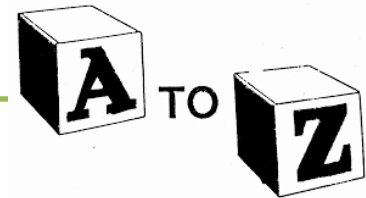




# Sweet Pepper & Tomato Production

## Protective Structures



Oscar Salazar  
Extension Officer I  
Protective Structures Unit  
Crop Research Unit  
Research Development & Innovation Center  
Central Farm

# Contents

1. Types & Varieties
2. Seedling Nursery Preparation
3. Land Preparation
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5. Plastic Mulch Installation
6. Transplanting
7. Pruning (Stems, Fruits)
8. Trellising
9. Irrigation
10. Fertilization
11. Fertigation Systems
12. Pests & Diseases
13. Harvesting
14. Protective Structure Management & Sanitation
15. Crop Rotation

# Determinate vs Indeterminate Variety of Tomatoes

## Determinate Tomatoes

are ***bush*** types that grow 2-3' tall, then the buds at the ends of all the branches form flowers instead of leaves. They flower all at once, set and ripen fruit, then die.

## Indeterminate Tomatoes

are ***vining*** types that need caging or staking for support, but will continue to grow and set fruit until frost kills them. They're generally later than determinate tomatoes, and produce larger crops over a longer period.



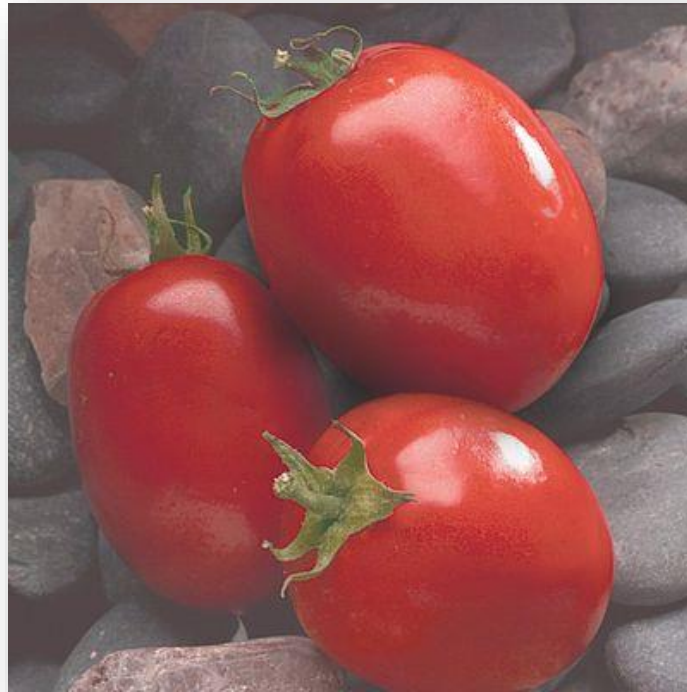
Figure 1a: Indeterminate type of tomato growth

Figure 1b: Determinate type of tomato growth

# Tomato Types

## **Saladette and Sauce**

Paste (Roma type), plum, pear, processing, saladette are all names for the same tomato type. Meaty and less juicy, they are the best choice for canning, sauces, salsa, and juice. With less juice, sauce-making time is half that of salad types.



# Tomato Types

## **Salad Tomatoes**

Salad Tomatoes form 2-3" diameter fruit, perfect for slicing on sandwiches or chopping into salads. They're usually a little tarter and juicier than cherry tomatoes or beefsteak tomatoes, with some acid to balance their sweetness. Some have undertones of tropical fruits.



# Tomato Types

## **Cherry or Grape Tomatoes**

Cherry and grape tomatoes are small, usually less than 1", and grow in large clusters.



# Tomato Types

## Cluster Tomatoes

Bunches of ripe tomatoes still clinging to the vine.



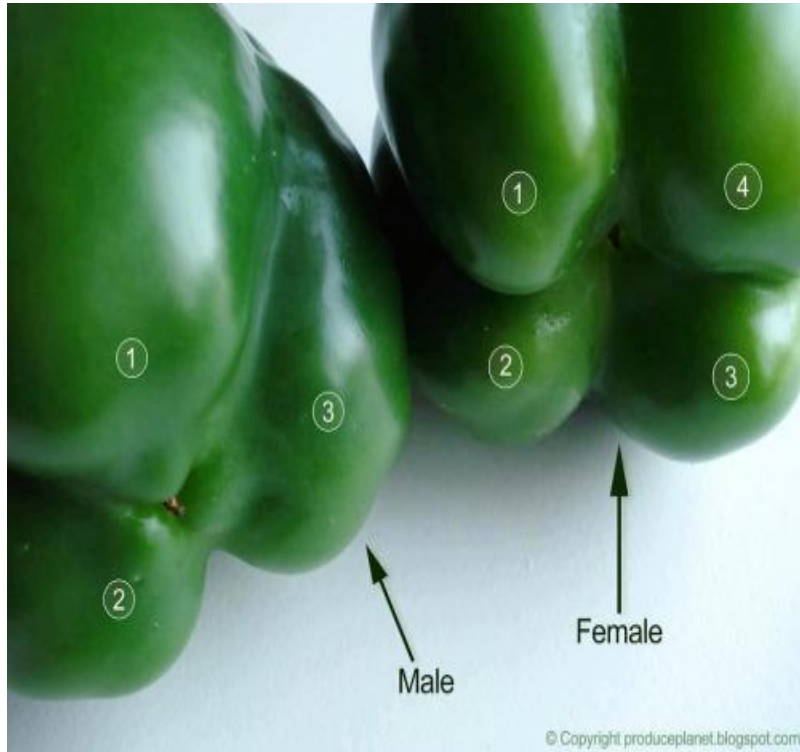
# Tomato Types

**Beefsteak Tomatoes** produce large, heavy fruit, up to 1lb. These are the big, thick, meaty tomatoes that are so prized for sandwiches—and one of the main reasons for growing tomatoes. Some varieties reach 6” in diameter. Beefsteak tomatoes need a longer season and more heat than smaller varieties





# Female or Male ?



## Female

- Contain More Seeds
- Sweeter when raw

## Male

- Good for grilling & cooking
- Less seeds

# Sweet Pepper

**Camelot**



**Lido**



# Germination Mix & Trays



# Seedling Nursery

Sowing of Seeds



# Seedling Nursery

(Seedlings Growing Protected)



# Small Seedling Nursery



# Land Preparation

Tilling of Soil – Mechanically



# Land Preparation

## Preparing Beds Mechanically



## Preparing Beds - Manually





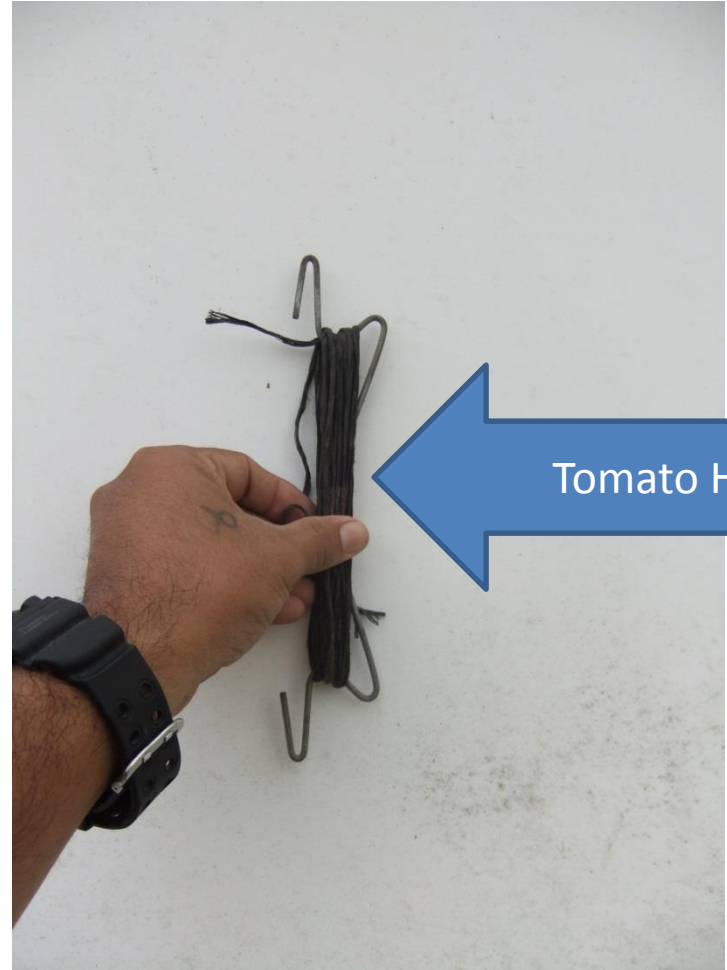
# Land Preparation



# Seedlings in Trays



# Prepare Trellising



Tomato Hook

# Drip Irrigation Installation

**Main Line**



**Drip Hose**



# Drip Irrigation Installation

**Hose Punch**



**Insert connectors**



# Hose Punch



# Installation of Plastic Mulch



# Measuring for plant spacing





# Make Holes to the Plastic Mulch





# Plastic Mulch prepared for transplanting



# Benefits of Plastic Mulch



1. Prevents water evaporation
2. Reflective Mulches helps in repelling insects
3. Prevents weeds from propagating
4. Prevents contamination of soil pathogens to fruits.



## **Plastic Mulch Colours and Purpose:**

White - Reduces temperature of soil

Black - Suppress weeds

Yellow - Control of White Flies

Silver - Repels insects

Blue - Control of Thrips

# Transplanting

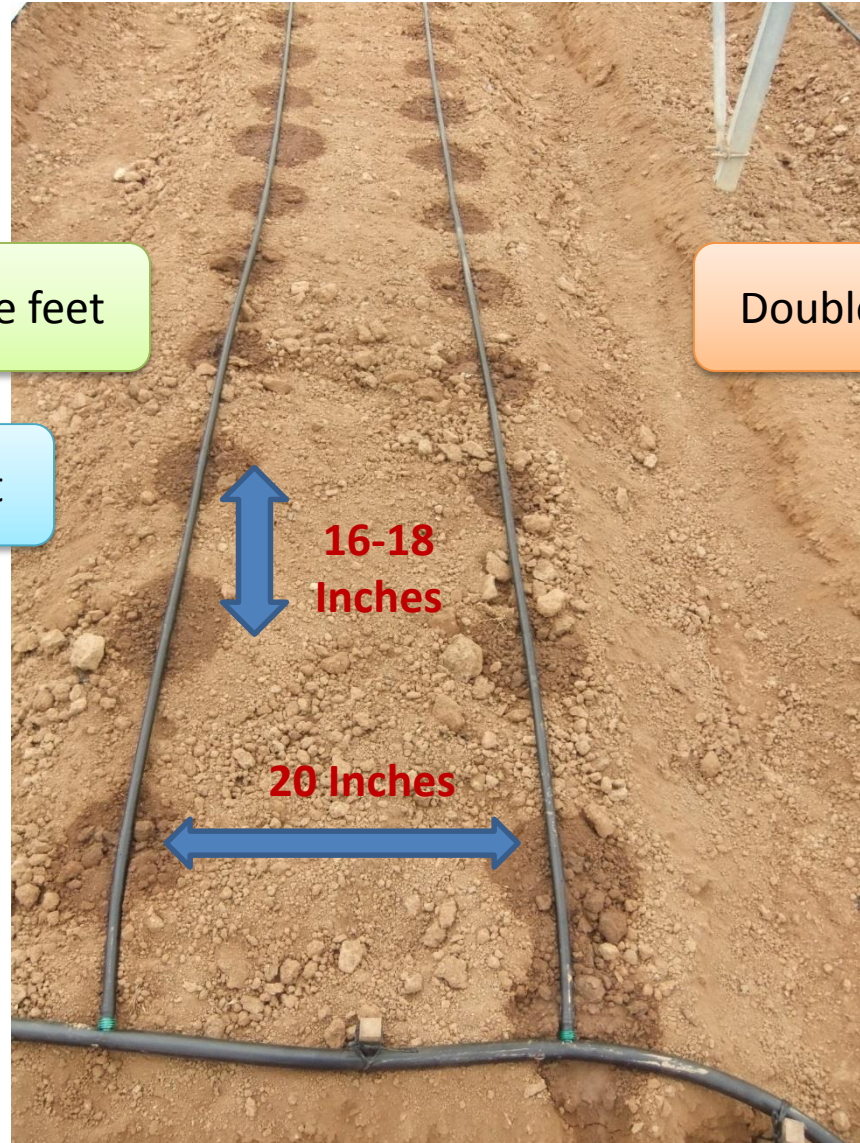


# Plant Spacing (Tomato & Sweet Pepper)

250 plants/1000 square feet

4 square feet per plant

Double Row Planting



# Plastic Mulch (Sweet Pepper)



# Pruning (Tomatoes)





# Trellising



# Pruning (Tool Disinfection)



# Trellising



# Trellising (Dutch Type)



# Trellising (Dutch Type)



# Trellising



Tomato Clip

# Pruning (Leaves)



# Pruning (Leaf Sweet Pepper)





# Trellising



One Main Stem

# Trellising (Lowering of Plants)



# Trellising (Lowering of Plants)



# Trellising (Lowering of Plants)



# Trellising



# Trellising (Spanish Type)



# Trellising (Sweet Pepper)



# Trellising (Sweet Pepper)





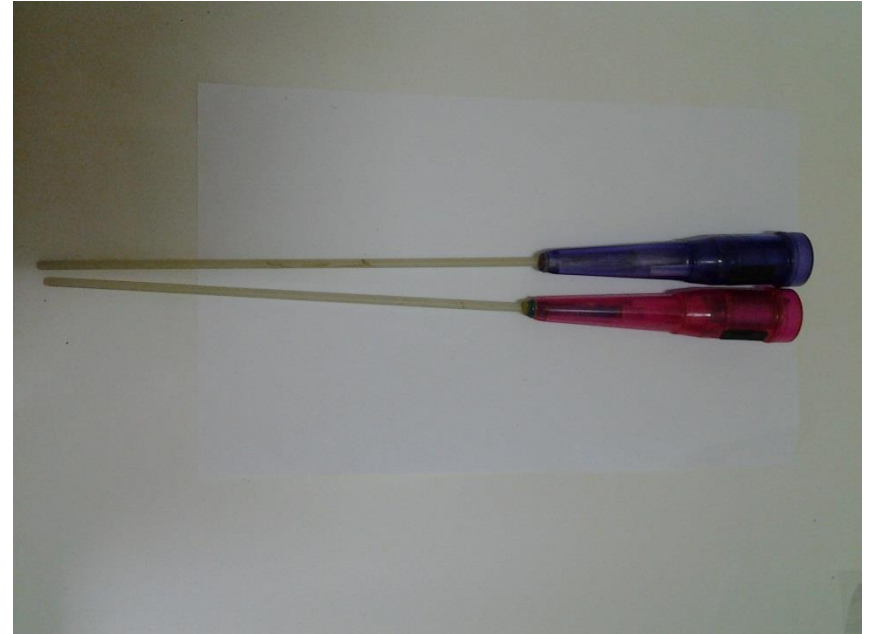
# Flower Pollination (Tomato)

## Manual



# Flower Pollination (Tomato)

## Vibrator Pollinators



# Flower Pollination (Tomato)

**Air Blower**



# Fruiting



# Pruning (Fruits)



# Pruning (1<sup>st</sup>. Flower)



# Fruiting (Sweet Pepper)



# Irrigation (Root Zone)





# Irrigation (Irrrometer)



# Irrigation (Soil Moisture Indicator)



# Irrigation



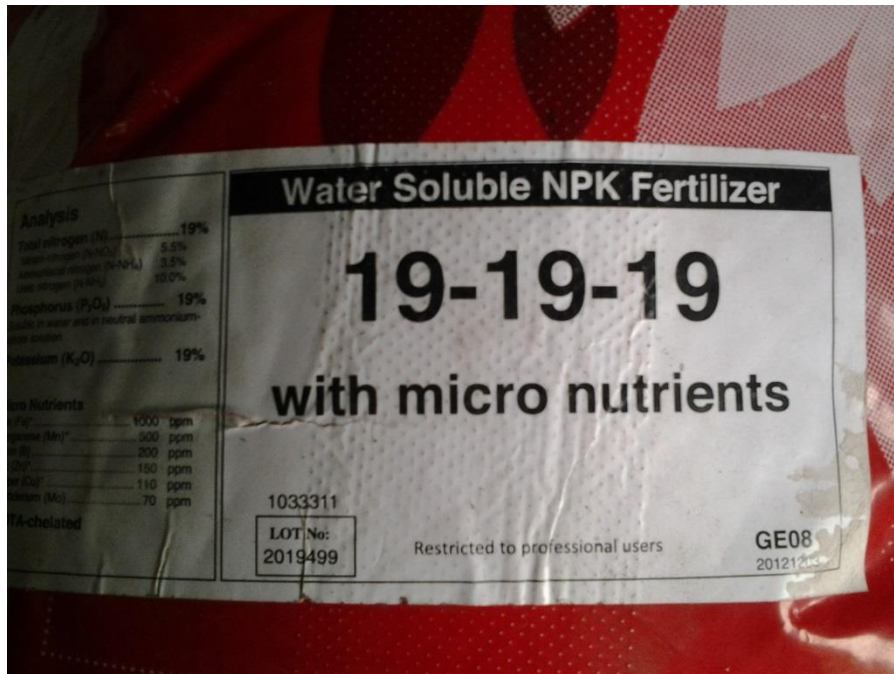
# Fertilization (Fertigation)



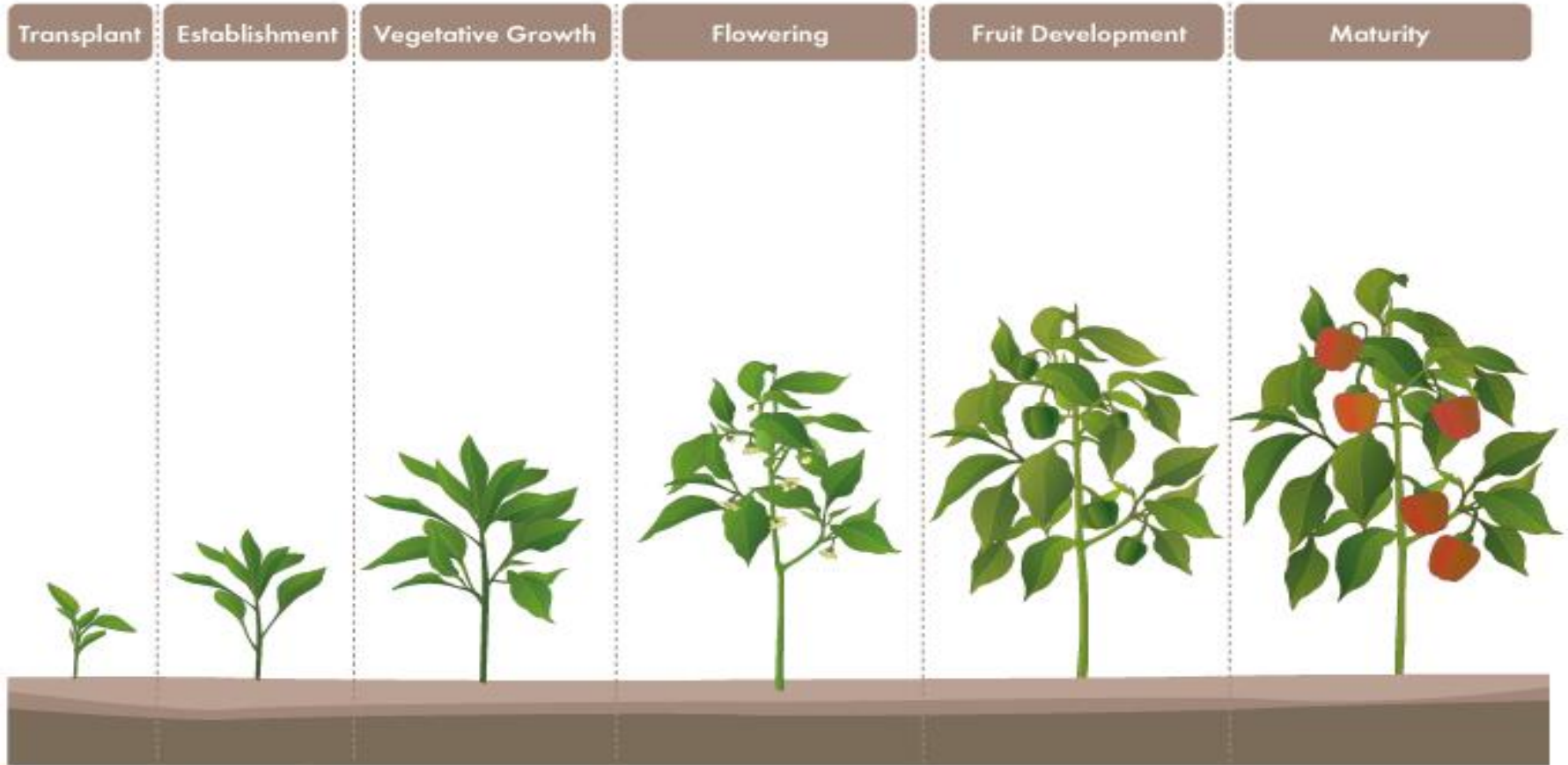
# Fertilization

- Polyfeed (12:43:12 , 19:19:19 , 20:5:30)
- Urea
- Magnesium Sulphate
- Foliar Fertilizers (Flower Power, Fruit Power, Boron and Calcium)
- Multi NPK

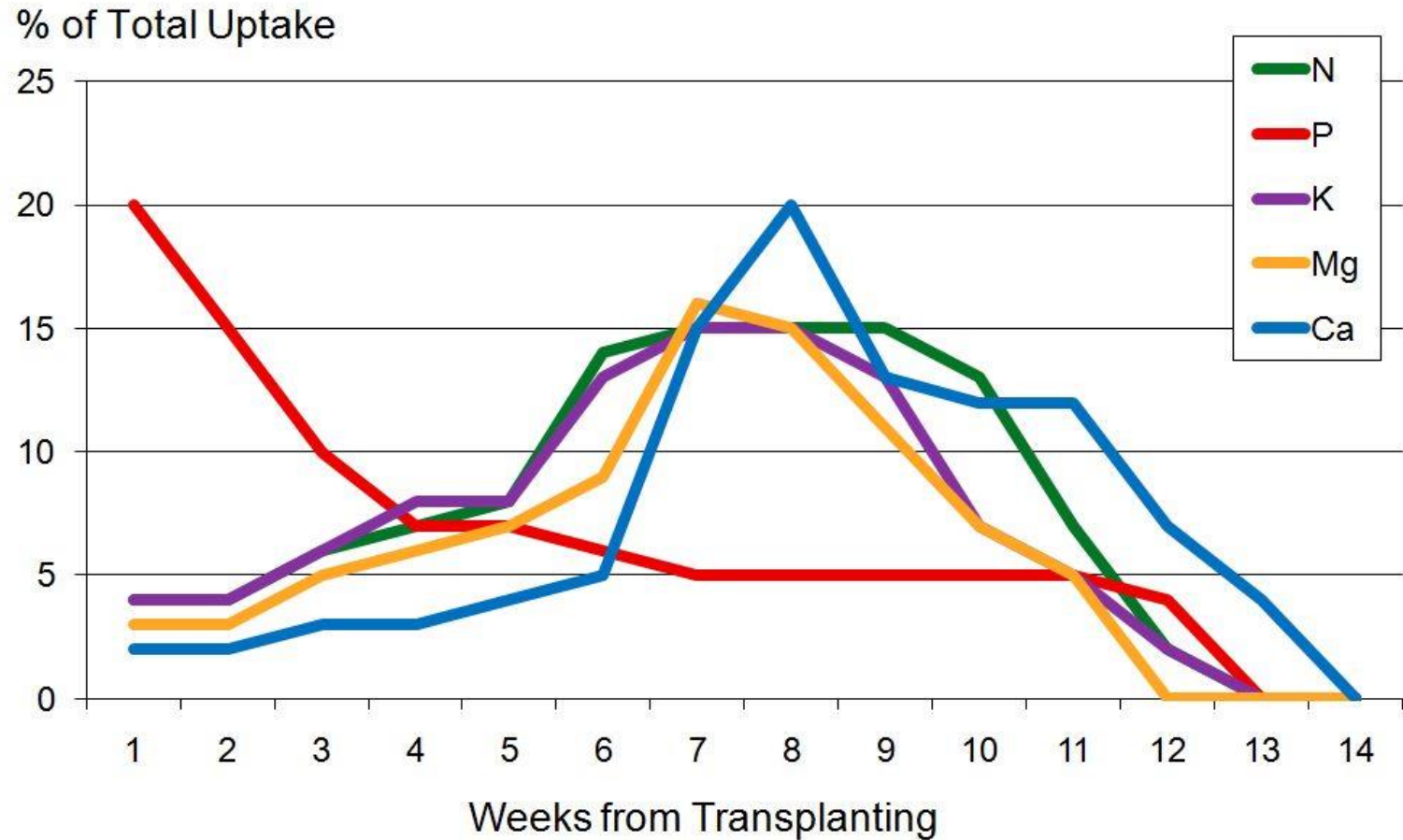
# Water Soluble Fertilizers for Fertigation



# Know your Plant Growth Stages



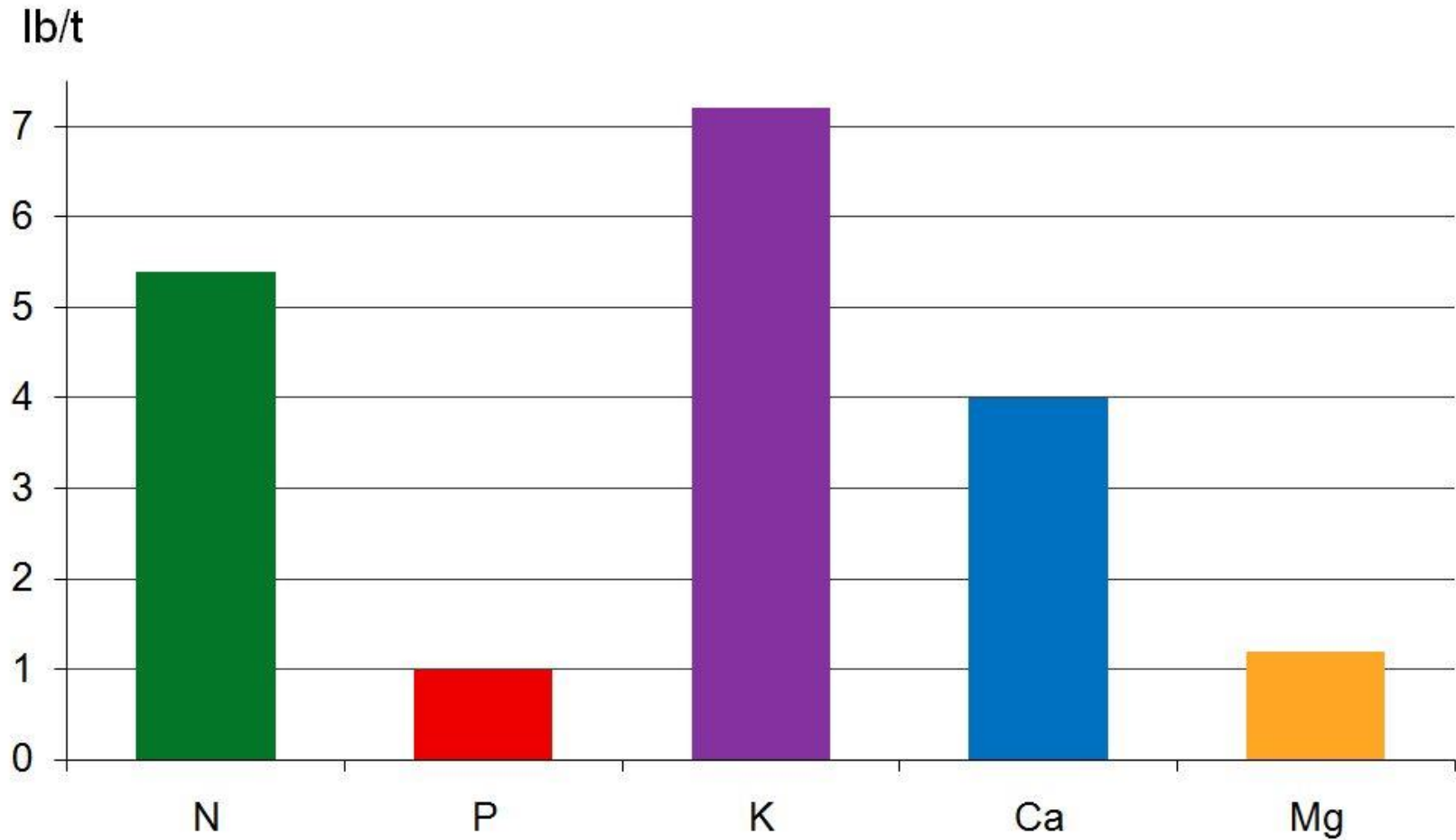
# Crop Nutrition based on Growth Stages



Ref: Impronta Yara - Italy

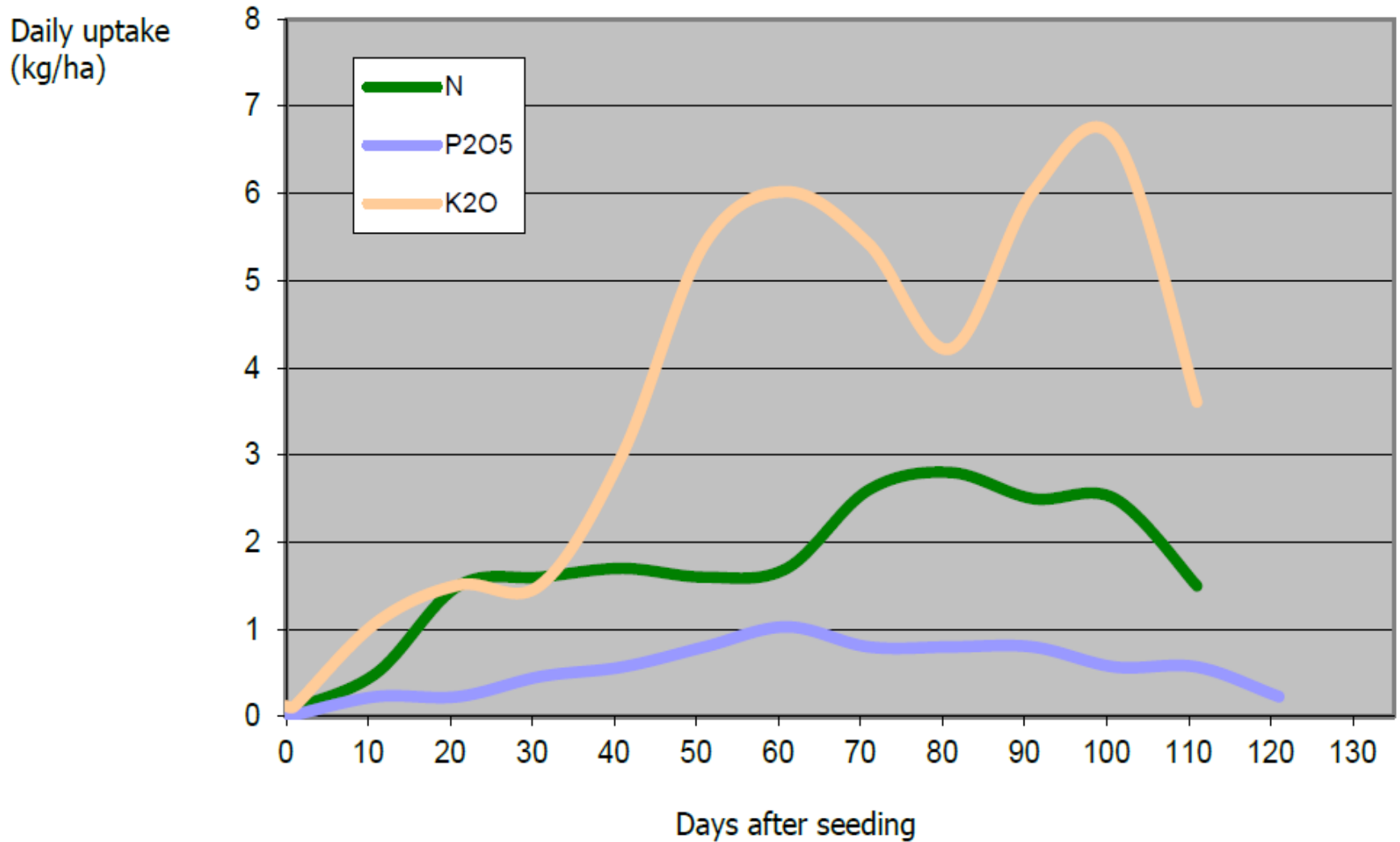


# Tomato Major Nutrient Removal



Ref: Christou et al. - 1999

# Sweet Pepper



# Ejemplo: Análisis de Suelo

AGRO SERVICES INTERNATIONAL, INC.

205 E. Michigan Avenue

Orange City, Florida 32763

Ph. 386-775-6601

Fax 386-775-9890



Ministry of Agriculture

Second Floor West Block Bldg

Belmopan City

Belize

Representative Eugene Waight

Crop to Fert. Hot Pepper

Yield Goal

Last Crop

Approx. Yield

Lime Applied

Field or Sample No. #6 SS-PDD-CY-003

Farm Location Oscar Figuerros

La Gracia

Date Sample Rec'd. 03-02-11

Date Processed 03-07-11

Act. C.E.C. 42.9 meq/100 cm<sup>3</sup>; Base Satn. 100 %; Acid. Satn 0 %; pH 7.3 ; O.M 1.4 %; Sol. Salts 420 ppm; Texture Code B2

ELEMENTS	SOIL ANALYSIS		INTERPRETATION GUIDE			FERTILIZER SUGGESTIONS	
	Lab No.	W6 28 - 1	Below	Optimum	Above	lbs/1000 sq. ft. or kg/230 m <sup>2</sup>	lbs/acre or X 1.12=kg/ha
Act. Acidity	A.A.	<u>0.0</u>					
Calcium	Ca	<u>35.3</u>			Ca	0.0	0
Magnesium	Mg	<u>7.19</u>		Mg		0.0	0
Potassium	K	<u>0.39</u>		K		3.4	150
Sodium	Na						
Ca/Mg Ratio	Ca/Mg	<u>4.9</u>		Ca/Mg		Dolomitic Lime	0
Mg/K Ratio	Mg/K	<u>18.4</u>			Mg/K	Calcitic Lime	0
		ug/cm <sup>3</sup>					
Nitrogen	N	<u>3</u>	N			Nitrogen	3.4
Phosphorus	P	<u>7</u>	P <sub>2</sub> O <sub>5</sub>	P		Phosphate (P <sub>2</sub> O <sub>5</sub> )	5.2
Sulfur	S	<u>14</u>		S		Sulfur (as Sulfate)	0.7
Boron	B	<u>0.52</u>		B		Boron	.01
Copper	Cu	<u>2.8</u>		Cu		Copper	0.0
Iron	Fe	<u>5</u>		Fe		Iron	0.9
Manganese	Mn	<u>4.5</u>		Mn		Manganese	0.5
Zinc	Zn	<u>1.8</u>		Zn		Zinc	0.2
Other							

This report is accepted by the client under the condition that Agro Services International, Inc. is responsible only for the accuracy of the analysis of the sample as received, such liability limited to the cost of the analysis. No other warranties, expressed or implied, are given. Comments: The suggested nitrogen rates are general for the crop. If better local information is available then use that. Recently applied organic material is not indicated by the analysis. Adjust fertilizer rates accordingly.

# Classification of Elements

Macro Nutrients

Micro Nutrients

High Quantities

Medium

Small

1. Nitrogen
2. Phosphorus
3. Potassium

1. Calcium
2. Magnesium

1. Copper
2. Iron
3. Manganese
4. Zinc
5. Boron
6. Chloro
7. Molybdenum
8. Cobalt
9. Sulphur

# Crop Nutrient Deficiencies

## Deficiencies:

1. Potassium
2. Magnesium
3. Phosphorous
4. Calcium



# Fertilization (Fertigation)



## WHAT IS FERTIGATION?

Fertigation is the application of fertilizers, soil amendments, or other water-soluble products through an irrigation system.

## WHY USE FERTIGATION?

1. **Higher yields and better quality crops:** The supply of nutrients to the crops according to the physiological stage, considering the climate and soil characteristics, resulting in high yields and high quality crops.
2. **Increased efficiency of nutrients:** Nutrients are applied to the root zone and uniformly, where the active roots are concentrated. Less fertilizer applied resulting on decrease of production costs.
3. **Reduction of groundwater pollution:** The exact dosage optimizes fertilization, reducing the potential for groundwater contamination caused by the leaching of fertilizers.
4. **Greater convenience and economy:** Allows use of fertilizer solutions, which is more practical than the solid or granular type fertilizers.
5. **Efficient application of microelements:** which are expensive and are required in small quantities.

## What should be considered?

1. **Soil Analysis:** to determine soil nutrient availability and soil type. The soil analysis will assist in the development of a fertilization program.
2. **Irrigation System & Injector Pump:** Drip Irrigation system is utilized for vegetable production. Injector pumps such as piston pump and Venturi type are recommended.
3. **Water Quality:** Sediments in the water can plug the emitters in drip hoses.
4. **Water Supply:** Adequate supply of water demanded by the crop.
5. **Fertilizers:** It is essential that nutrients used for Fertigation are soluble.

# Fertilization (Fertigation)

Piston Pump Injector



# Fertilization (Fertigation)

Piston Pump Injector



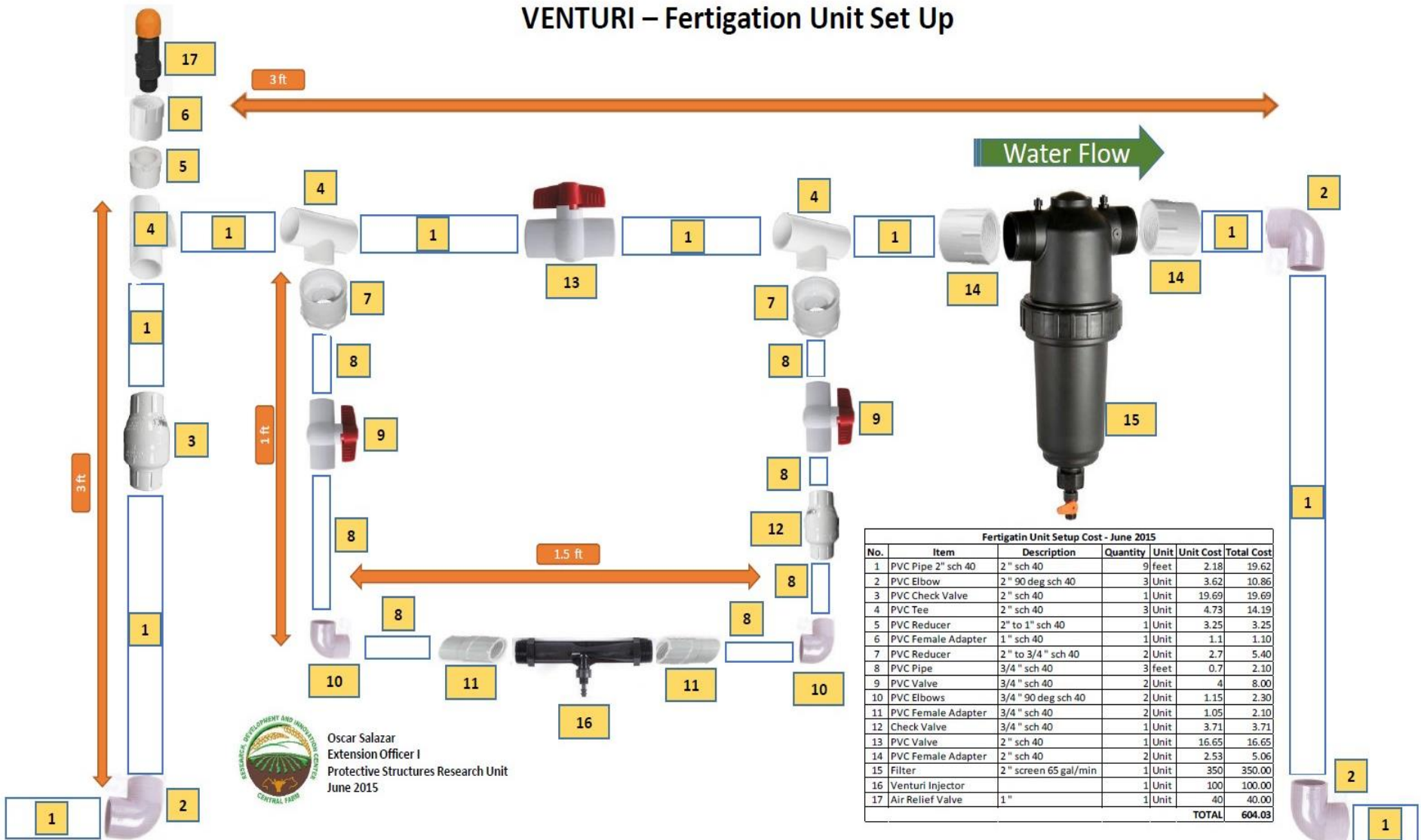


# Fertilization (Fertigation)

## Venturi Type Injector



# VENTURI – Fertigation Unit Set Up



Oscar Salazar  
 Extension Officer I  
 Protective Structures Research Unit  
 June 2015

Fertigatin Unit Setup Cost - June 2015						
No.	Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	PVC Pipe 2" sch 40	2" sch 40	9	feet	2.18	19.62
2	PVC Elbow	2" 90 deg sch 40	3	Unit	3.62	10.86
3	PVC Check Valve	2" sch 40	1	Unit	19.69	19.69
4	PVC Tee	2" sch 40	3	Unit	4.73	14.19
5	PVC Reducer	2" to 1" sch 40	1	Unit	3.25	3.25
6	PVC Female Adapter	1" sch 40	1	Unit	1.1	1.10
7	PVC Reducer	2" to 3/4" sch 40	2	Unit	2.7	5.40
8	PVC Pipe	3/4" sch 40	3	feet	0.7	2.10
9	PVC Valve	3/4" sch 40	2	Unit	4	8.00
10	PVC Elbows	3/4" 90 deg sch 40	2	Unit	1.15	2.30
11	PVC Female Adapter	3/4" sch 40	2	Unit	1.05	2.10
12	Check Valve	3/4" sch 40	1	Unit	3.71	3.71
13	PVC Valve	2" sch 40	1	Unit	16.65	16.65
14	PVC Female Adapter	2" sch 40	2	Unit	2.53	5.06
15	Filter	2" screen 65 gal/min	1	Unit	350	350.00
16	Venturi Injector		1	Unit	100	100.00
17	Air Relief Valve	1"	1	Unit	40	40.00
					<b>TOTAL</b>	<b>604.03</b>

# Fertilization (Fertigation)

## Knapsack Sprayer as Injector



# Fertilization (Fertigation)

## Gravity (Drum)



# Monitoring for Pest & Diseases



# Insects, Diseases or Physiological



# Major Insect Pests

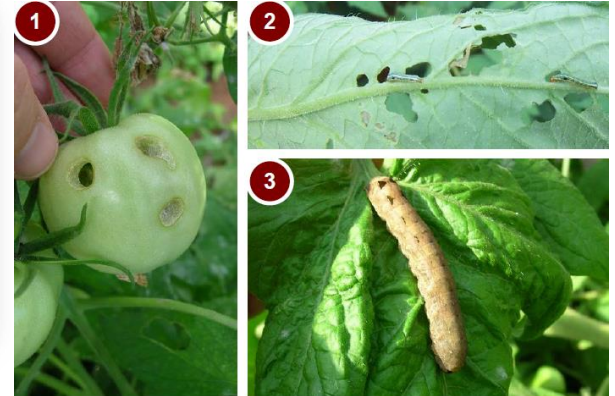
Whitefly



Aphids



Worms



Mites



Thrips



Leaf Miner



Nematodes



Mealy Bugs



# Major Diseases

Bacterial/Fungal Wilts



Early Blight



Late Blight



Anthraxose



Bacterial Spots



Cercospera



Botrytis





# Use of Yellow Sticky Traps to monitor and control insects



# Monitoring for Pests & Diseases

What are you looking for?



# Monitoring for Pest & Diseases

Fungus or Bacteria?



# Physiological Damages

Fruit Cracking



Blossom End Rot



# What is the difference between fruits?

A



B



# Control of Pest & Diseases



# Pesticides Application

Trade Name	Chemical Family	Mode of Action	Pests Controlled	Crops Approved <sup>2</sup>	Dosage	Pre-Harvest Interval	Re-entry Period	Compatibility
238 <b>Karate Zeon 5 CS</b>	Synthetic Pyrethroid	Contact with stomach action.	Thrips, Whiteflies	Corn, tomatoe, cabbage, beans, broccoli.	<b>Maize</b> - 175 to 250 ml/ha <b>Tomatoe</b> - 470 ml/ha <b>Beans and cabbage</b> - 300 to 500 ml/ha <b>12.5 to 17.5 ml for</b>	1 day.	Wait at least 24 hours after application	With other agricultural products of common use. Do not mix with alkaline products.
239 <b>Kendo 2.5 EC</b>	Synthetic Pyrethroid	Contact with stomach action.	Thrips, Whiteflies	Corn, sorghum, tomatoe, potatoe, cabbage, peanuts, sweet pepper, beans, onion, rice, melon.	350 to 500 ml/ha	Melon - 3 days, onion - 14 days, all others - 1 day.		With other agricultural products. Do not mix with alkaline products.
300 <b>Neem-X</b>	Botanical	Growth Regulator(Contact, Ingestion)	Whiteflies, Leafminers, Aphids, Thrips, Mealy bugs, Diamondback moth, Loopers, Armyworm.	Vegetables and ornamentals	<b>As preventative</b> use 125 to 200 cc/100 lt of water. <b>As curative</b> use 250 to 500 cc/100 lb of water	Zero	Once treated surface area has dried.	Compatible with other products; however, tests should first be carried out prior to application to the crop.
4 <b>Pegasus 50 SC</b>	Thiourea	Contact, Stomach	White fly, Thrips, Mites, aphids, diamondback moth, and more.	Tomatoe, pepper, onion, potatoe, cabbage.	0.4 to 0.5 lt/ha., or 60 to 100 ml/100 lts of water.	Tomato - 7 days; Pepper - 28 days, Potatoe - 21 days,		May be used with commonly used insecticides and

# Harvesting (Mature Stage)





# Harvesting



# Harvesting



# Harvesting



# Clean & Disinfect Boots or Shoes



# Cleaning of UV Plastic & Antiviral Netting



Dirty UV Plastic limits the sunlight to the plants reducing growth & yields



# Washing of UV Plastic



# Washing of UV Plastic





# Dirty Antiviral Netting reduces air ventilation inside the Protective Structure



# Using Citrus Power & Knapsack Sprayer



# Pressure Washer



# Antiviral Netting

**Dirty**



**Clean**



# Maintain the surroundings clean



# Open Field too close to Protective Structure



# Crop Rotation (Sweet Corn)



# Crop Rotation





# Removal of Plants after crop cycle



# Removal of plants after crop cycle



# NOT RECOMMENDED



# Maintain Irrigation System



# Shade affects growth and yield of plants



# Repair damaged Antiviral Netting



# Visitors or Extension Officers?



# Vegetable Production under Protective Structures Requires Knowledge & Skills

