GROW Jamaica
No. 1 Vol. 01
A MINISTRY OF AGRICULTURE AND FISHERIES TECHNICAL GUIDE SERIES

Growing Onions

(Allium cepa. L.) in Jamaica

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Introduction

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

Over the last 18 years, onion production has declined significantly from 4,200 tonnes in 1996 to 680 tonnes 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 2007-2012, average annual import of onions into Jamaica was 8.8 million kg, at a value of US$3.7m.

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.

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.

If the site has a history of nutgrass (*Cyperus rotundus*), onions should not be planted. For establishment of onions, it is recommended that fields chosen should not have been planted in any member of the onion family for at least five years.

This period may be reduced if onions are rotated with suitable crops 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.

Land Preparation

Land preparation is the activities that are taken to produce a soil condition that is suitable to optimizing crop production. This usually involves land clearing, ploughing, harrowing, rotovating and bed-shaping. Drains should also be constructed to prevent waterlogging 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 fine tilth.

Fig. 1 Proper site selection

Beds must be flat and at least 15-20 cm (6-8 in) high. For furrow irrigation bed height should be lower.

With clearing, ploughing and harrowing, weeds are destroyed. This is very important 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.

Fig. 2 Land peparation

Varieties and Time of Planting

Onions are classified as short, intermediate or long-day types, and this reflects the hours of sunlight (day length) which will trigger bulb formation. The day length for short, intermediate and long days are less than 12, 12-14 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. Jamaica's daily sunshine hours do not exceed 14 hours and thus long-day onions are not grown in Jamaica.

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

Fig. 3 Crop establishment

Crop Establishment

Onions may be direct seeded at a rate of 7-10 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.

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-eight weeks). They should be transplanted to field at the depth similar to what obtained in the trays. Spacing and plant population are similar to that for direct seeding.

Transplanting, although labour intensive, is advantageous as far as seed costs are concerned and especially useful when it is difficult to prepare soil adequately.

Cultural Practices

a. 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 and salinity of water must be less that 0.75 mmho/cm.

Fig. 4 Sprinkler irrigation

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 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 and and to properly determine whether onions are receiving optimum irrigation, a tensiometer is to be used.

b. 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) MUST be done to determine soil texture, pH, organic matter, nematode population, salinity, soil compaction and nutrient availability.

Depending on soil analysis results, all phosphorus should be incorporated four-five days before planting. One third potassium (if less than 100 ppm by soil analysis) can be applied pre-plant 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 excessive nitrogen application in the first early months as this can lead to bolting. Nitrogen fertilizers should never be applied after bulbing has started, as this can affect quality of the bulbs.

Sulphur (as indicated earlier) is an important element in onion and whenever nitrogen is applied, must be in the ratio of one part sulphur to 12 parts nitrogen.

Fig. 5 Well-established onion field

Soil salinity should not exceed 4 mmho/cm.

c. Weed control

This is extremely important 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 on 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, a herbicide is applied.

The more times the procedure is repeated, the greater the reduction in the weed seed bank and the greatest likelihood of having 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. Dual Gold® may be used as a pre-emergence 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 or organic mulch (eg. *Panicum maximum*, guinea grass), is also useful.

Pest and Disease Management

Purple Blotch *(Alternaria porri)*

Small whitish, sunken and irregular spots appear on the leaves. These spots increase in size, become purple in the centre and are bordered by a yellow ring. After three-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.


Fig. 6 Circular purple spots of purple blotch

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.


Fig. 7 Bacterial soft rot

Botrytis Leaf Streak *(Botrytis squamosa.)*

Grey-white lesions, about 3 mm in diameter, occur on 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.


Fig. 8 Botrytis leaf streak

Downy Mildew *(Peronospora destructor)*

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. 9 Downy mildew

Beet Army Worm *(Spodoptera exigua)*

Eggs are cylindrical, greenish to white in colour, covered with whitish scales; egg mass with 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. 11 Damage to crop

Fig. 10 Beet army worm larvae and moth

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. 12 Thrips on onion

Leaf Miner *(Liriomyza spp.)*

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 underneath the leaf surface where the larvae emerge, develop and feed, creating a snake-like leaf mine that gradually increases in width as the larvae grows. Damage may result in premature death of the foliage, impacting on the cosmetic appearance of the onions and reducing the photosynthetic activity of leaves.

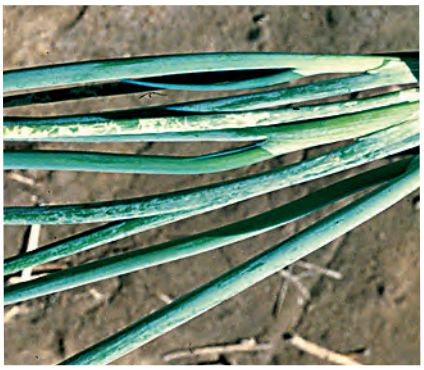


Fig. 13 Leaf miner damage on onion leaves

Nematodes *(Meloidogyne spp.)*

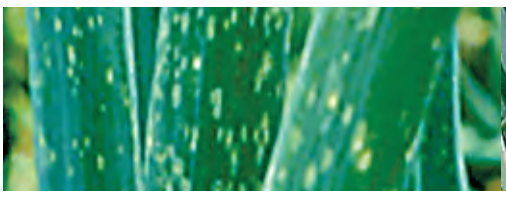
Above-ground symptoms include stunting, delayed maturity, thicker necks and smaller size bulbs which results in reduced marketable yield and other symptoms characteristic of nutrient deficiency. Below- ground symptoms on infected roots are slight root galling (knots) or root thickenings of various sizes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

Fig. 14 Nematode damage

Pest	Cultural Practices	Chemical Control
Beet Armyworm *(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 thuringiensis*), e.g. Xentari®, Dipel® or Agree® with abamectin formulations e.g. (Cure ® or Newmectin ®) • Agree: 5.7 g to 3.8L water. PHI* None • Cure: ® 5 ml to 3.8L water. PHI three-seven 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** • **5 ml = 1 teaspoon** • **55.7 g = 2 ml = 1/2 teaspoon**
Thrips *(Thrips tabaci)*	• Practise a crop-free period of two-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 water. PHI seven 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
Purple Blotch Alte maria 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 3.8 L water or Bravo® 15 ml to 3.8L water **PHI:** Champion® seven days; Phyton® None; Dithane® 14 days; Bravo® 14 days * Begin application when plants are 10 to 15 cm high and repeat at seven to 10 day intervals **Same active ingredient as Mancozeb 80WP® and Sancozeb® Phyton®: Water should be between pH of 4 to 5. Use pH PLUS to reduce the pH and hardness of water Phyton®: Water should be between pH of 4 to 5. Use pH PLUS to reduce the pH and hardness of water • **90 ml = 6 tablespoons 6 g = 1 teaspoon**



Pest	Cultural Practices	Chemical Control
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 careful-ly at harvesting. and en-sure proper curing pro-cedures. • Coloured onion varie-ties are more tolerant than white onions.	• Start fungicide applications three weeks after planting to reduce inci-dence 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 day intervals with a maximum of three applications per season. PHI seven days. • Dithane M-45® **See rates for purple blotch.** • Phyton 27® **See rates for purple blotch.** • **0.5 g = 1/10 of a teaspoon**
Downy Mildew *(Peronospora destructor)*	• Use optimal spacing which reduces plant density and level of humidity in the field. • Remove and destroy crop debris. • Practice crop rotation.	• Fungicide applications should begin on plants two to three 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–20 ml to 3.8L water. PHI seven days. • Top Cop with Sulfur® .**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®). • **0.5 g = 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.	



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 1).

Harvesting- the approximate time from planting to harvest, ranges from 110–160 days, depending on variety and time of planting.

Storage- For storage, onions should be packed in wooden crates or bags and allow for good air circulation to maintain constant temperature and removal of moisture 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 can be used. The shed should have a high roof with sides made of material that allows for good air circulation and protection from moisture. Stack to a height that does not interfere with the shed's ventilation.

Fig. 15 Onions are harvested when 50% onion tops are down (necks broken)

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 35°C, 60-70% relative humidity and one-day forced-air ventilation at 25°-27°C. Alternately bulbs can be cured for five to seven days at ambient temperature under covering on slatted tables.

Fig. 16 Toppled onions in the field

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

- ***Grading and storage,*** This is to be done to allow for uniform size, shape, colour of bulbs to be packaged according to buyer requirements. The preferred onion in Jamaica is 51-64 mm in diameter, white, flesh and yellow/brown skin.

Fig. 17 Grading onions

Fig. 18 Onions being cured on slated tables

Fig. 19 Onions stored in a warehouse

Appendix 1. ONION COST OF ESTABLISHMENT (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	" "	"	"	10000	$ 10,000.00
Rotavating		"	"	6000	$ 6,000.00
Bed shaping		"	"	5000	$ 5,000.00
Maintain trench		"	"	3000	$ 3,000.00
Planting with planter		MD	"	1500	$ 1,500.00
Installation of irrigation equipment		"	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					
Planting material					$ 100,000.00
Fertiliser					$ 80,000.00
Fungicide					$ 15,000.00
Insecticide					$ 25,500.00
Herbicide					$ 32,000.00
Water					$ 28,390.50
Onion storage bags					$ 11,200.00
SUBTOTAL					**$ 292,090.50**
Other costs					
Transportation (10 percent of material)					$ 25,970.00
Contingencies (10 percent of labour and material)					$ 46,539.05
**Tools depreciated (10.5 crop cycles in seven years)					$ 44,761.90
Land charges per crop cycle					$ 5,000.00
Supervision (15 percent of labour and material)					$ 69,808.58
SUBTOTAL					**$ 192,079.53**
TOTAL OPERATING EXPENDITURE PER CROP CYCLE					**$ 657,470.03**

Crop	ONION
Crop maturity	4 months
Reaping period	1 month
Planting distance lxw	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).

Fig. 20 Onions bagged and ready for transportation

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Eat what we grow

Published by the Ministry of Agriculture and Fisheries, Hope Gardens, Kingston 6.
2014, October