



Jamaica Greenhouse Growers Association HANDBOOK



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Basic Principles of Low Cost Greenhouse Production in Jamaica

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Introduction

The Technology of producing horticultural crops in greenhouses has been around for decades. Greenhouse production provides growers with the ability to achieve significantly higher yields than open field production. This is mainly due to the enclosed structure and protective antiviral netting which protects plants from pests, diseases and harsh elements as well as the use of drip irrigation and a fertilization program that ensures good plant nutrition and an increased capacity to bear more. The technology also involves the use of less land area compared to open field production, more efficient use of water resources; and far less use of chemicals to control pests and diseases.

Greenhouse production was introduced to Jamaica on a wide-scale in 2005. A few farmers planted lettuce, tomatoes and experimented with other crops before. As a form of Protective Agriculture it has shown great promise here.



Two Types of Low Cost Greenhouse

Management

This type of operation is intensive and needs dedication to be successful. A Low Cost Greenhouse is one which costs below U.S. \$30.00 per square meter. The minimum recommended altitude is 400 meters above sea level, when antiviral netting is used. Below this elevation antiviral netting should not be used unless additional equipment for cooling etc. is added.

Growing Mediums

These are presently in use here.

- a. Soil [direct]
- b. Soil with gravel in bags
- c. Coir
- d. Perlite

Basic Equipment

- a. Ph meter
- b. EC meter
- c. Thermometer
- d. Electronic Scale – 5 lbs. capacity.
- e. Measuring Cylinder
- f. Relative Humidity meter

Water

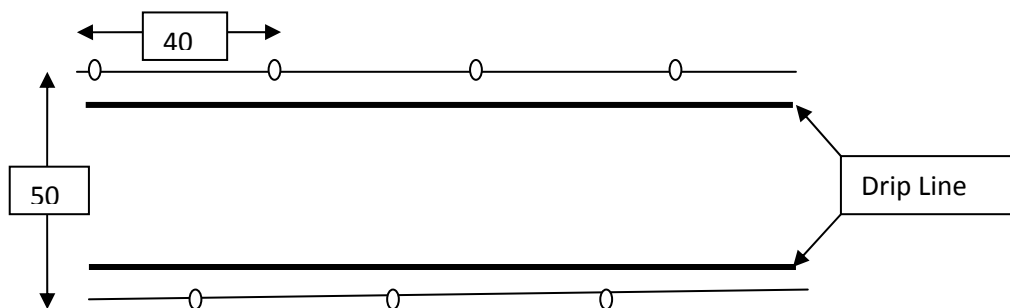
Availability and quality of water should be checked. Access to good quality water is one of the most important inputs for greenhouse production. At their early stage, crops require at least 0.75 to 1 liter per plant, per day and this increases at the blooming, fruiting, and harvesting stages. High yielding indeterminate tomatoes before harvest may require up to 2.5 to 3.00 liters per plant per day.

Growing in the Soil

The soil should be properly prepared to allow for excellent development of the root system. It is best to use Raised Beds which ensures less compaction and room for workers to manoeuvre. Beds should be 1.7 meters from centre to centre of beds. The suggested planting distance is

two rows per bed, 40 centimeters between plants along the bed and 50 centimeters between rows staggered for tomato and sweet pepper.

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Seedling Production

Seed selection – Tomato – Alboran is one of the recommended indeterminate varieties.

Beverley is nematode resistant and is gaining popularity.

Sweet Pepper – Early Sunsatation [yellow]

King Henry [Red]

Lexington [Red]

The use of disease free seedlings is a must, so seeds should be sown in a protected nursery.

FOR A 600 SQUARE METER HOUSE:

Sow 2000 seeds.

To fill 16 seedling trays [128 cells]

Mix 25lbs. of growing medium with 300 grams 12-61-0 [MAP], 50 grams Trichozam in 10 liters of water. Proper watering with good Pest and Disease control should be followed up until the seedlings are ready for transplanting.

Transplanting

During transplanting select your seedlings according to the length, thickness and turgidity of the plant. Starter Solution is used during the procedure. The solution is made by mixing 5 lbs. DAP [18-46-0] fertilizer in 80 gallons of water. Apply 200 cc of the solution to each hole. Transplant within 5 minutes.



Transplanting Tomatoes

When the solution has been completely absorbed but the holes are still very wet, that is within 5 minutes.

Drip Irrigation System

The Components are:

- a. Water Tanks
- b. Water Pumps – electric or gas
- c. Elevated stand of about 5 feet to support tanks for gravity feed.
- d. Filter Systems.
- e. Pipes
- f. Drip lines or Spaghetti system [Micro Tube 5/3]

Irrigation

The quantity of water used is dependent on the soil, the weather condition, growth stage of the plant and the pressure. The recommended pressure is between 8 – 12 psi. For the spaghetti system [Micro Tube 5/3] an electric pump is used, giving a pressure of 15 psi at the dripper. Also when using bags e.g. 6 x 11 x 14 two drippers are used per bag, with a dripper on either side of the plant.

Drip Maintenance

- a. Clean or check all filters daily. Where gravel or sand filter is used, backwash before filling tanks.
- b. Phosphoric acid or molasses can be used in the cleaning process. Using one of the tanks, add phosphoric acid to lower the ph of the water to ph 3. This solution is applied to the greenhouse drip system where plants are in the soil, to dissolve manganese, iron and calcium precipitates which have accumulated in the lines and drippers. All this process should last for approximately 30 minutes.
- c. The lines should be flushed weekly.

Fertilization Program

Plants are fertilized every time water is added except once per week when the system is cleaned. It is best to use individual soluble fertilizers when available to make your mixture. This is after a chemical analysis of the soil is done. The optimum ph range for the nutrient solution is 5.6 to 5.8. Most of Jamaica's water sources are alkaline, phosphoric acid is recommended to correct this problem to lower the ph. Add the acid to the mixture and not before.

Attached are general fertilization programs for Tomato and Sweet Pepper, changes will have to be made depending on the location.

Plant Support System

This can be made from any affordable material available e.g. bamboo, wood and metal. The wire at the top of the system should be about 2.5 meters above ground.

Trellising or Plant Training

The cord and wires should be in place immediately after transplanting. White is the recommended color of the cord. Plant training is done as required, possibly weekly.



Sweet Pepper Pruning and trellising

Attached is Sweet Pepper pruning.

Tomato pruning involves three operations:

- a. Suckers – To be removed twice weekly.
- b. Fruits – To be removed weekly (done during (a) developmental stage (b) to facilitate marketable fruit size).
- c. Leaves – Five days before harvest remove the lower leaves up to the lowest fruit bearing cluster. Once the lowest fruits have been harvested, continue the pruning by removing those leaves that were above the harvested cluster and that are now below the next lowest fruit bearing cluster.

Pollination

Tomatoes are self-pollinated. In the greenhouse the flowers must be vibrated for the pollen to be loosened and dusted onto the stigma. Pollination in tomato is achieved by vibrating the cluster for 1 to 2 seconds by shaking the trellising system by hand, by using a mist blower or an electric vibrator. This has to be done at least every other day, between 10:00 am and 2:00 pm or preferable when the relative humidity is between 60 to 70 percent. Without proper vibration poor fruit quality, shape and size will result. The optimum temperature for pollination is within 70 to 80 degrees Fahrenheit.

Sweet Peppers need no outside assistance.

Temperature

A day temperature of 70 to 82 degrees F. is optimum, while night temperature of 62 to 64 degrees F. is optimum for greenhouse tomatoes. Avoid temperatures above 90 degrees F. because at 86 degrees F. *lycopene* no longer develops.

Pest and Disease Management

Pests

a. Mites will be present even with the antiviral mesh especially on sweet pepper. The crops have to be monitored at least twice per week.

b. Aphids and White Flies.

With antiviral mesh these should not be present but in case use an insecticide which is recommended for greenhouse condition, and also check for plants with virus. These must be removed and discarded immediately.

Fungal Problem

These can be soil borne or on the foliage.

Soil Borne – The most common are the Damping Off complex [Phytophthora, Pythium and Rhizoctonia], Fusarium and Southern Blight.

Treatments – To avoid this problem use resistant varieties or use Trichoderma [beneficial fungus] from the seed sowing stage. If the fungus persists it will have to be identified and the appropriate fungicide applied. Apply the maximum recommended dosage, a week later re-apply Trichoderma.

Foliar Fungal Diseases – This is more prevalent where there is high rainfall, high day – time temperature and cool night-time temperature. The most common diseases are Alternaria [Early Blight], Phytophthora [Late Blight], Botrytis [Grey Mold] and Powdery Mildew [*Leveillula taurica*].

Treatment – a. Start with good quality seedlings

b. Apply proper fertilization program.

c. Check with RADA or JGGA for advice.

Basically there are three main bacterial problems which affect these crops.

- a. Bacterial Spot – *Xanthomonas campestris* – The symptoms are dark brown with a yellowish ring, spots about 2mm.in diameter. It has a soaked, oily area in the middle section of the spot; within a few days this area of the leaf will die and the plant drops all the infected leaves to protect itself.

Treatment – Use resistant varieties.

Good quality seedlings.

Use copper –based fungicides

- b. Bacterial Speck – *Pseudomonas syringae* – Symptoms are similar to bacterial spot .It can only be differentiated by the symptoms on the fruits.

Treatment – Same as bacterial spot.

- c. Bacterial Wilt – *Ralstonia solanacearum* – This disease is serious in tomato but peppers are not as susceptible. The disease has gained importance in protected cultivation where temperatures are usually higher and crop rotation is not properly performed. It usually occurs in foci associated with the accumulation of water in low spots. Common symptoms are wilting of upper leaves especially on hot days, the wilted leaves maintain their green color and do not fall as the disease progresses. Under favorable condition for the disease, the entire plant wilts.

Treatment – None

Virus

At the first sign of an infected plant pull it out as the infected plant cannot be cured. In Jamaica the major problem is “aphid transmitted virus”, so the best deal is to prevent the aphid from feeding and transmitting the virus to another plant.

Below are some basic prevention methods.

- a. Treat seedlings with systemic insecticide from the nursery stage, eg. Actara.
- b. Remove broad leaf weeds from the greenhouse surroundings especially those from the Solanaceae family.
- c. Keep at least one of the entrance doors to the greenhouse closed at all times.
- d. Scout inside greenhouse daily. Use clear sticky traps instead of yellow.

Root Knot Nematodes in Tomatoes – These are soil borne. These nematodes [*Meloidogyne* spp.] are very small and wormlike which infect the root system of the plants, damaging the tissue and reducing the capacity of the roots to move the water and nutrients to the leaves. The plant will die eventually.

Symptoms include elongated swellings of the root length forming galls, poor growth of the plant and wilting during the hot time of the day.



Root Knot Nematode

Treatment -

- a. Use resistant varieties.
- b. Use a nematicide such as Vydate.[Contact JGGA or RADA]
- c. Do not allow visitors in the Greenhouse.
- d. Use Footbath with a disinfectant such as bleach or iodine.

Post Harvest

Use field crates to harvest in order to avoid damages to the fruits. Clean the fruits after reaping and store in a cool environment until marketing. Additionally, clean the house by removing all fallen fruits, leaves and branches.

Hurricane Precautions

Jamaica is situated directly in the hurricane path. Regardless of the design or material used for construction, without executing pre-hurricane preparation measures, the greenhouses can be destroyed. These are minimum practices to be adhered to in the advent of a hurricane.

- a. Plastic and netting should be installed to the greenhouse by means of a type of locking device which will enable the quick removal of the pieces of these materials.
- b. Remove plastic and netting from the greenhouse structure.
- c. A fuel pump and standby generator maybe necessary to save the crop after the hurricane.
- d. Water tanks should be filled with water or removed to a protected area.
- e. If bags or pots are used for growing the plants, the plants can be removed to a safe area or lay on the sides with a light covering.
- f. If growing directly in the soil remove the plants from the trellising system and lay them flat.
- g. Arrange to get enough labour to carry out all these measures quickly.

Conclusion

Greenhouse farmers here tend to emphasize only the greenhouse construction and forget all about the good agricultural practices [GAP]. There is the need to apply all good practices to get high yields. Tomato – 20 lbs. /tree and Sweet Pepper 8 lbs. /tree per crop.

READY FOR SALE AND
HARVESTING



2/12/2008

Tomato

	From transplanting to 10 days before first Harvest	From 10 days before first harvest to end of the crop
	Lb	Lb
Potassium Nitrate	4.8	0
Monopotassium Phosphate	10.5	8.5
Potassium Sulfate	12.8	25
Iron Chelate	0.5	1
Magnesium Sulphate	22.0	24
Calcium Nitrate *	36.0	42
* Mixed by it self		
	Grams	Grams
Manganese Sulphate	45.00	45.00
Copper Sulphate	20.00	20.00
Zinc Sulphate	20.00	20.00
Boric Acid	80.00	80.00
Amonium Molybdate	5.00	5.00

Tomato

	From transplanting to 10 days before first harvest	From 10 days before first harvest to end of the crop
	ppm	ppm
N	150	155
P	55	50
K	242	310
S	69	75
Fe	2.8	5
Mn	0.8	0.8
Cu	0.3	0.3
Zn	0.4	0.4
Bo	0.7	0.7
Mg	52	57
Ca	196	191

Basic Principles of Pruning and Trellising Sweet Pepper

Sweet Pepper plants are indeterminate plants, which mean they continually grow new stems and leaves. In order to maximize production the plants have to be pruned and trained regularly to ensure a balanced growth. Pruning also improves air circulation around the plant which helps to reduce diseases.

There are several recommended ways of pruning although some farmers even suggest no pruning.

As new leaves and lateral side shoots develop from the axils of the new nodes on the growing stems, they have to be pruned to maintain the 2, 3, or 4 main- stem architecture of the plant. The pepper flower also develops at the node, that is the point of the stem from which leaves also arise. When the plant develops 2-3 stem shoots at the fork, the plant should be pruned to leave the two strongest stems.

As the plant grows another one or two shoots maybe chosen, to give three or four stems. This depends on the vigour of the plant where two, three or four stems are chosen for the life of the plant.



Choice of fruits-Some farmers allow fruits from all nodes to mature while others allow alternate ones.

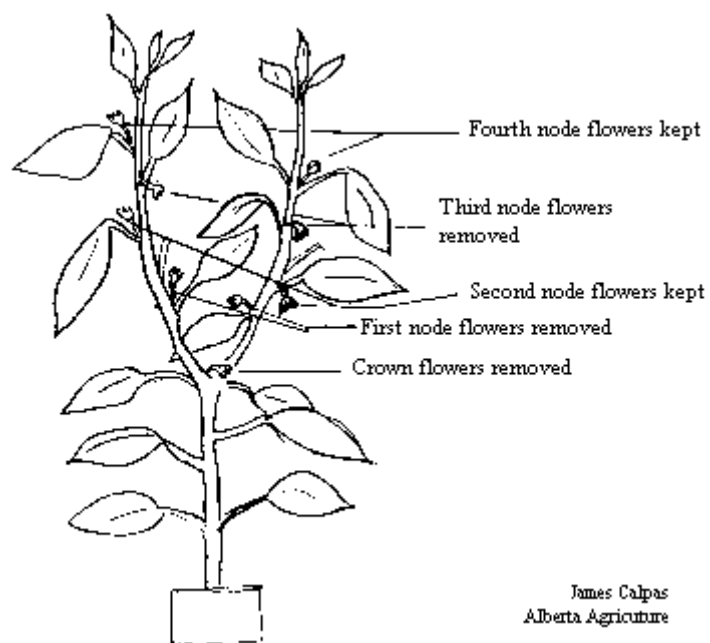
Trellising

Each stem will grow to a height of up to 12 feet and require support in order to remain upright. Twine hung from the overhead support wires is used to support each stem. The twine is tied to the main stem about 10 inches up from the soil or growing media, one length of twine per stem.

It is important to keep the pruning current with the development of the plant .The stem is brittle and easily snaps so pruning and trellising must start promptly. Also production will suffer if the plant's resources were allowed to go into unnecessary leaf and stem production. It must be emphasized that

peppers are pruned to two stems, and if possible maintain six fruits per stem to maintain vegetative and fruit balance, even if the fruit has minor damage , eg. a blossom end rot affected fruit should not be removed until the other fruits have emerged.

Unlike tomatoes pollination of pepper flowers occurs successfully without any outside pollination assistance, although Bumble bee can improve flower set and eventually yield and fruit quality. Pruning is done by using the fingers or cutters to ensure precise removal of the laterals and avoiding any damage to the main stem or main stem growing point.



A suggested method of pruning

Sweet Pepper

	From transplanting to 10 days before first harvest	From 10 days before first harvest to end of the crop
	Lb	Lb
Potassium Nitrate	4.8	4.8
Monopotassium Phosphate	10.5	10.5
Potassium Sulfate (KCl)	3.5	12.8
Iron Chelate	0.5	0.5
Magnesium Sulphate	22.0	24.0
Calcium Nitrate *	36.0	36.0
* Mixed by it self		
	Grams	Grams
Manganese Sulphate	45	45
Copper Sulphate	20	20
Zinc Sulphate	20	20
Boric Acid	80	80
Amonium Molybdate	5	5

Sweet pepper

	From transplanting to 10 days before first harvest	From 10 days before first harvest to end of the crop
	ppm	ppm
N	150	150
P	55	55
K	150	250
S	69	69
Fe	2.8	2.8
Mn	0.8	0.8
Cu	0.3	0.3
Zn	0.4	0.4
Bo	0.7	0.7
Mg	52	57
Ca	186	166