Hot Pepper Production Manual for Trinidad and Tobago

Written by

Herman Adams
Pathmanathan Umaharan
Richard Brathwaite
Kadeem Mohammed

Hot Pepper Production Manual for Trinidad and Tobago

An output of the CARDI project 'Improving the hot pepper industry of Trinidad and Tobago'

Written by
Herman Adams, MSc
Pathmanathan Umaharan, PhD
Richard Brathwaite, PhD
Kadeem Mohammed, BSc

Reprinted November 2011

The publication of this document was made possible through the kind courtesy of the Caribbean Agricultural Research and Development Institute (CARDI)

CARDI was founded in1975 as an autonomous institution of 12 member countries of the Caribbean Community (CARICOM). The member countries are: Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago. The Institute is governed by a Governing Body comprised of the Ministers responsible for agriculture and Board of Directors comprised of representatives nominated by member governments and key collaborating agencies.

CARDI, PO Bag 212, University Campus, St. Augustine, Trinidad and Tobago, West Indies

PSC# TT/001/06

Table of Contents

Foreword

Hot pepper has been identified as one viable option in the diversification thrust of the Regional agriculture sector, following the reduction in importance of the traditional export crops of banana, sugar and cocoa. It is within this context that the Caribbean Agricultural Research and Development Institute (CARDI) was mandated to develop the Regional hot pepper industry.

The Institute's programmes of research and development in hot peppers are designed to address some fundamental challenges along the value chain. CARDI's intervention focuses on the development and improvement of varieties of commercial importance across the Region, the improvement and stabilisation of indigenous varieties of interest to specific countries, the production of high quality seeds, and establishment of productivity indices and investment profiles for these varieties. It is hoped that collectively all of these activities will increase production and productivity so farmers can meet the growing demands of the local and international niche markets and ultimately enhance their quality of life and contribution to the economic development of their countries.

This publication is one of the outputs of work done with hot pepper farmers and has proven to be highly popular among all stakeholders hence the need for updating and reprinting the manual. Although the publication was specifically written for Trinidad and Tobago, the principles outlined are applicable throughout the Region.

I wish to thank all those organisations that directly contributed to the production of this manual: Ministry of Food Production, Land and Marine Resources (MFPLMR), the University of the West Indies (UWI), the Trinidad and Tobago Agri-Business Association (TTABA), the Sugarcane Feeds Centre (SFC) and the Technical Centre for Agricultural and Rural Co-operation (CTA) ACP-EU. We look forward to continued collaboration that would help with the repositioning of the agriculture sector in the Region.

H. Arlington D. Chesney

Executive Director, CARDI
November 2011

Introduction

Hot pepper is regarded as an important non-traditional crop in Trinidad and Tobago where it is utilised in the fresh and processed forms. Hot pepper products are traded extensively both on the domestic and export markets.

The hot peppers of the West Indies that are grown commercially belong to the *Capsicum chinense* Jacquin species. Another species of hot pepper is *Capsicum annuum* L which includes the chilli peppers of Mexico. The *C. chinense* group of hot peppers originated in the geographic area in the Tropical Americas covered by northern South America (Northern Brazil-Guyanas-Venezuela), Central America and the Antilles (Caribbean islands). This is the main reason why these varieties of hot pepper are most adapted to this area.

The species, *Capsicum, frutescens* L., also grows in the Caribbean and is the small conical pepper called "Bird Pepper" which is cultivated in backyards and found in the wild. This pepper is often bottled and pickled in rural households.

The Caribbean varieties of hot peppers, including the landraces grown in Trinidad and Tobago, are among the hottest peppers with strong flavours and are much in demand on the world market.

This manual is geared towards providing extension agents and farmers with the tools and techniques for the cultivation of the hot pepper crop. Trainers of farmers and extension agents as well as researchers should also find this document very useful.

In addition to these guidelines, it should be recognised that each planting site is unique and that the recommendations made are general in nature; modifications to suit specific sites are required.

The document should be used in conjunction with other publications including GAPS (Good Agricultural Practices), HACCP (Hazard Analysis and Critical Control Practices) and CODEX Alimentarius Commission (WHO/FAO).

The manual is a product of a project implemented by the Caribbean Agricultural Research and Development Institute (CARDI) aimed at improving the hot pepper industry of Trinidad and Tobago. Financial support was received from the Inter-American Institute for Cooperation on Agriculture (IICA). The Technical Centre for Agricultural and Rural Co-operation (CTA) ACP-EU, supported the reprinting of this manual. Project implementation is carried out in collaboration with the Ministry of Food Production, Land and Marine Affairs (FPLMA), the National Agricultural Marketing Development Corporation (NAMDEVCO), the University of the West Indies (UWI), St Augustine, and other stakeholders in the hot pepper industry.

Planning Production

The first step in planning production is to find out what kind of hot pepper is wanted by the buyers and in what quantities. This will help the farmer to decide on the variety and the size of planting.

Answers to the following questions are critical to the planning process:

- *How often do the buyers purchase peppers and how much can they handle at a time?*
  The answers to these questions will help to schedule planting and pickings and regulate the size of the area harvested at a time.

- *Which are the months of the year when peppers fetch the highest prices?*
  This answer will determine the best month in which to transplant the seedlings in order to harvest when prices are highest. Some producers think that the best time to transplant is in August-September so that harvest begins in October/November and continues up to March. The NAMDEVCO website gives valuable information on this question (www.namdevco.com).

- *How do the buyers want the pepper with regard to grading and packaging?*
  If they prefer to buy at farmgate and do their own grading and packaging then the price may be lower.

- *Do the buyers want the pepper graded and put into special boxes?*
  These issues should be agreed upon between farmers and buyers to give the farmers time to acquire the packages, schedule picking and make arrangements with the packhouse (NAMDEVCO, for example).

- *What are all the inputs required for the pepper crop and at what rates are they applied?*
  The answers to these questions will help the farmer to determine how much money will be needed to invest in the crop and permit the acquisition of inputs and equipment beforehand.

This manual will help to provide the answers to the above questions.

When planning production it is also important to estimate the cost of production for the crop. Table 1 shows the estimated cost of production for 1 acre (0.4 ha) of hot pepper. Fixed assets and operational costs are also listed in Table 4 and Table 5 and should be a good guide in planning the crop.

Table 1 Summarised cost of production for 1 acre (0.4 ha) of hot pepper

Costs	TT$
Labour	26,638
Materials and supplies	19,846
Equipment	49,848
Total costs	96,332
Gross income	236,250
Net Profit	139,918

Choice of Varieties

Hot pepper varieties/landraces

Farmers grow specific varieties[1] or landraces[2] of their choice. The hot pepper varieties are further categorised into purelines[3], hybrids[4] or bulk[5] varieties. There are a number of varieties

[1] A variety is a population of plants that is homogenous for a set of characteristics that typify the variety. Varieties are usually either purelines or hybrids developed by institutions or seed companies.
[2] A landrace is a population of plants maintained by farmers, which is often quite variable for commercially important horticultiral characteristics.
[3] Pureline varieties are uniform varieties, which breed true, and hence farmers could keep seeds for planting their next crop.
[4] Hybrid varieties are uniform varieties, which do not breed true. Hence, farmers cannot keep seeds for the next crop but have to purchase seeds from seed companies for each crop.
[5] Bulk varieties are not entirely uniform, but are fairly uniform with respect to most horticultural characters.

Table 2 A list of landraces in use across the region

Name	Landrace / variety	Purpose	*Source of quality seed
Scotch Bonnet	Pureline variety	Fresh fruit	Ministry of Agric., Bodles, Jamaica
West Indies Red	Bulk variety	Fresh fruit	CARDI, Antigua
Cardi Green	Pureline variety	Fresh fruit	CARDI, Antigua
Habanero	Bulk variety	Fresh or processed	Imported
Big Sun	Hybrid	Fresh fruit	Imported
Tiger Teeth	Landrace	Processed into sauce	CARDI, Barbados
Cayenne Pepper	Pureline variety	Dried and ground	Imported
Wirri Wirri	Landrace	Pickle	CARDI, Barbados
Faria	Landrace	Fresh fruit	Available from farmers/nurseries
Hood	Landrace	Fresh fruit	Available from farmers/nurseries
Congo Pepper	Landrace	Fresh fruit	Available from farmers/nurseries
Seven Pod	Landrace	Fresh fruit	Available from farmers/nurseries
Pimento Pepper	Landrace	Fresh fruit (seasoning pepper)	Available from farmers/nurseries

*See Appendix No 1 for contacts

Figure 1 West Indies Red berries

Figure 2 CARDI Green berries

Figure 3 Faria berries

Figure 4 Hood berries

Figure 5 Tiger teeth berries

Figure 6 Red Congo berries

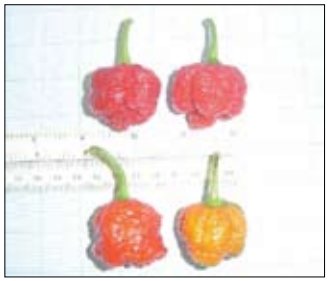

Figure 7 Seven Pod berries

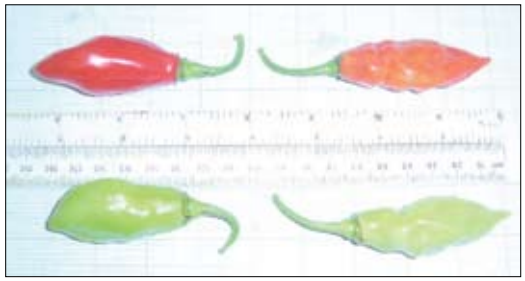

Figure 8 Pimento berries

and landraces of hot pepper that are used in the Caribbean. Some landraces such as Scotch Bonnet have been purified and developed into varieties, while others are simply maintained by farmers. Examples of some commonly grown varieties/ landraces are shown in table 2.

The commonly used landraces in Trinidad and Tobago include Faria, Hood, Congo Pepper, Seven Pod and Pimento (a seasoning pepper) Other popular landraces from the region are Scotch Bonnet (Jamaica), Wirri Wirri and Tiger Teeth (Guyana), Peggy Mouth (Antigua), Goat Pepper (Bahamas), Bonnie Pepper (Barbados) and Bonda Majaque (Dominica and St. Lucia).

Factors determining choice of variety

The choice of hot pepper variety/landrace to be grown depends on the purpose of the production activity, consumer/market preference, productivity and adaptability of the variety to the intended agro-ecozone, tolerance of variety to the important pests and diseases and availability of quality seed or seedlings.

Quality seeds

Availability of quality seeds is an important criterion in variety selection. Use of quality seeds ensures that the seedlings germinate uniformly, conform to varietal purity standards, are of good vigour and do not harbour seed borne diseases. Quality seeds for the various landraces are not always available, as they are not part of national or regional seed production and certification programmes. This along with the fact that product quality and varietal characteristics may not be uniform for landraces can result in agronomic and/ or marketing problems to growers of landraces. Quality seeds of West Indies Red and CARDI Green are produced and marketed by CARDI. Efforts are being made to provide quality seeds for the local commercial landraces by early 2008.

Market preference

Although market preferences vary from country to country, from time to time, and depending on the intended use of the peppers, it is possible to outline some general criteria for market acceptability for the various purposes. The fresh fruit market generally prefers a large fruit (>0.35 oz or 10 g), with a thick pericarp, with a deep green colour when immature turning to red when ripe. The fruits should be of medium-to-high pungency with a strong flavour. Certain varieties such as Scotch Bonnet have characteristic shapes, pungency and flavour profiles that are preferred by the market. Although all varieties of hot pepper can be ground to make pepper sauces, the purposes in table 2 are some recommended uses of the varieties.

Productivity

Productivity is an important criterion in selecting a variety, since it determines to a large degree the profitability of the operation. Productivity is also affected by planting density and the local adaptability of the variety. In Trinidad and Tobago, the average productivity of hot pepper varieties is very low being around 15,000-35,000 lb/acre (16,815-39,235 kg/ha); all things being equal, the main reason for low yields is the low planting densities used. Farmers usually plant 2,000- 3,000 plants per acre (4,940-7,410 plants/ha) thereby obtaining the low yields. It is important to evaluate the productivity levels of selected varieties in your own environment prior to embarking on large scale planting of hot pepper.

Adaptability to pests and diseases and growing environment

Environmental adaptability and tolerance of varieties to the various pests and diseases prevalent in Trinidad and Tobago is also another critical factor that must be considered in choosing a variety or a landrace for planting. This determines the cost of production and the agricultural risk associated with planting peppers. At present, West Indies Red and CARDI Green (a selection from the West Indies Red) are the only varieties with proven levels of tolerance to pests and diseases and general adaptability to environments across the Caribbean. The landraces of Trinidad and Tobago exhibit the highest levels of adaptability to local conditions. For this reason and once a source of pure and healthy seeds is found, Faria, Moruga Red, Moruga Yellow and Hood are recommended for the fresh fruit market. The above varieties along with Seven Pod and Scorpion are good for processing for the production of hot pepper sauces.

Field and Soil Preparation

Field selection

The hot pepper field should ideally be sited on land without obstacles to mechanical soil preparation. A tractor should be able to easily effect ploughing and rotavating. The land should be cleared of all trees, stumps, rocks and be free of depressions. Access to quality irrigation water from any suitable source would be an asset. Mild slopes to provide rapid run-off of excess rainwater are also an advantage. It is a distinct advantage to have an access road running by the field to make transportation easier.

The other important aspect to site selection is security. The farmhouse should be located near the field or a guardhouse should be built on the field itself. Fencing an entire field may be too expensive to consider; this is reason why some farmers organise a system of guarding all the fields within a community and share the costs.

Soil preparation

The soils of Trinidad and Tobago, for the most part, must be carefully prepared for the hot pepper crop.

The following are some of the operations that may be required:

- Take soil samples and send them to a soil laboratory for analyses

- Remove tree stumps and rocks; disturb the top soil as little as possible. Where land levelling is required, store the 0-12 inches (0-30 cm) layer of top soil for re-distribution over the surface after levelling.

- Use a chisel plough 15-30 inches (38-76 cm) deep in two directions to break the hard pan layer or on heavy clay soils. Leave soil to weather for 2-3 weeks before rotorvating.

- Form 12-16 inches (30-40 cm) high cambered beds, 16-20 feet (5-6 m) wide on heavy clay soils. Cambered beds on light textured soils may be 8-12 inches (20-30 cm) high at the crest.

- Apply limestone to acid soils before the final rotavating at rates of 1-3 tons per acre (2.5-7.5 t/ha) depending on the degree of soil acidity as shown by the pH in the results of the soil analyses.

- Dig drains at intervals to collect and discharge run-off water. The heavier the clay and the flatter the land, the closer and deeper the drains. Drains of 20-25 inches (50-65 cm) deep are necessary between the cambered beds. The depth of the drains must be greater than the depth of the bulk of the roots, i.e., deeper than 30 inches (78 cm) in clayey soils. Since hot pepper cannot tolerate waterlogging, the field must be drained efficiently.

- Tillage operations as far as practical should be carried out along the contours in order to prevent soil erosion. Normal soil conservation measures, contour drains, grass barriers and terraces, should be developed along the contour lines. This means that these operations should be carried out perpendicular to or across the slope, not up or down slopes.

- During soil preparation operations, the opportunity should be taken to apply the “stale seed bed” technique to manage weeds. After the sod is turned by soil moving equipment such as the plough or rotavator, the weed seeds are left to germinate and grow. When the weeds are growing vigorously and reach a height of 2-4 inches (5-10 cm), they should be sprayed with an efficient systemic herbicide. Repeat this procedure on 2-3 flushes of weed growth. A pre-emergent herbicide should also be applied prior to transplanting on the already prepared land.

Windbreaks

In areas where the wind speed surpasses an average of 5 meters per second (16 ft/sec), the wind dries out the soil moisture and increases evaporation; this means an accelerated loss of water through the openings (stomata) in the leaves. Windbreaks are necessary when wind speeds surpass 8 meters per hour (18 mph).

Windbreaks are planted across the direction of the main winds to reduce water loss by wind. Fast growing species including maize (*Zea mays* L.), sugarcane (*Saccharum officinarum* L.), guinea corn (*Sorghum halepense* L.), gliricidia (*Gliricidia sepium* Jacq.) and pigeon pea (*Cajanus cajan* L. Millsp.) can be planted a month or two before transplanting

the hot pepper seedlings. The windbreak should be planted at close spacing and in 3-5 rows thick. If the field is large then the windbreak should be planted at 100-165 feet (30-50 m) intervals. In the case of a small field the windbreak should be planted along the borders facing the strongest winds.

Wide and dense windbreaks more than 6-10 feet (2-3 m) high can also help to keep out insect pests such as whitefly and aphids.

Irrigation

Irrigation water quality, especially from streams and ponds, should be sent for analyses to ensure that the water is not too polluted or saline. It must be of optimal quality for irrigating crops.

Hot pepper does not thrive under drought conditions. The crops need adequate irrigation to produce high yields and quality berries. The critical moisture periods are during the seedling stage, at transplanting and the week after, just before flowering and during fruit set and development. Since the bulk of the roots is up to about 30 inches (78 cm) deep, irrigation water must be supplied to wet the soil profile up to this depth. Too little watering will encourage shallow rooting while too much will cause waterlogging and wash away nutrients and top soil.

Irrigation water is mainly supplied in the following ways:

- sprinklers
- drip lines
- gravity flow

Some farmers use the first two systems; the sprinklers are best used immediately after transplanting and in very hot and dry weather in order to reduce ambient temperature, increase air humidity and moisture in the soil. Drip lines economise on water use and deliver the water directly into the root zone. Water soluble fertilisers are also supplied through the drip lines. This is a great advantage since fertilising can be effected after every picking and at lower costs than manual application.

Tensiometers are used to indicate how much water is in the soil. Ideally, soil moisture should be kept at 60-80%. Hot pepper thrives best in the Caribbean where the average daily temperatures are between 77-95 0F (25-35 ºC) and the night temperatures 72-79 ºF (22–26 ºC).

Where rainfall is adequate, above 50 inches (1,300 mm) annually, planting should be timed to benefit from rain-fed conditions under which hot pepper thrives best. The highest yields are obtained under rain-fed conditions supplemented by drip irrigation.

Figure 9 Drip irrigation lines in a ridged and furrowed field

Figure 10 Pigeon Pea (Cajanus cajan L. Millsp.) windbreak in a hot pepper field

Figure 11 Cambered beds

During the dry season, hot pepper should be irrigated at least once every 2 days to maintain adequate soil moisture.

Seedling Production

Seedling nursery

The result of the crop is determined largely by the quality of the seedlings. Healthy, vigorous, evenly and well-developed seedlings from the right variety, have the genetic potential of producing high yields. The requirements for the seedling nursery that can produce seedlings as described above should be as follows:

- Built in a location with low disease pressure; this is usually in isolation from production plots of the same species of crops hosting the same pests and diseases as the seedlings.
- The nursery should be built of insect-proof mesh and frequently sterilised with bleach, insecticides, acaricides, trisodium phosphate and other sterilants.
- The irrigation water quality should enable rapid plant growth.
- Kept as a no-smoking zone since viral particles are transported on tobacco and smokers' hands.
- The hot pepper seedlings should be treated with a systemic insecticide (imidacloprid e.g. Admire) and fertilised with water soluble fertilisers containing both macro and micro-nutrients.

If a farmer cannot produce seedlings on-farm, an order should be placed at a reliable commercial seedling nursery, where high quality seedlings are produced.

Developed seedlings

Within four weeks the seedlings should be weaned and hardened reaching a height of 6-7 inches (15-18 cm) and more than one eight of an inch (0.3 cm) thick stem with at least four well-developed true leaves.

Whether produced on-farm or bought from a commercial nursery, hot pepper seedlings must be transplanted ideally at 4 weeks old. They must be produced in trays where the cells are as large

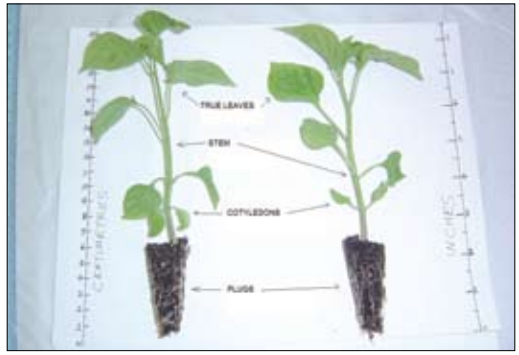

Figure 12 Anatomy of developed hot pepper seedlings

Figure 13 Four-week-old seedlings ready for transplanting

Figure 14 View of a seedling nursery

Figure 15 View of benches in a seedling nursery

as possible. This is required for a large “plug” of potting mix to adhere to the roots. The bigger the plug the more water and nutrient it can hold and the smaller the shock to the seedling at transplanting. The transplants recover quickly and grow and produce more uniformly. Seedling mortality is also reduced.

Transplanting and spacing

Transplanting can be done manually or by a mechanical transplanter. The transplanter punches a hole through the mulch or into the bare soil, places the plug (roots with adhering soil) of the seedling into the hole, pulls soil around the plug with the roots and firmly presses down the soil around the roots, leaving the seedling in an upright position and firmly anchored into the soil.

The depth of transplanting should be deeper than 1½ inches (4 cm) and up to the cotyledons. The root plug and the soil should be kept moist during transplanting. It is essential that the entire field be kept well watered for the entire week after transplanting.

Higher plant population densities are recommended. Accordingly, seedlings should be spaced at 3 ft x 2 ft (90 cm x 60 cm) producing 7,260 plants/ac (17,932 plants/ha), 2.5 ft x 2 ft giving 8,712 plants/ac (21,527 plants/ha) or 2 ft x 2 ft (60 cm x 60 cm) producing 10,890 plants/ac (26,898 plants/ha).

Varieties (e.g. Moruga Red, Moruga Yellow and Hood) with profuse branching and taller plants are spaced wider. Faria and West Indies Red are medium sized; Scotch Bonnet and CARDI Green with smaller plants can be spaced the closest.

Crop Care

Weed control

Proper weed management begins at the land clearing and land preparation stage during which the ‘stale seed bed technique’ is applied. This entails two to four applications of systemic herbicides (such as Round-up) on successive flushes of weed growth. After the first cut the weeds are left to emerge and grow up to 3 to 4 inches (8-10 cm). At the point of vigorous growth, they are then sprayed with systemic herbicide when uptake of the active ingredient would be greatest and subsequent weed kill most thorough and efficient. This should be done each time after the soil is turned over by plough or cultivator.

The next step is the application of an efficient pre-emergent herbicide before transplanting. High plant population densities [more than 8,000 plants per acre (19,000 plants per hectare)] also help to smother weeds since the canopy closes over sooner. Some hand weeding or mechanised cultivator may be needed before the canopy closes over. If the dominant weeds are true grasses, from the family Gramineae, then a selective herbicide, such as Fusilade, can be applied. It will kill only the true grasses and does not harm the crop when sprayed over the top. Weeds surrounding the field should also be controlled since they harbour pests and diseases.

The more common weeds frequently met in pepper fields are as follows:

- Fowl foot grass – *Eleusine indica* (L.) Gaertn. (Fig. 17)
- Seed under leaf – *Phyllanthus amarus* Schum. & Thonn. (Fig.16)
- Bermuda grass – *Cynodon dactylon* (L.) Pers. (Fig.18)
- Nutgrass – *Cyperus rotundus* L. (Fig. 20)
- Bhaji – *Amaranthus* spp. (Fig. 19)
- Tapia grass – *Sporobolus indicus* L. (Fig. 21)
- White Top – *Parthenium hysterophorus* L. (Fig. 23)

Figure 16 Seed Under Leaf

Figure 17 Fowl Foot Grass

Figure 18 Bermuda grass

Figure 19 Wild bhaji

Figure 20 Nut grass

Figure 21 Tapia Grass

Figure 22 Water Grass

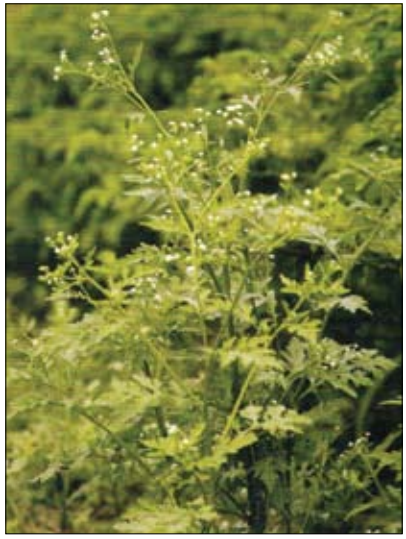

Figure 23 White Top

These weeds can be managed by good land preparation and herbicides. Mulching with dried vegetative mass, plastic or fabric can also be effective in keeping down weeds.

Generally, the farmer should choose the more environmentally friendly herbicides and always use the rates specified on the labels. Spraying should not be done in windy weather and spray shields should be used in spraying between the rows in order to prevent the spray from drifting onto the plants within the rows.

Pest management

Integrated pest and disease management strategies should always be employed to protect the environment and provide maximum protection to the crop. Some of the recommended strategies are as follows:

- crop and field rotations
- removal of weeds that host pests and diseases
- planting resistant varieties
- use of organo-phosphates and pyrethroids based on the economic threshold of the infestation
- pesticides to conserve the natural enemies
- intercropping
- barrier rows of other crop species
- insect traps
- release of parasites
- biological insecticides such as *Bacillus thuringiensis* L.
- vegetable extracts such as neem oil and
- reflective mulches

Some of the more important pests on hot pepper and recommended control measures are as follows:

Name of Pest	Management Strategy
Whitefly (*Bemesia tabaci* Genn.)	Rotation with corn, sweetpotato, cassava and pineapple; reflective mulches, windbreak barriers, high plant population densities, sticky traps and imidacloprid spray.
Aphids (*Aphis gossypii* Glover and *Myzus persicae* Sulzer)	Same as above
Broad mite (*Polyphagotarsonemus latus* Banks)	Spray with acaricides such as New Mectin, Cascade and Torque
Red spider mite (*Tetranychus merganser* Pritch. & Bak)	*The control is the same as above.*
Palm thrips (*Thrips palmi* Karny)	Control is effected through good field sanitation, thick and tall windbreaks, lower doses of N fertilizers, mulching and appropriate biocides such as Admire, Cascade, Belmark and Marathon.
Flower bud moth (*Symmestrichema capsica*)	Spray with insecticides such as Malathion, Karate, sevin, Basudin, Admire and Ambush.
Chili thrips (*Scirtothrips dorsalis* Hood)	Spray alternately with insecticides chlorfenapyr, spinosad and imidacloprid.

Always select the more environmentally safe biocides which should always be rotated. The application of "cocktails" (mixtures of products) should not be done. Also read the labels and follow the instructions.

Some pest characteristics and damage

Figure 24 Whitefly

Whitefly

Adult whitefly has white to pale yellow bodies covered in a fine, white, waxy material and is about 0.04 inch (0.1 cm) long.

The whitefly feeds by piercing and sucking mouth parts on the sap from the foliage; this results in chlorotic spots on leaves, wilting of leaves, retarded plant growth and shedding of leaves.

The whitefly carries viral particles from plant to plant. Viral diseases crinkle and curl leaves which become chlorotic, turn leathery and brittle. Fruits may become striped and malformed. Younger plants may be killed by viral diseases.

Figure 25 Aphids

Aphids

There are two main species of aphids: *Myzus persicae* and *Aphis gossypii*. The nymphs of *M. persicae* are reddish while the colour of the adults varies from green to yellowish green. The females are between 0.07 - 0.1 inch (0.18 - .25 cm) long.

A. gossypii adults range in colour from light or dark green to black but may be yellow to white on older leaves. The length of the females is 0.03 - 0.07 inch (0.07 - 0.18 cm).

Both species of aphids feed on the undersides of leaves piercing and sucking the sap which cause stunting, deformation, gall formation, withering and drying of plants. Leaves may become curled, wrinkled or cup-shaped.

The symptoms may be due to feeding or the viral diseases which are spread by the aphids: chlorosis, puckering, vein banding, mosaic and fruit

deformation. Honeydew secreted by the aphids encourages the growth of black sooty mould on leaves.

The feeding of the insects themselves and the effects of the viral diseases cause losses in yield and quality of berries.

Figure 26 Mites

Mites

The male's body is short and broad 0.006 inch x 0.004 inch (0.15 mm x 0.09 mm) with long conspicuous legs. The female's body is oval and broad 0.009 inch x 0.006 inch (0.22 – 0.15 mm) with white stripes on the back and whitish legs. They are so small that they are difficult to be seen with the naked eye.

Feeding by mites produces brown rough spots which may later become dry, cracked and brittle on areas between the veins of the leaves or on fruits. Leaves may wilt and curl the young ones tending to curl under and are narrower than normal. In extreme cases, leaves may fall off. Fruits become smaller, round and hard. Attacked fruits and leaves show typical mite symptoms of bronze colour.

Damage of plant and losses of yield may be very severe.

Figure 27 Palm thrips

Palm thrips

Adults are very small, flea-sized and silver coloured. Nymphs are light yellowish orange-brown with two brown stripes down their backs.

Feeding by thrips produces bronze dry areas along the mid-rib and on both surfaces of the leaf which become deformed. Yield losses are significant.

Disease Management

Wilts (Fig. 32)**, blights and foot/collar rot**
Fungal diseases on roots caused by *Phythophthora* spp (Fig. 28), *Sclerotium* spp, *Pythium* spp and *Rhizoctonia* spp in wet weather, can bring about wilting and death of plants especially if the field is waterlogged. The remedy is rapid draining, drying of the field by sunshine and spraying fungicides into the rhizosphere (root zone) of the plants. It is better to alternate spraying with a few fungicides. The best control, however, is to plant tolerant varieties.

Soil fungi cause root rot, collar rot and the blockage of the vessels which take water and plant food from the roots up to the leaves and other parts of the plants. The leaves wilt and droop as a result.

Figure 28 Typical symptoms of Phythophthora root rot

Viral diseases

There are several viral diseases on hot pepper (Fig. 29 & 30). Insect vectors and handling spread the viral particles from infected to healthy plants. There are no cures as yet for viral diseases. However, the following measures should be taken to contain these diseases:

- planting tolerant/resistant varieties.
- management of insect vectors (whitefly, aphids, etc.) from the seedling nursery and the field
- use of seeds which have been specially grown, selected and treated to wash off viral particles.
- rouge-ing of all seedlings and plants showing symptoms of viral diseases and burning them. Washing of hands thoroughly before handling other plants.
- practice of field and crop rotation (with corn, cassava and sweetpotato) and the use of higher planting densities.

The Tobacco Mosaic Virus (TMV), Cucumber Mosaic Virus, the Potato Y Virus (PYV), the Tobacco Etch Virus (TEV) and the Geminiviruses can all cause damage to hot pepper. These diseases may appear

Figure 29 Viral disease symptoms

together as a Viral complex. The symptoms are mosaic on leaves, deformation of leaves, cupping

and crinkling of leaves, retarded and stunted plants. Viral diseases can drastically reduce yields and kill plants.

Figure 30 Viral disease symptoms

Anthracnose (Fig.31) is caused by a fungus and is seen as small sunken, water soaked, circular lesions on fruits. The fungus is spread by wind and water splashing from the ground and other surfaces. The disease is also seed borne. Management consists of the removal of infected fruits, improved drainage, wider spacing in the wet season and the use of fungicidal sprays. A major control method is the use of clean seed from healthy fruits. Crop rotation and the burning of crop residues from infected field are also recommended.

Figure 31 Anthracnose symptoms on a pimento berry

Figure 32 Wilt symptoms on hot pepper plants

Figure 33 Bacterial leaf spots of hot pepper

Bacterial spots (Fig. 33) appear on leaves infected with the bacterium, *Xanthomonas campestris*. These numerous spots 0.008-0.08 inch (0.2-2 mm) have a central depression on the upper leaf surface and slightly raised brown areas centrally on the lower surface. The spots on fruits are raised and measure about 0.08 inch (2 mm) in diameter and have distinct holes. The disease is wind and water borne and the causal organisms are also spread by the movement of people through the fields.

Control measures may include the following:

- drain soil well and control weeds
- rotate crops especially with cucurbits such as pumpkin and squash which are not affected

- keep fruits off the soil, burn residues from infected fields and spray with suitable fungicides

General considerations

In carrying out pest and disease management, care should be taken to protect the health of people, animals and the environment through the application of Integrated Pest Management (IPM) measures. Biological control measures should always be given preference. Operators should wear protective gear and observe all safety precautions. Environmentally safe chemicals should always be applied and empty containers should be disposed of responsibly. The labels on containers of all products should be read and followed at all times. Applying GAP (Good Agricultural Practices) is strongly recommended.

Fertility Management

General principles

It is impossible to recommend a specific fertiliser management programme that has universal application in all pepper fields. Specific kinds and rates of fertilisers must be determined from the results of soil and leaf analyses*, from the history of the field, residual fertility, plant population density of the crop and the expected yield level. Organic manure helps in the uptake of nutrients from inorganic fertilisers, adds organic matter to the soil, is beneficial to soil structure and enhances growth of micro-flora and fauna. However, all manure should be well composted to ensure that harmful micro-organisms and seeds of weeds are not transmitted to the next crop.

Adequate soil moisture is also crucial for nutrient uptake; available soil moisture should be around 60%. The optimum soil pH for pepper is 6.5 (the range is 5 - 7.5). Suggested sufficiency levels of macro-nutrients in pepper leaves are N, 4 - 6%; P, 0.35 - 1.00%; K, 4 - 6%; Ca, 1 - 2.5%; Mg, 0.3 - 1.00%. Uptake of macro-nutrients by a high yielding hot pepper crop in Antigua was N, 178 lb/ac (199 kg/ha); P2 O5, 31 - 45 lb/ac (35 - 50 kg/ha); and K_2O, 107 lb/ac (119 kg/ha).

*There are two analytical laboratories for soil in Trinidad and Tobago: the Centeno Laboratory of the Ministry of Food Production, Land and Marine Affairs and the Analytical Soils Unit of UWI on the St. Augustine Campus.

The critical periods for nutrients on pepper are as follows:

- 1-2 weeks after transplanting to boost early growth and development of leaves.
- at flowering and early fruit formation for improved fruit set.
- after the first and every harvest to compensate for nutrients removed with the harvest through the production of berries and to provide nutrients for subsequent production.
- at fortnightly intervals after each picking through fertigation or chemigation.

The following blanket recommendation can serve as a broad guideline to be refined in accordance with the results of the soil analyses: 360 - 540 lb/ac (403 - 541 kg/ha) NPK in a proportion of 4:1:3.

Proper fertiliser practices are important for production and quality of hot peppers. A typical one acre (0.4 ha) hot pepper field at a spacing of 16 - 24 in x 36 in (40 - 60 cm x 90 cm), giving 8,000 - 10,000 plants per/ac (19,760 - 24,700 plants/ha), uses 152 lb N/ac (168 kg N/ha), 98 lb P2O5/ac (110 kg P_2O_5/ha) and 223 lb K_2O/ac (250 kg K_2O/ha).

Plants also require secondary nutrients, calcium, magnesium, sulphur and micronutrients (iron, zinc, boron, etc.) which can be found in many fertiliser formulations.

A schedule of fertiliser applications is proposed as follows:	
1. First application	Broadcast manually or mechanically 1/3 the total N and K and all of the P and micronutrients; this is best done after the first or second ploughing. Harrow fertilizer into the soil 1 week before transplanting.
2. Second application	Apply as a "top-up" dose of N and K fertilisers, a further 1/3 of the total requirement within a week after transplanting. Apply as a side dressing 3 - 4 inches (7 - 10 cm) away from the seedlings and 2-3 inches (5 - 7 cm) below the root zone.
3. Third application	Apply the remaining 1/3 of the total N and K fertilisers at the first flowering also as a side dressing.
4. Supplementary fertigation	Start supplementary fertigation (applying water soluble fertilisers through the drip irrigation lines) at 50% flowering and fortnightly intervals thereafter with the following fertilizers dissolved in water [45 gallon (170 L) drum]: potassium nitrate 50 lb/ac (56 kg/ha), phosphoric acid 85% – 2 pints/ac (2.3 L/ha), liquid urea (21-0-0) – 1 gal/ac (9.35 L/ha). Flush the irrigation system for at least an hour with irrigation water after fertigation. Spraying these fertilisers on to the leaves over the top of the crop can also be done. (foliar feeding)

Some specialised plant nutrient formulations containing critical micro-elements are on the market. Biostimulants and plant growth regulators are also found in the garden shops. These products may be used only to supplement basic fertilisation but not to replace it.

Fertiliser recommendations

The following is a general example of a prescription-based recommendation:

1. Pre-plant –180 lb/ac (201 kg/ha) mixed fertiliser (NPK) grade 12-24-12 incorporated into planting rows or ridges.

2. Two weeks after transplanting apply NPK 15-15-15 at 0.7 oz (20 g)/plant in a 4 inch (10 cm) diameter circle around plants and cover lightly. Repeat at 4 and 8 weeks.

3. Liquid feed plants weekly for the first 6 weeks with 20-20-20 NPK at ½ oz /1gal (3.7 g/L) water. Apply 88 fl. oz (2.6 L) to each plant.

4. At 50% flowering, give each plant 0.7 oz (20 g) NPK at a ratio of 12-11-18 and repeat at monthly intervals during production.

5. It is advisable to foliar feed plants during fruit production with Potassium Nitrate/Calcium Nitrate at a rate of 0.1 oz/2 pints (3 g/1.1 L) water to each plant at weekly intervals.

Plant hormones and plant growth regulators

Plant hormones and plant growth regulators (PGRs) are chemicals used by plants to regulate their growth. The fundamental difference between both is that hormones are naturally produced by the plant tissues

whereas PGRs may either be natural hormones that are extracted from their tissues or synthetic compounds which are administered to plants. The growth processes, which are regulated, include germination, rooting, leaf growth, flowering, fruit ripening and even death. Traditionally five major classes of plant hormones have been identified; these are auxins, cytokinins, gibberellins, abscisic acid and ethylene.

Today, much use is made of commercially available synthetic growth regulators to improve agricultural productivity. The applied concentrations of these substances are measured in parts per million (ppm) and in some cases parts per billion. The use of PGRs has given growers a new opportunity to influence growth to their advantage. The timely application of PGRs has the potential to promote crop earliness, higher nutrient uptake as well as to keep vegetative and reproductive growth in harmony so in order as to improve crop yield and quality.

These growth-regulating substances are often applied as sprays to foliage or as liquid drenches to soil around the plant base. Generally their effects tend to be short lived, and they may need to be reapplied in order to achieve the desired effect. It is however very important to follow manufacturers instructions since these growth regulators are very crop specific and tend to elicit different responses in different plants.

Table 3 Some commercially available plant hormones and plant growth regulators in Trinidad

Plant hormones	Active ingredients	Effects on plant	Application rates for hot peppers
PGR IV	Indolebutyric acid Gibberellic acid	Increased root mass, earlier fruit initiation, increased fruit retention, increased nutrient utilization and higher yields.	Band 2 fl oz./ac (0.15 L/ha) at 2 weeks post transplant Broadcast 2 fl oz /ac (0.15 L/ha) at early bloom Broadcast 1 to 2fl oz /ac (0.15 L/ha) at 21 - day intervals
NewGibb	Gibberellic Acid 10%	Improved yield, fruit size and quality	1st appl. Use 0.35 - 0.5 oz/ac (25 - 35 g/ha) at the emergence of flowers 2nd appl. 0.35 - 0.5 oz /ac (25 - 35 g/ha) at 15 - 30 days after the first application
Cytokin	Cytokinin	Improved flower set & retention, improved fruit set, promotes bud initiation and development, more tillering, uniform fruits size, delays ageing and rejuvenates plants under stress	Apply every 14 days from 6 - 8 leaf stage for 4 application at 4 tsp /gal (5 mL/L)
Bayfolan Forte	Indolebutyric acid	Improved flowering and fruit set	Apply every 8 - 15 days 1 lb 12 oz - 2 lb 10 oz /ac (2 - 3 kg/ha) application should be made prior to flowering

Harvest and Post Harvest Operations

The farmer should make all marketing arrangements with buyers before harvest in order to determine prices for the variety grown, delivery dates and schedules, kinds of packaging and where to deliver the pepper. The buyer should inform the farmer what kinds of pepper are required in terms of stage of maturity and colour.

Peppers sold directly to processors can be picked fully ripe (red or yellow) without the fruit stalk. Whereas, pepper for export is usually picked fully developed but still green or slightly turning. The petiole or fruit stalk is left intact on the fruit.

Flowering in hot pepper generally begins at about 7 weeks after transplanting, with fruit development a further 6 - 7 weeks later. The first flush of mature berries can be harvested about 3½ months after transplanting. Thereafter, regular pickings can be carried out over a period of 8 months or longer given good management of pests and diseases, good weather and high level general crop management. Weekly or fortnightly pickings are usually carried out. Harvesting should cease when yields and berry quality significantly drop.

Fruit production is not constant since the hot pepper plant goes through a series of flowering flushes about once every 3 weeks. Rainfall (soil moisture availability), disease and pest pressure, weed pressure and soil nutrient status are all important contributing factors to flowering and fruiting. Of course, the genetic potential of the variety plays a major role.

Fully developed and mature berries are picked and placed in approved, well-ventilated field containers which should not bruise the fruits. The harvested fruits should be taken from the field and placed in a cool shaded area to lose field heat immediately after harvest. The ideal cooling area is fitted with fans that force cool air through the peppers.

Harvesting should be done in dry weather. Wet hot pepper berries rot a lot faster than dry ones.

Good management of harvest should also ensure the following:

- harvesters should wash hands with soap and water and wear sanitary gloves
- containers cleaned and washed with soap, water and bleach; crates preferably made of firm plastic or wood and with good ventilation.
- careful picking by workers to prevent the breaking of branches especially in fields with a high plant population density.
- separate picking and removal from the field of diseased, damaged, deformed or over-ripe berries.

Picking the hot pepper berry from the plant is achieved by grasping the fruit stalk (or petiole) at the point of the abscission layer where it is joined to the plant, between the thumb and forefinger and pulling upwards. The petiole will break off at its base when the berry is mature. The art of picking is mastered after some practice. This way of picking will prevent breakage of the petiole leaving them whole and undamaged as required by the export market.

Harvested fruits should be placed in firm, non-collapsible crates that can be stacked without placing pressure on the berries. Do not use collapsible containers such as onion bags. Fruits must be delivered to the pack-house as soon as possible after harvest.

Grading

The following berries should be rejected:

- damaged, diseased and undersized
- berries with damaged, discoloured or broken petioles (fruit stalks)
- berries with scale insects, stem borer larvae, any other insects or organisms

Pepper berries are generally selected based on size, colour and degree of ripeness. Size grading can be carried out during harvest and in the pack-house. A size grader (Fig. 34) is very useful for grading. The size grader is simply a hole of a given diameter cut in cardboard or any other material. The grader is also graduated to measure length of the berry. Berries which do not pass through the 1.3 inches (3.3 cm) hole and those equal to or longer than 1.7 inches (4.3 cm) are selected for export.

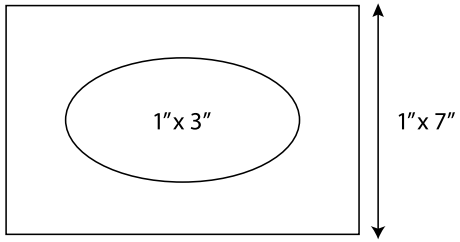

Figure 34 Diagram of a size grader

Figure 35 Boxed hot pepper berries for export

Financial Analysis

There are many variables that determine the returns from a hot pepper crop: the costs of inputs may be high or favourable or the weather may be conducive to high yields and high quality. Therefore, the figures presented in the cost of production in Table 5 are to be taken as a guide in Trinidad and Tobago conditions.

Notes and assumptions for cost of production for 1 acre (0.4 ha) of hot pepper

Technical

- 1 acre (0.4 ha) of land
- seedlings purchased from nursery
- spacing is 30” x 24” (60 cm x 75 cm)
- high plant population density -8,712 plants/acre (19,166 plants/ha)
- average wholesale price for 2007: TT$ 3.75 per lb (TT$ 8.25 per kg)
- fully irrigated drip system
- fertigation through drip lines

Financial (TT$)

- $100/hr for tractor and driver
- $18.00/hr for unskilled labour
- $18.75/hr for semi-skilled labour
- $25/hr for skilled labour

Harvest and Post Harvest

- average yield is about 70,000 lb/acre (78,456 kg/ha)
- 10% field losses

Table 4 Fixed investment * costs (TT$) for establishing a field of hot pepper

		Fixed Investment Costs (TT$)		
Fixed Assets	**Item**	**Unit Cost**	**Quantity**	**Total Cost**
Equipment	Knapsacker sprayer - 5 gl (19 L)	275.00	1	275.00
	Mist blower (4 hp)	3,380.00	1	3,380.00
Packaging	Hard plastic crates	20.00	30	600.00
	Scale - 1000 lb (454 kg)	1,560.00	1	1,560.00
	Light scale - 25 lb (11 kg)	240.00	1	240.00
Irrigation system	3.5 hp pump	2,587.00	1	2,587.00
	Irrigation pipes and fittings, tanks, drip lines, filters etc			21,000.00
	55 gallon (208 L) drum	348.00	1	348.00
Vehicle	Pick up truck 4 x 4 - 22,000 lb (10,000 kg)	50,000.00	1	50,000.00
Field equipment	Shovel	70.00	3	210.00
	Garden fork (5 tines)	300.00	3	900.00
	Cutlass	60.00	3	180.00
	Hoe -10” (25.4 cm)	50.00	3	150.00
	Plastic bucket - 2.5 gallons (7.6 L)	70.00	3	210.00
Housing	Storage shed (15 ft x 15 ft x 15 ft) (4 m x 4 m x 4 m)	5,000.00	1	5,000.00
TOTAL (fixed investment costs)				**86,640.00**

*These costs should be distributed over 3 – 10 years

Table 5 Cost (TT$) of production for 0.4 hectare (1 acre) of hot pepper

Item #	OPERATION/TASK	LABOUR					MATERIAL & SUPPLIES		
		Kind	Unit	Unit Cost	Q'ty	Cost (Sub - total 1)	Kind	Unit	Unit Cost ($)
1	Clear land								
2	Dig drains								
3	Deep plough								
4	Broadcast pen manure	US	hr	18	24	432	manure	bag	12.00
5	Apply pre-plant fertilizer (12-24-12)	US	hr	18	25	450	fertiliser	40 kg bag	150.00
6	Harrow								
7	Ridge and furrow								
8	Apply pre-emergent herbicide	S	hr	25	16	400	herbicide	gallon	460.00
9	Assemble drip irrigation system	S	hr	25	32	800			
10	Spread plastic mulch	S	hr	25	16	400			
11	Transplant	SS	hr	19	34	646	seedlings		0.23
12	Fertilise (15-15-15)	SS	hr	18.75	24	450	fertiliser	40 kg bag	150.00
13	Fertilise (12-11-18) X 10	SS	hr	18.75	240	4,500	fertiliser	40 kg bag	150.00
14	Fertigation X 10	S	hr	25	20	500	Chemicals	bags	300.00
15	Spray growth enhancers	S	hr	25	8	200	Chemicals	125 ml	

Abbreviations:

US - unskilled
no. - number

SS - semi-skilled
S - skilled
Q'ty - quantity

Total operational cost = Labour cost + material + supplies
Total investment cost = equipment + total operational cost

Table 5 Cost (TT$) of production for 0.4 hectare (1 acre) of hot pepper

MATERIAL & SUPPLIES		TOTAL OPERATIONAL COST	EQUIPMENT					TOTAL INVESTMENT COST
Q'ty	(Sub - total 2)		Kind	Unit	Unit Cost ($)	Q'ty	Cost (Sub-total 3)	
			Tractor & blade	hr	100.00	8	800.00	800.00
			Tractor & blade	hr	100.00	4	400.00	400.00
			Tractor & blade	hr	100.00	4	400.00	400.00
500	6000	6432	Tractor	hr	100.00	2	200.00	6632.00
4	600	1050						1050.00
			Tractor	day	350.00	1	350.00	350.00
			Tractor	day	350.00	2	700.00	700.00
1	460	860	Spraycan	no.	500.00	1	500.00	1,360.00
		800	irrigation sys	1 acre	21000.00	1/3	7000.00	7,800.00
		400	Tractor & blade	roll	4,500.00	7	31,500.00	31,900.00
8,286	1,906	2,552	Tractor					2,552.00
2	300	750		no.	25.00	6	150.00	900.00
5	750	5250	Tractor					5,250.00
10	3,000	3,500	Tractor	no.	348.00	1	348.00	3,848.00
781	981							981.00

NOTES AND ASSUMPTIONS

Item # 5: Fertiliser broadcast after ploughing prior to harrowing

Item # 9: Spread cost over 3 years ($12,000/3) for drip irrigation system

Item # 11: High plant population density - spacing 30" X 25"

Item # 12: Fetiliser applied 2 weeks after transplanting, banded around plants

Item # 13: 50% of fertiliser applied at flowering and repeated at fort-nightly intervals for the duration of the cropping season

Item #15: Cytokin 125 ml X 5 bottles X $23.00 = $115.00
Flordimex 1litre X 3 bottles X $222.00 = $666.00

Continued on Page 26

Table 5 Cost (TT$) of production for 0.4 hectare (1 acre) of hot pepper *(continued)*

Item #	OPERATION/TASK	LABOUR					MATERIAL & SUPPLIES		
		Kind	Unit	Unit Cost	Q'ty	Cost (Sub - total 1)	Kind	Unit	Unit Cost ($)
16	Apply insecticides (X10)	S	hr	25.00	80	2,000.00	Insecticide	500 ml	185.00
17	Spray acaricides (X4)	S	hr	25.00	32	800.00	Acaricide	125 ml	97.00
18	Spray fungicides (X2)	S	hr	25.00	16	400.00	Fungicide	200 g	230.00
19	Manage irrigation & drainage	S	hr	25.00	200	5,000.00	Water	m^3	0.10
20	Scout daily	S	hr	25.00	60	1,500.00			
21	Harvest (X15)	SS	hr	18.75	240	4,500.00			
22	Loading /unloading	US	hr	18.00	120	2,160.00			
23	Grading /packing	SS	hr	18.75	80	1,500.00	crates	no	40.00
		Subtotal				**26,638.00**	**Subtotal**		

NOTES & ASSUMPTIONS

Item # 16: First application should be a systemic insecticide applied as a drench at transplanting
For subsequent applications use a contact insecticide as the need arises

Item # 19: Assuming an 8 - 12 month crtopping cycle 50% would be in the wet and 50% in the dry season.
loss of 15% due to evapotranspiration

Item # 23: Produce sold at farmgate

Item #15,16,17,18: The same spray can be used for these activities.

Table 5 Cost (TT$) of production for 0.4 hectare (1 acre) of hot pepper *(continued)*

MATERIAL & SUPPLIES		TOTAL OPERATIONAL COST	EQUIPMENT					TOTAL INVESTMENT COST
Q'ty	Cost (Sub-total 2)		Kind	Unit	Unit Cost ($)	Q'ty	Cost (Sub-total 3)	
4 bottle	740.00	2,740.00	Spray can	no.	500.00	1	500.00	3,240.00
3 bottle	291.00	1,091.00						1,091.00
3	690.00	1,090.00						1,090.00
3,280	328.00	5,328.00						12,328.00
	1,500.00							1,500.00
	4,500.00							4,500.00
	2,160.00							2,160.00
100	4,000.00	5,500.00						5,500.00
	19,846.00	**46,484.00**					**42,848.00**	
			TOTAL INVESTMENT COST					**89,332.00**

NET PROFIT

Average yield per acre	: 70,000 lbs
Expected 10% harvest loss	: 10/100 X 70,000 = 7,000
Marketable yield	: 70,000 - 7,000 = 63,000
Average wholesale price per lb	: $3.75
Gross income per crop	: $236,250.00
Total production cost	: $89,332.00
Cost of production for 1 lb	: $1.27
Net profit per crop	: $236,250.00 - 89,332.00
	=$146,918.00

Appendix #1

Contacts For Quality Seeds

a. CARDI – Antigua: e-mail – cardi@candw.ag, telephone (268) 463-3755
b. Ministry of Agriculture, Director of Research and Development, Bodles Research Station: e-mail – bodlesresearch@moa.gov.jm, telephone (876) 983-2267
c. CARDI-Barbados: e-mail – cardibdos@uwichill.edu.bb, telephone (246) 425-1334
d. Caribean Chemicals: website – www.caribbeanchemicals.com, telephone (868) 638-4769

References

Fournet, Jacques and John L. Hammerton. 1991. Weeds of the Lesser Antilles. INRA, Guadeloupe and CARDI-St. Lucia. INRA, 147 Rue de l'Universite′, 75007 Paris; pp 46, 64, 94, 162,170, 178 & 188.

Ministry of Agriculture. 2003. A crop production technical guide – Hot Pepper. Ministry of Agriculture and Fisheries, St. Vincent and the Grenadines, March 2003, Communications Unit; pp 11, 12, 23 & 26.

Persad, Seunarine; Ian Rampersad and Ravindra Ramnarine (2005). Management of soils for hot pepper production. Proceedings of Workshop on "Identification and Solutions to Problems in Hot Pepper Production", 3 & 10 May 2005 in Macoya and Penal. Pp 10 - 12. MALMR, CARDI and NAMDEVCO.

Ryckewaert, P. 1998. Illustrated guide of insects and mites on vegetable crops in the lesser Antilles. CIRAD-FLHOR Martinique. Book financed by the General Council of Martinique European funds and CIRAD; pp 11, 17, 69 & 35.

Disclaimer

The use of trade names in this document is only to cite examples and not meant to endorse nor discredit any product.

This document has been produced with the financial assistance of CTA.
The views expressed herein are those of CARDI and can therefore in no way
be taken to reflect the official opinion of CTA.