, two are medium sized, and one is a small . The focus this year was establish the colony and in the future to use the hives as an educational and research tool.

## 9. Donations of crop productions on the farm

Specialty crops grown on the farm funded by USDA program are used as a source of food supply for the community in the district of Columbia. The farm has produced a lot of crops as shown in the crop production and yield data in this report. The three major recipients of donations from the farm were Bread for the City, DC Central Kitchen and members of the community through which the food supply reaches.



Figure 74. DC Central Kitchen Volunteers

*Bread for the City*

By far, Bread for the City is the largest recipient of crop donations from the farm. They harvested approximately 14005 5 lbs. During the growing season, volunteers with Bread for the City come to harvest from the orchard as well as the other areas of the farm. Below is a list of most of the crops harvested by Bread for the City. For more specific data, contact Ms. Zachari Curtis, employee of the Bread for the City.

Table 7. Bread for the City Donations

| <b>Crop</b>     | <b>Amount Harvested in lbs</b> |
|-----------------|--------------------------------|
| Apples          | 1976                           |
| Asian Pears     | 1193                           |
| Basil           | 71                             |
| Bell Pepper     | 655                            |
| Blackberries    | 379.25                         |
| Blueberries     | 8.5                            |
| Broccoli        | 227                            |
| Broccoli Greens | 38.25                          |
| Bush Beans      | 47                             |
| Chinese Cabbage | 21.75                          |
| Collard Greens  | 92                             |
| Cucumbers       | 367.75                         |

|              |                |
|--------------|----------------|
| Eggplant     | 527            |
| Hot Peppers  | 485.65         |
| Kale         | 213            |
| Okra         | 405            |
| Squash       | 98.75          |
| Strawberries | 350.05         |
| Sweet Pepper | 371            |
| Tomato       | 990.5          |
| Watermelon   | 2636.3         |
| Zucchini     | 457.25         |
| <b>Sum</b>   | <b>14008.5</b> |

The following is a pie chart of the top ten crops harvested by Bread for the City.

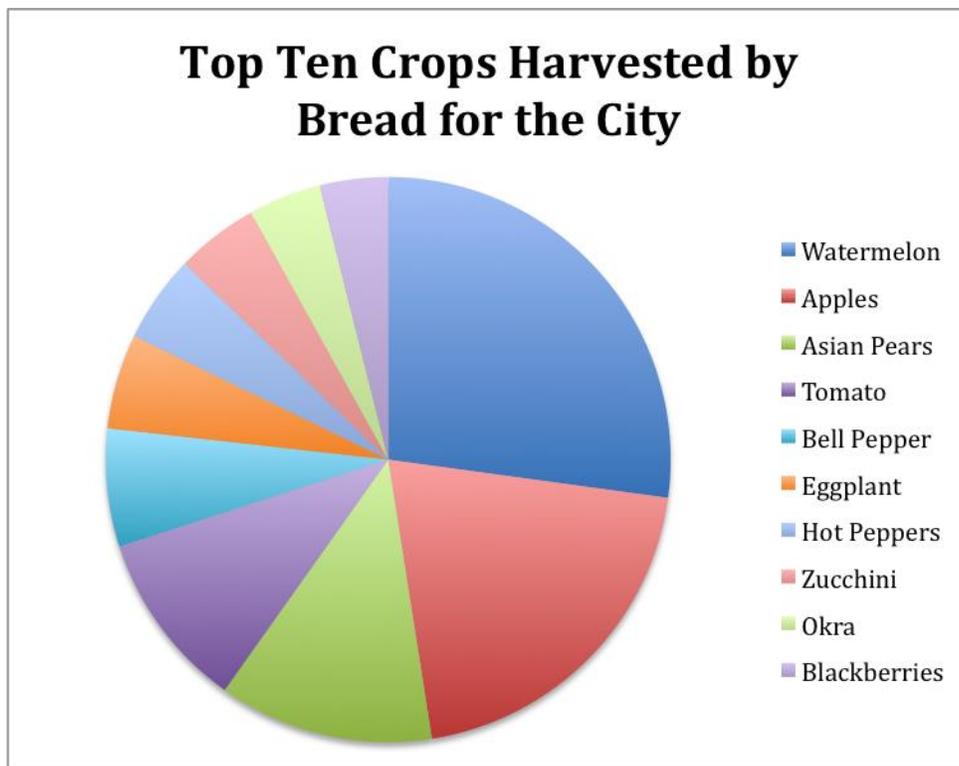


Figure 75. Top Ten Crops Donated to Bread for the City

- *DC Central Kitchen*

DC Central Kitchen also came to harvest crops from the farm. The following chart shows what they harvested and how much. They harvested approximately 500 lbs of different crops for the Kitchen from the farm.

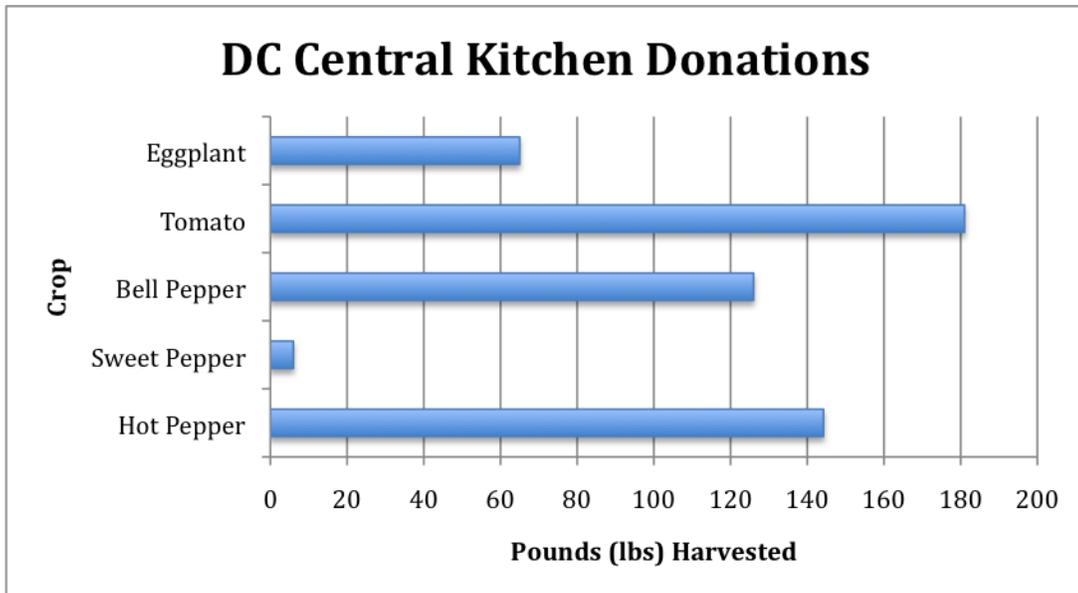


Figure 76. DC Central Kitchen Donations

- *Community*

Donations given to the community include those given to employees, volunteers, and participants of the Harvest Days hosted at the farm. These donations were not as meticulously documented, however those documented were included in the total harvest amounts listed in Table 2. The farm management advised community members coming to the farm to record any harvest done from the hoop houses and fields on the harvest form in the training trail. However, some people used the harvest form and recorded crops harvested. The information obtained from the harvest form folder shows the following different crops that totals to 458.3 lbs.

1. Kale - 187.5 lbs,
2. Collard greens - 36.8 lbs,
3. Mustard greens - 8 lbs,
4. Sweet Potato - 48.5 lbs
5. Bell Peppers - 46 lbs,
6. Garden Eggs - 130 lbs.

## 10. Grounds Maintenance

Mr. Roy Lycorish and Mr. Alemayehu Waggie performed the regular upkeep of the site especially grassy areas and the facilities in general at the farm. Their activities include mowing grasses, trimming bushes, shrubs and trees, weeding, applying compost to beds, and cleaning and organizing the classroom, Administration Building and storage areas.

Mr. Nazirahk Amen of Purple Mount Organics took charge of applying any needed pesticides, mainly to the orchard. All of the pesticides used are organic and are listed below.

- Serenade (Bacillus subtilis)
- Nickel 55 (Bacillus D747)

- Pyganic (Pyrethrin)
- Entrust (Spinosad)
- Ahimsa (Neem)
- Javelin (Bt)
- Neemix (Azadirachtin)
- Cueva (Copper)
- Oxidate (H2O2 Oxidate)
- THAT (Sulphur)
- Surround WP (Kaolin)
- Procidic
- Regalia (Reynoutria)
- EM

The fertilizers used on the farm are listed below.

- Neptune's Harvest (Fish)
- Biolink 3-3-3
- Fish Emulsion
- Bioweed (Kelp)
- High Brix
- Yucca and mainly organic compost.

## **11. Composting**

Starting in 2013, the farm began to compost its own waste with wood chips brought in from various sources. The practice has continued, although because of time constraints and manpower limitations, the furrows were not sufficiently turned to produce usable compost yet. Five Acres of land was cleaned and prepared for compost production though not yet started due to different reasons.



**Figure 77. Compost Pile**

## **12. Activities and Programs**

One of the goals of the farm is to engage and educate the community on urban agriculture and nutrition. Throughout the year several groups were invited to the farm for tours, classes, and special programs. Among them were school groups, 4H participants, UDC faculty and students, as well as members of the local community.



**Figure 78. Students Harvesting Carrots**

Over the summer, participants in the 4H program held an overnight camping trip in the orchard. Other 4H events were also held in the orchard area throughout the year as well.

### *Sustainable Urban Agriculture Certificate Program*

The Sustainable Urban Agriculture Certificate Program initiated in 2014 and held some classes and workshops at the farm. Topics included hydroponics, biointensive agriculture, and growing nutrient rich food.

### *Harvest Days*

In 2014 the farm hosted two Harvest Days during which members of the community were allowed to come in and harvest food for themselves.



**Figure 79. Participants Harvesting from Field**

## **13. Suggestions for Improvement**

- **Labeling**

**An issue encountered at the farm was the lack of or improper labeling of crops in the hoop houses and fields. This presented a problem for data collection purposes because the crops, more specifically their varieties, were not always accurately documented.**

In the future, care should be taken to correctly and visibly label all crops, particularly different varieties that look alike. Label apple varieties to ensure better data collection by Bread for the City.

- **Data Collection**

The following are problems that affected data collection on the farm in 2014:

- Unreported harvests
- Unrecorded plantings, lack of information
- Missing or wrongly labeled crops – e.g. Bread for the City wrongly recorded Super sweet 100 tomatoes as BHN 268 tomatoes.

All plantings, harvests, and input applications should be recorded same day. Data collection is far more difficult and inaccurate when done retroactively. All appropriate data fields should also be recorded.

Employee training on AgSquared and data collection techniques would help ease these issues.

- **Standardization**

Set units to be used on the farm: US units (pound, square foot, acre, etc.) or metric (kg, square meters, etc.). Measuring equipment such as scales should be in the unit system chosen.

- **Spacing**

Crops should be planted at proper spacing. The tomatoes in particular were planted too close together which made access to the fruits more difficult and may have even decreased the yields and increased disease.

- **Manpower**

With the development and fast growth of the different projects such as Aquaponic system, Hydroponics system, Urban Forestry, expansion of farm plots and construction of many Hoop Houses on the farm research station, researchers, skilled laborers and seasonal workers are required for research, demonstration, and commercial production. The farm used UDC interns for hydroponics system and urban forestry activities. The farm frequently used volunteers for seeding, planting seedlings, weeding and harvesting crops, though finding volunteers at the required time was the major issue on top of the lack of experience, knowledge and skills in crop production.

:

- **Evaluation of objectives for 2014**

- 1) The farm has provided a valuable educational resource to the UDC students, faculty, and staff. The farm held its first Agroecology Day program and introduced this valuable ecological concept to over 100 DCPS students and UDC students.
- 2) To model the most economically, socially, and ecologically sustainable farming practices available to us, while preserving an integral part of the landscape and the local economy.
- 3) To serve as a resource and link to all urban centers worldwide.
- 4) Our target audience was the local community, UDC staff, students and international visitors. Our objective as to provide members of the community with locally and sustainably produced food of the highest quality imaginable and an educational experience. The farm held several gleaning day programs for UDC staff and shareholders. The farm also provided a gleaning day for The D.C. Central Kitchen in which over 100lbs of field greens were donated to this very valuable food provider for low income D.C residents.
- 5) **(FUTURE OBJECTIVE)** To teach students at the university, by serving food grown on the farm, perhaps even harvested by the students themselves, that eating is an agricultural act..
- 6) To provide the UDC students, faculty, and staff with the opportunities to work on a farm and to learn the skills needed to produce food, experiencing its joys and challenges.
- 7) **(FUTURE OBJECTIVE)**. To compost UDC's organic waste and other local universities, therefore reducing the University's disposal costs and creating a source of fertility for the farm and other local urban farms.
- 8) To make UDC-MRF a model for peri-urban sustainable organic agriculture and food system sustainability.

The farm will continue with these objectives with the added prospect of on farm revenue generation

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