Fruits and Vegetables

1. Broccoli
2. Cabbage
3. Cantaloupe
4. Carrot
5. Cauliflower
6. Celery
7. Corn
8. Cucumber
9. Hot Pepper
10. Lettuce
11. Parsley
12. Passion fruit
13. Pineapple
14. Pumpkin
15. Salad Beans
16. Sweet Peppers
17. Tomato
18. Watermelon

TECHNOLOGY PACKS

LETTUCE

November 2015

Background

Production decisions concerning how much effort and resources to invest and which farming practices to follow, have consequences and create opportunities for the farm affecting production levels, input costs, time constraints, and the potentially size of the operation. They also may have implications for resource use and environmental quality.

Numerous information exist on the various aspects of production and handling/ marketing of crops and livestock, the majority of which are outdated, not easily understood and lacking the where with all for addressing present day challenges such as good agricultural practices (GAPs) and food safety and climate change that impact on the environment and rural livelihoods. These issues are also closely related to the importance of the role of primary producers in increasing the earnings of all actors along the value chain in supporting the development of a commercially viable and sustainable agricultural industry.

The production of high quality and easily understood information packages is critical as this forms a basis for farmers to obtain financing from lending institutions and to efficiently increase their production through the availability of modern technology. This will also result in a reduction of rural unemployment and will greatly help in alleviating poverty and other associated social ills.

TECHNOLOGY PACKS

LETTUCE

November 2015

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Published by

Ministry of Agriculture, St. Lucia

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Introduction

This Technological Package (Tech Pack) deals with the production and postharvest aspects of lettuce.

Also included in the Tech Pack are appendices:

- Template for cost of production
- List of recommended pesticides and application rates
- Good Agricultural Practices data record sheet.

Notwithstanding the identification of any specific pesticide for the control of pests and diseases, this decision is for the discretion of the Ministry of Agriculture Area Extension Officer and the farmer.

However, the mention of any pesticides and other products used in the Tech Pack should strictly comply with local regulations and all instructions provided by the manufacturer. Also, the use of trade names in the Tech Pack is for the purpose of citing examples and is not meant to either endorse or discredit any particular product.

Botanical Description

Lettuce (*Lactuca sativa*) belongs to the family Asteraceae. The local name in Creole is Léti. It is grown as a leaf vegetable and is a rich source of vitamin K and vitamin A, and is a moderate source of foliate and iron.

Ecology and Environment

Lettuce grows best in full sun, in loose, nitrogen-rich soils with a pH of between 6.0 and 6.8. High ambient temperature generally prompts lettuce to bolt, with most varieties growing poorly in very hot conditions; cool temperatures give better performance.

Varieties/Cultivars

Recommended varieties are Tropical Emperor, Eden, Lyra, Minetto, Mignonette Bronze and Red Rapid.

Seedling Production

In order to produce strong and healthy seedlings, establish a seedling nursery, specifically for seedling production. The area should comprise two sections:

1. A seed germination section which is covered with solid roof to protect the germinating seeds from sun and rain
2. A hardening section with a transparent roof or netting that allows for the penetration of light for hardening the seedlings. Hardening protects seedlings from transplanting shock when planted in the field.

The entire nursery area should be weed free and preferably totally screened with polyvinyl insect netting to protect seedlings from any insect attack and/or transmitted insect diseases. Seeds are sown either in seedling trays containing peat moss as the growing medium or in peat moss blocks

(Plates 1 & 2). Though seeds can be directly sown in the field, the success of germination and survivability of most seeds is not guaranteed as both soil pests and diseases can affect them. To achieve 95 - 100% seed germination and strong and healthy seedlings, seedlings produced in nurseries is the preferred option.

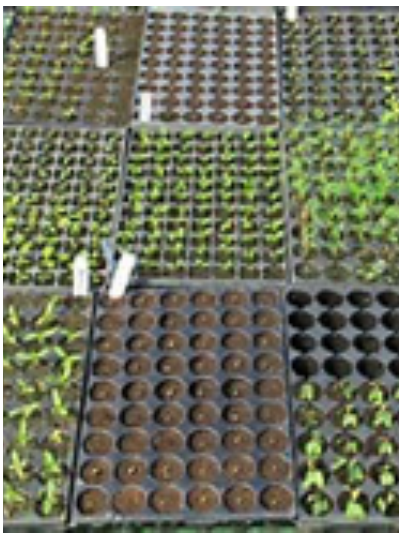

Plate 1 Seedling production in seed trays

Plate 2 Seedling production in nursery

Plate 3 Hardening seedlings

The following practices should be adopted in the production of strong healthy lettuce seedlings:

- When purchasing seed material obtain from a reputable source
- Read the label on the seed package. Ensure that the seeds are 90 - 100% viable which must be indicated on the label and is in keeping with the expiratory date
- Use seedling trays for sowing seeds. Ensure that they are sterilized by immersing into commercial bleach solution 1 tablespoon/gallon (5 cc/litre) of water
- Use peat moss as the planting medium
- Treat the planting medium with a broad spectrum fungicide, 6 ounces of Banrot in 15 gallons of water (170 g/68 litres), before placing in trays
- Seedling trays should be placed on raised platforms
- Make a planting hole in each cell and plant one seed per hole
- Water seeds to aid germination
- Spread peat moss lightly ensuring that the seeds are covered
- Cover trays with saran netting to hasten germination
- Place trays in the seed germination section of the nursery
- Remove the covering of saran netting at the first sign of germination
- Water seedlings at least twice per day
- Apply plant nutrient as a foliar spray once per week when seedlings are ½ inch (1.2 cm) in height
- Spray seedlings with insecticide and fungicide once per week for pest and disease control

- Apply fertilizer solution, Tropi-Gro 1 tablespoon/gallon (5 cc/litre) of water twice per week when seedlings are 1 inch (2.5 cm) in height
- Harden seedlings by placing them in the hardening section of the nursery for 3 hours during the early morning and late evening, for 2 - 3 days (Plate3)
- Expose seedlings to full days of sunlight until ready for transplanting
- Transplant seedlings when they are 3 inches (7.6 cm) tall

Land Preparation

There are three main systems of lettuce production: small-scale backyard, large-scale "Open Field" and "Protected Agriculture" (Plates 4, 5 & 6).

When cultivating on a large scale, the land should be ploughed and rotavated twice. Incorporate large quantities of well-composted animal manure during land preparation. Prepare beds 3 feet (1.0 m) wide and 2 feet (0.6 m) apart.

Plate 4 Small-scale lettuce production

Plate 5 Large-scale "Open Field" lettuce production

Plate 6 "Protected Agriculture" lettuce production

Spacing and Planting

Establish holes for planting 12 x 12 inches (30 x 30 cm) apart in rows (Plate 7). Water the holes thoroughly and transplant one seedling per hole. It is usually preferred to transplant seedlings late in the afternoon to minimize transplant shock.

Plate 7 Spacing and planting lettuce

Irrigation

Irrigation water, especially from streams and ponds, should be sent for analysis to ensure that the water is not polluted or saline, and must be of good quality for irrigation.

Adequate watering is necessary to produce succulent heads or leaves. The most efficient method is to supply water using a drip irrigation system (Plate 8), particularly under "Protected Agriculture". Drip irrigation delivers sufficient water without wetting the foliage, and reduces the incidence of diseases. Overhead irrigation can also be used but may result in low yields due to flower drop at time of flowering.

which promotes the development of diseases. Overhead irrigation can also be used but may result in low yields due to flower drop at time of flowering. Soon after transplanting, seedlings should be watered thoroughly.

Plate 8 Drip irrigation in lettuce

Fertilization

Specific kinds and rates of fertilizers must be determined from the results of soil and leaf analyses. Composted manure if available should be applied to the soil to help with the uptake of nutrients from inorganic fertilizers; it adds organic matter to the soil, enhances soil structure and growth of micro-organisms. All manure should be well composted to ensure that harmful microorganisms and weed seeds are destroyed.

During transplanting, apply ½ ounce (15 g) per hole of 14-14-14 as basal fertilizer. At 15 and 30 days after transplanting, side-dress with a 1:1 mixture of urea and muriate of potash at the rate of ¼ ounce (8 g) per plant for crisp-head varieties. Loose-leaf varieties need only one side dressing of urea at the rate of ¼ ounce (8 g) per plant 15 days after transplanting.

Under "Protected Agriculture" apply NPK fertilizer (20:20:20) and nitrogen fertilizer weekly at the rate of 0.5 gallon (2l) per hour through a drip line fertigation system.

Weed Control

Plastic mulch can be used for suppressing weeds and therefore manual weed control is not required (Plate 9). If plastic mulch is not in use, then weed control of lettuce should be carried out manually.

Plate 9 Use of plastic mulch for weed control in lettuce production Plate 9 Use of plastic mulch for weed control

Pests and Diseases

The major pests and diseases, symptoms and control/management lettuce are shown in Table 1.

Table 1 Causal agents, symptoms and control of pests and diseases of lettuce

Pest & Diseases	Symptoms	Control/ Management
 Plate 10 Aphids	Symptoms are stunting, deformation, gall formation, withering and dying of plants. Leaves may become curled, wrinkled or cup-shaped. The symptoms may be due to the feeding and viral diseases. Honeydew secreted by aphids encourages the growth of sooty mold (black in colour) on the leaves.	Apply contact and systemic insecticides.
 **Plate 11** Leaf Hoppers	Symptoms are stunted growth, leaves that are curled, stippled, or have a burned appearance.	Elimination of weeds that are alternate hosts to leafhoppers. Leafhoppers can be controlled by application of foliar and soil applied insecticides.
 **Plate 12** Slugs and snails	Snails and slugs are most active at night. They chew irregular holes with smooth edges in leaves and flowers and can clip succulent plant parts and leave a silvery mucus trail.	Use metaldehyde baits, 4% active ingredient. Do not water heavily for at least 3 or 4 days after bait placement, watering will reduce effectiveness of the bait.

Pest & Diseases	Symptoms	Control/ Management
 **Plate 13** Botrytis Grey Mold caused by *Botrytis cinerea*	The disease causes newly transplanted lettuce to wilt, dry up, and eventually die. The transplant crown tissue becomes brown and soft. The characteristic fuzzy grey sporulation of the pathogen is usually present on the affected crown tissue in contact with the soil. On established lettuce plants, grey mold can cause a decay disease of the crown tissue that result in poor growth, wilting of older leaves, and eventual collapse and death of the plant. Infected crowns develop a soft, mushy rot that is orange-brown to light brown in colour.	These pests can be controlled using a contact or systemic insecticide. Before harvest, use insecticides with a short harvest interval of 5 to 7 days e.g. Dipel (Bacillus thuringiensis).
 **Plate 14** Lettuce Drop Sclerotina Disease caused by two fungi, *Sclerotinia sclerotiorum* and *S. minor*	Under moist conditions, outer leaves wilt, and there is a slimy rot of the plant. A cottony fungal growth appears on the stem near the soil level. The oldest leaves wilt, drop off and this continues until the plant collapses.	Control is through proper drainage of the land, minimizing crowding of plants in the field, removal and destruction of plant trash. Chemical control is mainly through the use of fungicides.
 **Plate 15** Lettuce Mosaic Virus (LMV)	LMV is seed borne in all lettuce types. The symptoms are intense mosaic with veinal chlorosis and frequently veinal browning and necrosis.	Control is through the use of resistant varieties. Strict sanitation and destruction of diseased plants and proper rotation practices.

Good Agricultural Practice (GAP) related to the use of pesticides, requires farmers to maintain up to date records on the application of pesticides to the crop. These records should include trade names, application rates and dates of application. During the harvesting period use pesticides with a very short harvest interval.

Harvesting/Maturity

Judge maturity by a combination of characteristics including size, shape, firmness, duration of growth and general appearance.

Crisp-head lettuce can be harvested 45 - 60 days from transplanting and the loose-leaf lettuce is harvested as needed but before bolting, as leaves will turn bitter. Harvesting should be done early in the morning (Plate 16).

Plate 16 Harvesting lettuce

Field Handling

Lettuce should be removed from the field quickly after harvest, over exposure to heat will result in rapid quality deterioration. It is a good idea to sprinkle the leaves with water to reduce evaporation during field handling.

Preparation for Market

Lettuce should be stored in a cool place after harvest, in an open container to minimize wilting. Lettuce should be cleaned of undesirable leaves at harvesting.

Yields

Yields vary depending on variety. Crisp-heads can give 8,000 - 10,000 lb/acre (9,000 - 11,000 kg/ha) and leaf types 15,000 - 20,000 lb/acre (17,000 - 22,000 kg/ha).

Storage

Lettuce is highly perishable and deteriorates rapidly at ambient temperatures. It should be pre-cooled to below 36°F (2°C) very soon after harvest and stored at 32°F (0°C) and 95 - 100% relative humidity for maximum retention of quality and shelf life. Common post-harvest diseases include bacterial soft rot, grey mould, downy mildew and watery soft rot. Bacterial soft rot is the most severe disease in transit and storage. It is much less serious at 32°F (0°C) than at higher temperatures.

APPENDICES

APPENDIX I: TEMPLATE FOR COST OF PRODUCTION ANALYSIS: LETTUCE

	Input	Quantity	Units	Unit Cost	Total Cost
1.	**Seedling production**				
	Seed material				
	Seedling trays				
	Peat moss				
	Saran netting				
	Fungicide, plant nutrient, insecticide, fungicide, fertilizer (specify names used)				
	Total cost for seedling production				
2.	**Land preparation**				
	Animal manure (if purchased)				
	Plastic mulch				
	Other land preparation costs (e.g. equipment rental)				
	Total cost for land preparation				
3.	**Crop maintenance**				
	Water/irrigation				
	Fertilizer (specify types used)				
	Pest and disease control (specify chemicals etc. used)				
	Total cost for crop maintenance				
4.	**Harvest/storage**				
	Storage containers				
	Estimate any utility costs				
	Transport to market				
	Total cost for harvest/storage				
5.	**Labour**				
	Seedling production				
	Land preparation				
	Crop maintenance				
	Harvest/storage				
	Total cost for labour				

APPENDIX I: TEMPLATE FOR COST OF PRODUCTION ANALYSIS: LETTUCE

	Input	Quantity	Units	Unit Cost	Total Cost
6.	**Rent/insurance**				
7.	**Miscellaneous costs**				
	Total cost of production				

Notes

1. It is recommended that the above data be completed on a per crop basis.

2. The cost of any fixed structures should be considered. For example if a seedling nursery is solely used for to produce lettuce seedlings in the year and is expected to last for 10 years, then one tenth of the cost of construction (plus any annual maintenance) should be added at item 7. If, however seedlings for other crops are also produced then these also need to be considered. If lettuce seedlings account for half the seedlings in a year, then the annual cost calculated as above needs to be divided by 2. Similar considerations should be given to the cost of any refrigerator if the crop is stored at a low temperature and to an irrigation system. If the lettuce is grown under Protected Agriculture perhaps 1 -2% of the cost of the structure should be added to item 7.

3. The revenue obtained from sale of the crop should be compared with the cost of production to determine the profit/loss on the operation.

APPENDIX II: LIST OF RECOMMENDED PESTICIDES AND APPLICATION RATES

INSECTICIDES	APPLICATION RATE
Pronto 35 SC	3 - 5 teaspoons/gallon of water
Target	1 - 2 teaspoons/gallon of water
Pirate	½ - 1 teaspoons/gallon of water
Fastac	1 - 2 teaspoons/gallon of water
Caprid	½ - 1 teaspoon/gallon of water
Diazinon (Basudin)	¾ - 1½ pints/acre
Admiral	¼ teaspoon/gallon of water
Dipel	1½ - 2 teaspoons/gallon of water
Aza-direct	1 - 2 teaspoons/gallon of water
Cure	½ - 1 teaspoon/gallon of water
Danitol	1 - 2 teaspoons/gallon of water
Cypro	½ tablespoon/gallon of water
Dimethoate (Perfecthion, Rogor 40)	1 pint/acre
Phosvel	1¼ - 2 pints/acre
Orthene	3.2 ounces/acre
Permethrin (Ambush)	½ teaspoon/gallon of water
Padan 50 WSP	2 - 3 teaspoons/gallon of water
Lannate	1 teaspoon/gallon of water
Decis	½ teaspoon/gallon of water
Kelthane 42%	1¼ lb/acre
Orthene 75S	1 lb/acre
Malathion	½ - 1 pint/acre
Sevin	1½ lb/acre
BT (*Bacillus thruingiensis*)	Label rates
Rotenone	1 - 2 teaspoons/gallon of water
Neem X.	8 - 10 oz/gallon of water
FUNGICIDES	**APPLICATION RATE**
Bellis	2 teaspoon/gallon of water
Acrobat	2 - 4 teaspoon/gallon of water
Mancozeb (Dithane M45)	1.5 lb/acre
Cabendazim	2 teaspoon/gallon of water
Daconil	1½ - 2 pints/acre
Benomyl (Benlate)	6 oz/acre
Captan	2 - 3 teaspoons/gallon of water
Peltar	3 teaspoons/gallon of water
Manzate DF	2 - 4 teaspoons/gallon of water
Bravo	1½ - 2 pints/acre
Tri-Miltox-Forte	3 teaspoons/gallon of water
Botrilex	5 - 200 lb/acre
Kocide 101	2 - 4 teaspoons/gallon of water
Cupravit	2½ lb/acre

APPENDIX II: LIST OF RECOMMENDED PESTICIDES AND APPLICATION RATES

WEEDICIDES	APPLICATION RATE
DCPA (Dacthal W-75)	10 lb/acre
Diphenamide	4 - 10 lb/acre
Paraquat (Gramoxone)	1 - 2 pints/acre
Dymid 80W	5 lb/acre
Atrazine 80 (Gesaprim).	1¼ - 1½ lb/acre
Linuron (Lorox)	1 pint/acre
Prometryn (Caparol)	0.8 - 1.6 lb/acre
Sethoxydim (Poast)	1¼ - 3½ lb/acre
Clethodim (Select)	0.094 - 0.25 lb/acre
Prometryn 50WP (Geagard)	2 - 3 lb/acre
Herbicidal Oil (Stoddard Solvent, Kerosene oil)	40 - 80 gallons/acre

APPENDIX III: GOOD AGRICULTURAL PRACTICES DATA RECORD SHEET

Grower name:							
***Name of applicator**	**Date**	**Brand and product name**	**Rate**	**Size of area/no. of plants treated**	**Total application (amount of the product used)**	**Notes/target pest**	**Start/finish time**

*The applicator should be trained or, if not, supervised by a trained or certified person. Proof of training required.