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MSME JAMAICA

ONION

Production in Jamaica

TECHNICAL GUIDE

Ministry of Industry, Commerce, Agriculture & Fisheries

ONION DEVELOPMENT PROGRAMME

It is estimated that approximately 10 million kg of onion are consumed in Jamaica annually, some 9 million kilograms of which are imported at a cost of US$4m.

Since 2009, the Jamaican government, through the Ministry of Industry, Commerce, Agriculture, and Fisheries (MICAF), has been implementing an Onion Development Programme as part of its import substitution thrust to reduce the food import bill and secure the nation's food security.

Increased sufficiency in onion production is being achieved through capacity building of farmers and technocrats in onion cultivation and marketing, and by strengthening partnerships with major buyers, input suppliers, and financial institutions.

The target over the next few years is to increase local production to a level where up to 70% of demand will be satisfied. To that end, major focus is also being placed on improvements in productivity and the quality and consistency in the local production of onions.

ONION

PRODUCTION IN JAMAICA

TECHNICAL GUIDE

GlenMais PUBLICATIONS

ONION: Production in Jamaica | Technical Guide

GlenMais Publications

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From farm to fork, PROPEL is working to improve agricultural market systems and linkages in the Caribbean

The Promotion of Regional Opportunities for Produce through Enterprises and Linkages (PROPEL) is a sustainable economic growth project that aims to increase the value of Caribbean fresh produce accessing high value markets (HVMs) in the Caribbean and internationally by CAD $100 million over six years. PROPEL is implemented by World University Service of Canada (WUSC), a Canadian non-profit organization dedicated to providing education, employment, and empowerment opportunities for youth around the world. Established in 2015, WUSC Caribbean runs PROPEL in Jamaica, Barbados, Dominica, St. Lucia and Guyana.

The project works with private sector buyers, producers, business service providers, and other market system actors to facilitate the safe, effective, and efficient movement of fresh produce from the farm level to high value markets. PROPEL identifies the needs of HVM buyers at the local, intra-regional and extra-regional levels and then identifies producers that have the potential to meet that market demand in terms of quality and quantity of produce. Using a market systems approach, PROPEL facilitates and strengthens linkages between commercial producers and HVMs, with the aim of achieving sustainable economic growth.

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Foreword

Jamaica's onion production began in Pedro, St. Elizabeth in the early 1960s, with the introduction of the Texas Early Grano, Granex Hybrid and Red Creole varieties. In later years and up until the 1990s, Jamaica's local production accounted for over 50% of domestic demand, but thereafter, imports peaked to over 90% to supply Jamaica's consumptive need.

The Ministry, in its import substitution thrust, is moving apace to reverse the trend and this technical bulletin, titled "Onion (*Allium cepa L.*) Production in Jamaica", is timely as it provides current information regarding varieties, planting seasons, pest and disease management, post-harvest practices, and economics of production.

The bulletin will prove valuable to farmers, marketers, financial institutions and is an important first step towards Jamaica's goal of achieving 70% self-sufficiency in onion production in the medium term.

Honourable Audley Shaw, CD, MP.
Minister of Industry, Commerce, Agriculture and Fisheries

Acknowledgements

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Dermon Spence

Chief Technical Director

Ministry of Industry, Commerce, Agriculture and Fisheries

1

Introduction

Onion (*Allium cepa L.*) cultivation in Jamaica dates back to more than 50 years ago (ADC, 1963). It is a culinary 'must use' in Jamaican diets, with more than 10 million kg (10,000 tonnes) consumed annually.

Over the last 18 years, onion production has declined significantly from 4,200 tonnes (4.2 million kg) in 1996 to 680 tonnes (680,000 kg) in 2013 (AMID, MOAF). Productivity over the same period averaged 12t/ha, which is considerably less than the 35-40t/ha reported in the USA and elsewhere (Chandler, 1994, Lorenz and Maynard, 1988). It is also important to note that between 2007 and 2012, the average annual import of onions into Jamaica was 8.8 million kg (8800 tonnes), at a value of US$ 3.7 million.

Against this background and the government's thrust at import substitution, onion production is being promoted. This guideline, therefore, aims to provide preliminary information on the cultivation, harvest and post-harvest of onions for profitable onion production.

2

Crop Establishment

Fig. 1 Onion seedlings in greenhouse for onion transplanting

Varieties and Time of Planting

Onions are classified as short, intermediate or long-day types. Each classification represents the hours of sunlight (day length) which will trigger bulb formation. The day length for short, intermediate and long days are less than 12 hours, 12-14 hours, and greater than 14 hours, respectively.

The mean monthly sunshine hours between March 12 and September 26 is 12.7 and the onions best suited for this period are the intermediate types. The short-day onions will produce better between September 27 and March 11, with a mean of 11.5 sunshine hours. As Jamaica's daily sunshine hours do not exceed 14 hours, long-day onions are not grown in Jamaica.

Mercedes, Arad, Superex and the Grano type onions are recommended for cultivating between mid-October and December. For March/April planting, Orlando, Caballero, Yellow Granex hybrid, and Noam are the varieties that will produce good yields.

Fig. 2 Site selection of flat land with medium-texture loams, with full sunlight exposure, and good wind circulation

Site Selection

Onions can be grown in all parishes in Jamaica. For commercial production, the crop is best grown in full sunlight in medium-texture loams. Land should be flat, and the site chosen should allow for good wind circulation.

Onions should not be planted in sites with a history of nutgrass (Cyperus rotundus). For establishment of onions, it is recommended that fields chosen should not have used for cultivation of any member of the onion family (e.g. leek, scallion, garlic, shallots, and chives) for at least five years.

This period may be reduced if onions are rotated with suitable crops (e.g. cucumber, sweet peppers, and sweet potatoes), and land fallowed with cover crops. Additionally, if soil bacteria, fungi, and nematodes specific to onion are low in incidence, a return to the same field could occur in three years.

Site selection should be always be accompanied by soil and water analyses where possible, as the results should inform the producer whether the site is appropriate for planting of onions.

Fig. 3 Land preparation

Land Preparation

Land preparation encompasses the activities that are taken to produce a soil condition that is suitable to optimum crop production. This usually involves land clearing, ploughing, cross-ploughing, harrowing, rotovating, ripping, and bed-shaping. Drains should also be constructed to prevent water-logging of fields. For onions, land preparation is very critical, especially if the crop is to be direct seeded, and must result in a soil that is crumbly and of proper/good tilth. As ripping of lands can vastly improve internal drainage, ripping of lands should be carried out in lands characterized by heavy clay or sandy loams, in alluvial lands, and particularly in virgin lands. Depth of ripping should be approximately 18 inches, which can be achieved with the use of a 36 inch plough. Beds must be flat and at least 15-20 cm (6-8 in) high. Bed height should be lower for furrow irrigation (6-4 in).

Proper clearing, ploughing, and harrowing, which aid in the extermination of weeds, should always be carried out prior to planting, as onions do not compete well with weeds. Additionally, there should be sufficient time between land preparation and planting so that the soil is properly weathered. During this period, the use of the 'stale bed' technique is highly recommended.

3

Cultural Practices

Planting

Onions may be direct seeded at a rate of 3.5 - 4.5 kg/ha (3-4 lb/acre). Seeds may be planted in rows 20-30 cm (8-12 in) apart, and along rows, at 2.5 cm -10 cm (1–4 in) at a depth of 1.25 cm (1/2 in). For direct seedling to be successful, soil must be prepared to a condition that will facilitate mechanical planters. Planters must be calibrated for depth of sowing, spacing, and discharge of seeds.

Fig. 4 Drip irrigated onion plants

Fig. 5 Crop establishment using drip irrigation

For onion transplanting, 1.25-2.5 kg/ha (1-2 lb/acre) of seeds is needed. Seedlings are to be produced in nursery using polyethylene trays and transplanted when plants are at the two-leaf stage (within six to eight weeks). They should be transplanted to the field at a depth similar to that obtained in the trays. Spacing and plant population are similar to conditions used for direct seeding.

Transplanting, although labour intensive, is advantageous as far as seed costs are concerned and is especially useful in cases where sufficient land preparation is difficult to achieve.

Fig. 6 Newly transplanted onion seedlings

Irrigation

Onions require approximately 4,600 m3/ha (500,000 gallons/acre) of water for growth and development per crop cycle (110 days). The critical stages at which moisture stress is to be avoided are germination/ emergence and bulbing. Sprinkler, drip, and furrow irrigation may be used in onion production. The salinity of the water must be less that 0.75 mmho/cm.

Sprinkler (overhead) Irrigation – this method is ideally suited to germinate the crop and to allow for good seedling establishment up to about three weeks.

Drip Irrigation – a very good method, especially after the seedling establishment phase, as it supplies water evenly, allows for fertilizer application through the drip lines (fertigation), and does not lead to a buildup of humidity, which causes the development of plant pathogenic diseases.

Furrow Irrigation – not frequently used as it requires substantial amounts of water. Avoid overwatering and do not allow for periods of dry and wet in the top 2.5-7.5 cm (1-3 in) layer of soil.

To properly determine whether onions are receiving optimum irrigation, a tensiometer is to be used. For all three methods, it is important to discontinue irrigation when 20% of bulbs have 'broken' necks.

Crop Nutrition

The important nutrients for onion production are nitrogen, phosphorus, potassium, sulphur, manganese, copper and molybdenum. For the primary nutrients, onion absorbs 165 kg (145 lb/acre), 28 kg (25 lb/acre) and 177 kg (155 lb/acre) of nitrogen, phosphorus and potassium respectively, per hectare.

Prior to any fertilizer application, a soil analysis (chemical, physical, biological) should be carried out to determine soil texture, pH, organic matter, nematode population, salinity, soil compaction, and nutrient availability. Considering how water content plays a vital role in crop nutrition, a water analysis is also recommended prior to planting.

Depending on soil analysis results, all phosphorus should be incorporated four to five days before planting. One third potassium (if less than 100 ppm by soil analysis) can be applied prior to planting along with nitrogen. Micronutrients, if required, may be incorporated at planting or by foliar application. When plants are 8.5 cm (3 in) tall, an additional one-third quantity of potassium is to be added, along with nitrogen, and the remainder three to five weeks later. Avoid adding nitrogen 4-6 weeks before harvesting, as excessive nitrogen application may hinder bulb formation.

Sulphur is an important element in onion cultivation,and whenever nitrogen is applied, it must be done in the ratio of one part sulphur to 12 parts nitrogen. Soil salinity should not exceed 4 mmho/cm.

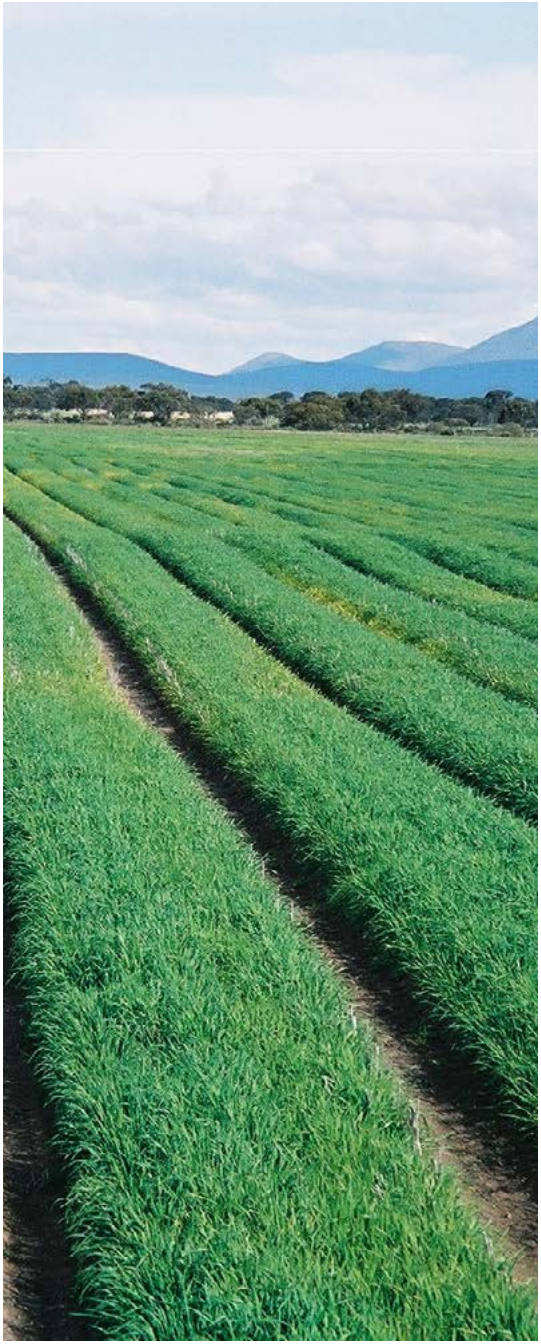

Fig. 7 Crop establishment

Weed Control

Adequate weed control is extremely important to crop establishment, as onions are slow growing and cannot tolerate weeds at the early stage. The first third of the crop is the critical period, and efficient measures must be taken to manage weeds.

Following land preparation, where some weeds would have been controlled, the use of the 'stale bed' technique is highly recommended. This involves irrigating (or by rainfall) prepared land to stimulate weed growth and, while the weeds are actively growing, applying a herbicide.

The more times the procedure is repeated, the greater the reduction in the weed seed bank, and the greatest likelihood of achieving a weed-free bed.

A pre-emergence herbicide such as Dacthal™ is effective against broad–leaf weeds and grasses, and can be applied to the soil after sowing and transplanting. A pre-emergence herbicide that has s-metolachlor as an active ingredient (such as Dual-Gold 960®) can be used at at the two-three true leaf stage of the crop. In both cases, irrigation MUST be applied so that the herbicides are 'activated' and percolate into the soil.

Fluazifop butyl (as Fusilade®) and Nabu-S® are selective post-emergence herbicides that are effective against grasses, and can be safely applied over the onions.

The application of plastic mulch can be used to help control weeds in transplanted fields. Organic mulch can also be used in both direct and transplanted fields. An example of organic mulch is *Panicum maximum* (guinea grass). Producers should consider the overwintering of pests in organic mulch.

4

Pest and Disease Management

Purple Blotch *(Alternaria porri)*

Fig. 8 Circular purple spots of purple blotch

Symptoms of this disease include small whitish, sunken and irregular spots on the leaves. These spots increase in size, become purple in the centre and are bordered by a yellow ring. After three to four weeks of infection, the leaves turn yellow and fall. Infection can spread to the bulb, causing them to become dry and papery. Development of the disease is favoured by humid conditions caused by rain, overirrigation, or dew.

Best cultural practices to avoid purple blotch include the use of crop rotation; selection of tolerant varieties; adaptation of field sanitation and weed management practices; proper plant nutrition; use of optimal spacing to reduce plant density and level of humidity in field; and avoiding the use of overhead irrigation.

Certain fungicides can be used to control purple blotch. A list of appropriate control treatments is available in Appendix B.

Bacterial Soft Rot *(Erwinia spp.)*

This disease usually begins at the neck of the bulb where the plant tissue first becomes water soaked and later becomes soft and mushy with an offensive odour.

Plants should not be irrigated heavily just before harvest, as moisture favours disease development. Afflicted plants should be removed and destroyed to prevent spread of disease.

Weekly application of copper-based fungidices will also aid in disease control. Details regarding dosage are available in Appendix B.

Fig. 9 & 10 Bacterial soft rot

Botrytis Leaf Streak *(Botrytis squamosa.)*

This is a disease that causes grey-white lesions, about 3 mm in diameter, on the leaves. Spots have greenish borders that at times appear to be water soaked. When the spots are numerous, the tip of the leaf dies back. Bulb infection takes place in the field and progresses after harvest. The disease spreads rapidly during periods of continuous rain.

It should be noted that coloured onion varieties are more tolerant to this disease than white onions.

Fig. 11 Botrytis leaf streak

Prevention of this disease can be practiced through employment of crop rotation; adequate field sanitation practices; the use of clean planting materials pre-treated with fungicides; avoiding excessive use of fertilizers high in nitrogen; careful handling during harvesting; and use of proper curing procedures;

In addition, application of certain fungicides 3 weeks following planting can reduce the incidence of this disease as well. Details regarding dosage are available in Appendix B.

Downy Mildew *(Peronospora destructor)*

This disease causes white to light-green spots on leaves, which later darken. A fuzzy, grey growth is seen on the leaf surface, particularly during periods of high humidity. Lesions enlarge and leaf tissue dies. Lesions may resemble those caused by the purple blotch fungus. Fields should be monitored closely, particularly during prolonged cool, wet weather, when the disease is more likely to occur. Dense stands and overhead sprinkler irrigation encourage development of the disease.

Fig. 12 & 13 Downy mildew

Prevention should be practiced by allowing for optimal spacing between plants, which reduces plant density and the level of humidity in the field. Crop debris should be continuously removed and destroyed throughout the crop cycle, and crop rotation should be practiced to lower the incidence of this disease. In addition, application of fungicide on plants 2-3 months old should be practiced if conditions prevail. Further details concerning chemical control options can be found in Appendix B.

Beet Army Worm *(Spodoptera exigua)*

Beet army worm eggs are cylindrical, greenish to white in colour and covered with whitish scales, with an egg mass between 50 to 150 eggs. The young worms are pale green or yellow in colour, while the older larvae are darker when viewed from above and possess a dark lateral stripe. Pupae/cocoons are light to dark brown in colour and are found in the soil. Moths/bats have forewings which are mottled grey and brown, and normally with an irregular banding pattern and a light-colour bean-shaped spot. Larvae feed on both foliage and fruit of many crops. Young larvae feed gregariously

and move in swarms. As they mature the larvae become solitary and eat large, irregular holes in foliage and bulbs, and produce frass.

Fig. 14 Beet army worm larvae

In addition to practicing crop rotation and adhering to good sanitation, weed control, and water management practices, the beet army worm is best controlled by ensuring the preservation of its natural enemies, such as wasps, spiders, and birds. Beet army worm phrenomone traps can be used to monitor the presence of adult moths. Early detection through monitoring of eggs and young worms is recommended; if found, worms and eggs should be hand-picked for low populations in small acreages.

Fig. 15 Beet army worm moth

Chemical treatment should follow if populations amounting to 5 or more worms per 25 plants are found. It is essential that young worms are treated/removed before they enter the leaves. Further details concerning chemical treatment options can be found in Appendix B.

Onion Thrips *(Thrips Tabaci)*

The young stages are white to pale yellow in colour. The adults are 2 mm long; pale yellow to dark brown in colour and have fully developed wings which at rest are folded along the back of the insect. Immature and adult thrips prefer to feed on young leaves in the inner neck of plants by rasping the leaves and sucking the juice, leaving whitish to silvery patches on the leaves.

Fig. 16 & 17 Thrips on onion

To control onion thrips, a crop-free period of two to three weeks should be practiced to break the thrips lifecycle. Other good cultural practices include proper nutrition and water management, preservation of natural enemies, and the practice of good field sanitation and weed control. Adults should be monitored with the use of white or yellow sticky traps, and newest leaves of 5 plants should be monitored periodically.

Chemical treatment should be applied when 3-5 trips are present per green leaf, or if over 20% of the plants are infested with thrips. Details related to specific chemical treatment options and dosages are available in Appendix B.

Leaf Miner *(Liriomyza spp.)*

Fig. 18 & 19 Leaf miner damage on onion leaves

The maggots are bright yellow to yellow green in colour. The adult is a small grey fly with black and yellow splotches. Females lay eggs within the leaf surface where the larvae emerge, develop, and feed, creating a snake-like leaf mine that gradually increases in width as the larvae grow. Damage may result in premature death of the foliage, impacting on the cosmetic appearance of the onions and reducing the photosynthetic activity of leaves.

Avoid planting the crop close to other host crops such as lettuce or celery, and preserve natural enemies (parasitic wasps, etc.) to minimize the incidence of this pest.

Nematodes *(Meloidogyne spp.)*

Fig. 20 & 21 Nematode damage

Above-ground symptoms include stunting, delayed maturity, thicker necks and smaller size bulbs which result in reduced marketable yield and other symptoms characteristic of nutrient deficiency. Below-ground symptoms on infected roots are slight root galling (knots) or root thickenings of various sizes and shapes and extensive root branching.

It is important to note that nematodes cannot be seen with the naked eye. A soil analysis should be undertaken prior to crop establishment to indicate the presence of pathogenic nematodes, and whether population size is large enough as to cause economic losses. Deep ploughing of soils one to five times for a two-month period before planting onions is recommended in case nematodes are present on the ground, as well as two months of soil solarization during the hot, dry summer months. Use transplants to establish onion crop. Do not plant onions after cucurbits (melon), legume (peas), or Solanaceous (pepper) crops which were infested with plant pathogenic nematodes, and practice crop rotation.

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Harvest and Post-harvest Management

Yield

Under irrigated conditions, suitable varieties, and proper management practices, the minimum yield expected is 37t/ha (15t/acre). (See appendix A).

Harvesting

The approximate time from planting to harvesting ranges from 110–160 days, depending on variety and time of planting.

The harvesting process begins when 50% of onion tops are down (necks broken). Onions may be lifted or toppled over and laid to one side in the field. To allow for optimum drying, onions should be left in the field for 10-14 days.

Curing

On removal from field, onions should be 'cured' to retain outer scale leaves and for protection against decay and early sprouting. The conditions for curing are 35ºC, 60-70% relative humidity and one-day forced-air ventilation at 25º-27ºC. Alternately bulbs can be cured for five to seven days at ambient temperature under covering on slatted tables.

Storage

For storage, onions should be packed in wooden crates or bags that allow for good air circulation. A constant temperature should be maintained and moisture allowed to escape from storage containers. Bags should not be used if cold storage is anticipated. Bags or crates should be stacked on each other on mesh tables (or pallets).

If onions are to be temporarily stored on farms, a shed must be used. The shed should have a high roof with sides made of a material that allows for good air circulation and protection from moisture. Stack to a height that does not interfere with the ventilation of the shed.

Onions can be stored for up to two months at a room temperature of 30º-35ºC, with less than 80% relative humidity and good ventilation. For longer storage, the temperature of dried onions should be lowered gradually to 0ºC.

Grading and storage

Grading should be carried out to allow for uniform size, shape, and colour of bulbs to be packaged according to buyer requirements. The preferred onion in Jamaica is 51-64 mm in diameter, has a white flesh, and yellow/brown skin.

Fig. 22 Grading onions

Fig. 23 Onions are harvested when 50% onion tops are down (necks broken).

Fig. 24 Field harvesting crates

Fig. 25 Onions being cured on slated tables

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Appendices

Appendix A: Onion Cost of Production (0.4 Ha)

Labour Operations		Unit	No. of Units	Cost/Unit	Total Cost
Soil analysis		CW	1	6000	$6,000.00
Land clearing		tractor	"	20000	$20,000.00
Ploughing	2 cuts	"	"	12000	$12,000.00
Harrowing	2 cuts	"	"	10000	$10,000.00
Rotavating		"	"	6000	$6,000.00
Bed shaping		"	"	5000	$5,000.00
Maintain trench		"	"	3000	$3,000.00
Planting with planter		"	"	1500	$1,500.00
Installation of irrigation equipment		MD	3	1500	$4,500.00
Fertilising		"	4	1200	$4,800.00
Pest management	Insecticide	"	6	1500	$9,000.00
	Fungicide	"	9	1500	$13,500.00
Weeding		"	5	1500	$7,500.00
Harvesting		"	47	1500	$70,500.00
SUBTOTAL					**$173,300.00**
Material inputs					$100,000.00
Planting material					$80,000.00
Fertilizer					$15,000.00
Fungicide					$25,500.00
Insecticide					$32,000.00
Herbicide					$28,390.50
Water					$11,200.00
Onion storage bags					

Labour Operations	Unit	No. of Units	Cost/Unit	Total Cost
SUBTOTAL				$292,090.50
Other costs				$25,970.00
Transportation (10 per cent of material)				$46,539.05
Contingencies (10 per cent of labour and material)				$44,761.90
**Tools depreciated (10.5 crop cycles in seven years)				$5,000.00
Land charges per crop cycle				$69,808.58
Supervision (15 per cent of labour and material)				
SUBTOTAL				$192,079.53
TOTAL OPERATING EXPENDITURE PER CROP				$657,470.03

CROP	ONION
Crop maturity	4 months
Reaping period	1 month
Planting distance	20 cm x 6 cm
Plant population (0.4 ha)	=270,000 plants
Terrain	Flat
Land preparation	Mechanical
Irrigated/rain-fed	Irrigated
Area (hectare)	0.4
Man-day charge (excluding lunch)	$1,500
Projected marketable yield (kg)	15,000
COST OF PRODUCTION $/KG	J$43.83 kg

Initial land clearing costs are not included given the wide variations that may exist.

NOTES

Irrigation equipment and tools, inclusive of overhead sprinklers and drip system have been depreciated using the **Straight Line Method** with no salvage value (Total*$470,000) **(It is assumed that there exists 1.5 crop cycles per year and the useful life of all equipment and tools will be seven years).** The establishment/initial setup cost can be derived by expanding the depreciated figures.

Price for seeds based on local farm store Caballero: $29,800 for 100,000 seeds (The model assumes $25,000 based on a possible discount for four (4) tins)>

Fencing costs and security have not been factored into this estimate.

Transportation included refers to the delivery of inputs to the farm. (Transportation to market has not been included given the variations that may exist in terms of the locations of markets if delivery is required.)

Appendix B: Pest and Disease Management

Pest	Cultural Practices	Chemical Control
Beet Army worm ***(Spodoptera exigua)***	✪ Practise crop rotation ✪ Practise good field sanitation, weed control and water management ✪ Preserve natural enemies or farmers' friends (wasps, spiders and birds) ✪ Use beet army worm pheromone traps for monitoring adult moths ✪ Monitor crop twice/week for early detection of eggs and young worms. ✪ Hand-pick worms and egg mass for low populations in small acreages ✪ Apply treatments when there are five worms to 25 plants. Treat young worms before they enter the leaves	✪ Target very young worms by alternating Bt formulations *(Bacillus thuringlensis)*, e.g. Xentari® , Dipel® with abamectin formulations e.g. (Cure® or Newmectin®) ✪ Agree: 5.7g to 3.8L water. PHI* None ✪ Cure: ® 5 ml to 3.8L water, PHI 3 -7 days ✪ Target older worms by alternating Danitol® and Match ✪ Danitol® 5-10 ml to 3.8L water. PHI 14 days ✪ Match® 10 ml to 3.8L water. PHI 20 days ✪ Match® 10 ml to 3.8L water. PHI 20 days ✪ Timing of spray application and good leaf coverage are critical ✪ **PHI = Pre Harvest Interval** ✪ **3.8L = 1 gallon** ✪ **5ml = 1 teaspoon** ✪ **55.7 g = 2 ml = ½ teaspoon**
Thrips ***(Thrips tabaci)***	✪ Practise a crop-free period of two to three weeks to break the thrips lifecycle ✪ Provide adequate irrigation and crop nutrition ✪ Preserve natural enemies ✪ Practise good field sanitation and weed control ✪ Monitor adults by using yellow or white sticky traps ✪ Inspect the newest leaves of five plants; ✪ Apply treatments when there are three thrips per green leaf or 20% of the plants infested with thrips	✪ Rely on use of biorational insecticides ✪ Rotate Cure®, Newmectin® Diazinon ✪ Malathion®15 ml to 3.8L watrer. PHI 7 days ✪ Diazinon® 15 ml to 3.8L water. PHI 14 days ✪ Apply approved insecticides at recommended dose rates ✪ When spraying provide good leaf coverage and target base of leaves ✪ **15 ml = 1 tablespoon**
Leaf Miner ***(Liriomyza Huidobrens)***	✪ Avoid planting the crop close to other host crops such as lettuce or celery ✪ Preserve natural enemies (parasitic wasps, etc.)	✪ Pest can be controlled by spraying with insecticide Trigard® in rotation with other approved insecticides ✪ Trigard: 5.7 g – 15 g to 3.8L water ✪ Good leaf coverage is important ✪ Spraying should be targeted to the base of leaves, where pest is concentrated
Botrytis Leaf Blight ***(Botrytis squamosal)***	✪ Practise crop rotation field sanitation. ✪ Use clean seeds pre-treated with fungicides ✪ No excessive use of fertilizers high in N ✪ Handle produce carefully at harvesting, and ensure proper curing procedures. ✪ Coloured onion varieties are more tolerant than white onions.	✪ Start fungicide applications three weeks after planting to reduce incidence of disease. ✪ Apply Bellis® in rotation with Dithane M-45® ✪ Bellis® 0.5 g to 3.8L water. Apply Bellis® as a preventive treatment at 10-14 days intervals with a maximum of three applications per season. PHI 7 days. ✪ Dithane M-45®. **See rates for purple blotch** ✪ Phyton 27® **See rates for purple blotch.**

Pest	Cultural Practices	Chemical Control
Purple Blotch ***Alternaria porri***	✪ Use tolerant varieties ✪ Practise crop rotation ✪ Maintain good field sanitation and weed management ✪ Ensure good plant nutrition. ✪ Use optimal spacing which reduces plant density and level of humidity in the field ✪ Avoid overhead irrigation	✪ Rotate Champion® 15 ml to 3.8L water*, Top Cop with Sulfur® 90 ml to 3.8L water* or Phyton 27® 5 ml-8 ml to 3.8L water with Dithane M45® **6.08 g-8 g to 3.8L water or Bravo® 15 ml to 3.8L water ✪ PHI: Champion® 7 days; Phyton® None; Dithane® 14 days; Bravo® 14 days ✪ *Begin application when plants are 10 to 15 cm high and repeat at 7 - 10 days intervals ✪ ***Same active ingredient as Mancozeb 80WP® and Sancozeb® Phyton®: Water should be between pH of 4 and 5. Use pH PLUS to reduce the pH and hardness of water ✪ Phyton®: Water should be between pH of 4 and 5. Use pH PLUS to reduce the pH and hardness of water ✪ **90 ml = 6 tablespoons 6 g = 1 teaspoon**
Downy Mildew ***(Peronospora destructor)***	✪ Use optimal spacing which reduces plant density and level of humidity in the field. ✪ Remove and destroy crops debris ✪ Practise crop rotation	✪ Fungicide applications should begin on plants 2- 3 months old as soon as disease conditions prevail. ✪ Weekly application of Dithane M-45® **See rates for purple blotch.** ✪ Rotate with the systemic fungicide Ridomil MZ® 15 ml-20ml to 3.8L water. PHI 7 days. ✪ Top Cop with Sulfor®. **See rates for purple blotch.** ✪ Champion®. **See rates for purple blotch.** ✪ Bravo®. **See rates for purple blotch**
Bacterial Soft Rot ***(Erwinia spp.)***	✪ Plants should not be irrigated heavily just before harvest, as moisture favours disease development. ✪ Remove and destroy diseased plants.	✪ Weekly application of copper-based fungicides (Champion 77WP®, Top Cop with Sulfur® and Phyton 27®. ✪ 0.5g = 1/10 of a teaspoon
Root Knot Nematode ***(Meloidogyne spp.***	**Non-chemical approach** **Soil testing must be conducted prior to establishing fields to determine** 1. Presence of pathogenic nematodes 2. If nematode population densities are high enough to cause economic loss. The results will be able to guide management options, which may include ✪ Deep ploughing of soils one to five times for a two-month period before planting onion. Use transplants to establish onion crop ✪ Two months of soil solarization during the hot, dry summer months ✪ Do not plant onions after cucurbits (melon), legume (peas) or Solanaceous (pepper) crops which were infested with plant pathogenic nematodes. Practise crop rotation.	

7

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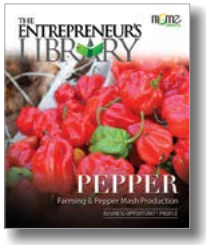

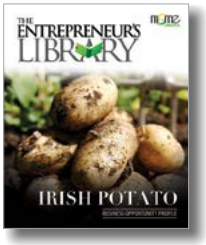

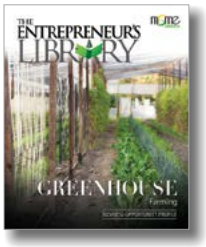

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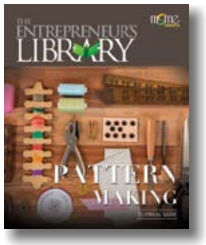

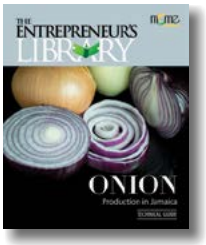

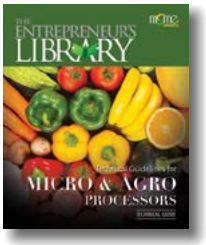

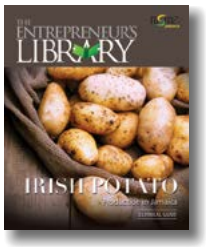

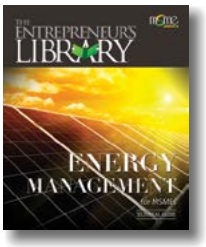

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