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**GROWING AND HANDLING
DRY BULB ONION
IN THE CARIBBEAN**



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FOREWORD

The Common or Dry Bulb Onion (*Allium cepa* L.) is one of the few bulb crops used for food. It is popular as a vegetable, but is used more often as a seasoning. Onion is second only to tomato in world vegetable production and demand is generally inelastic.

In the Caribbean, over 8,000 tonnes of onions are imported annually at a cost of approximately EC\$11 million mainly from Netherlands, USA and Spain. Foreign exchange savings through import substitution is a priority for Caribbean governments, and onion shows potential for this purpose.

Onion is currently being produced in Antigua, Barbados, Grenada, Jamaica, Montserrat, St Kitts, Nevis and St Vincent. Research is aimed at increasing self-sufficiency in onions in these countries. While intra-regional exports could also be considered at certain periods of the year particularly when the world market price for onions is high, it is doubtful whether extra-regional exports would be feasible.

The major constraints to achieving self-sufficiency have been seasonality of production, limited availability of water for irrigation in some countries, poor shelf-life of most short-day varieties and a host of pests and diseases which make onion a "high risk" crop for growers in the Caribbean.

The scale on which onion is grown varies from one country to another eg. in Montserrat, production is characterised by small plots 0.05-0.1 ha (0.1- 0.2 ac) in area, while in Barbados the crop is grown on a larger scale i.e 1-5 ha (2.5-12 ac) mainly by sugar cane farmers and specialist vegetable producers, but a few small farmers have started production during recent years. The production system varies from totally manual in St Vincent to partly mechanised in St Kitts to nearly fully mechanised (except for the harvesting operation) in Barbados.

Although the climatic conditions within the Caribbean region are relatively uniform, onions are sensitive to small environmental changes, even at a particular site from year to year, and varietal performance may vary slightly from country to country. It is therefore important to note that when new varieties are being introduced, they should be tested in small plots alongside proven varieties over at least two seasons before acreages are increased.

This bulletin seeks to bring together information gathered from a number of sources, including farmer experience over the past two decades to provide both large and small scale onion growers in the Caribbean with comprehensive production and post-harvest recommendations which are relevant to the prevailing environmental and economic conditions. The bulletin is divided into three sections:

- Section I covers detailed recommendations for the production of the onion crop.
- Section II describes the major aspects of post-harvest management of onion bulbs.
- Section III gives general information on the maintenance of equipment and on pest and disease control methods.

Frances Chandler

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The author would also like to thank Messrs Gerald Proverbs and Bruce Lauckner for their editorial comments and advice.

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SECTION I

PRODUCTION PRACTICES FOR GROWING ONIONS

Onion requires a high level of management and considerable inputs, particularly in the areas of pest, disease and weed control. Unless the crop is mechanised, it is very labour intensive and therefore not attractive to many growers. Since timeliness of cultural operations (e.g. land preparation and pest control) is important, growers who have their own equipment have a distinct advantage over those who have to rely on contractors to carry out these operations.

1. Site selection & Land preparation

Onions should be planted on flat or gently sloping land which is prone neither to erosion nor flooding. The site should be easily accessible since frequent inspections of the crop are necessary and theft is often a problem in isolated areas. Areas which are naturally sheltered from strong winds are recommended.

The crop should not be planted in the same field more than once every four years. This is a precaution against the build-up of nematodes and diseases like *Sclerotium rolfsii* and *Fusarium* sp. which may reduce yield. Sugarcane and sweet potato are among the best crops to precede onions in a rotation. Since *Xanthomonas campestris* which causes "blast" disease has been isolated from many leguminous crops, it is wise to avoid these in your rotation.

Fields should be relatively free from weeds, particularly nutgrass (*Cyperus rotundus*), devil's grass (*Cynodon dactylon*) and other perennial weeds. The slow establishment of the onion seedling makes it susceptible to weed competition particularly in the early growth stages. The land preparation methods used will depend on a number of factors, including the type of crop preceding the onion crop.

Fields coming out of sugar cane

If the field has not been burnt, it will be necessary to chop and invert the large quantity of crop debris which will remain on the field. If this is not done well, the sugar cane will grow again, and this will affect the growth of the onion crop.

Chopping and inverting debris

The field should be disc-harrowed in two directions. A disc plough is sometimes used, but this will not chop the cane stubble as effectively as the harrow.

Loosening compaction

The field should be subsoiled to loosen compaction resulting from the passage of heavy implements over the field during the past season. Subsoiling also removes hard pans and improves drainage.

Soil refining

Onion, like most other vegetable crops, requires a fine soil tilth. This is usually achieved by rotavating the field. However, care must be taken to avoid the overuse of rotavation since this can cause the breakdown of the soil structure and crusting of the soil surface which will hinder seed germination. A power harrow may be used under conditions which are too wet for a rotavator. On light soils, rotavation is sometimes replaced by power harrowing which also assists in levelling the field.

For successful seeding, land preparation should be completed far enough in advance to allow a fine tilth free of clods to develop by weathering. In addition, cane stumps and stones should be removed since these will cause obstruction to the seed drill and may result in a poor crop stand.

Bed formation

During the dry season or in well-drained soil, very shallow beds are produced by the pressure of the tractor wheels, so that the wheelmarks separate the beds. However, during the wet season or if the soil tends to waterlog, slightly higher beds



Figure 1 Ridging to produce seedbeds

are produced by ridging with a furrowing implement and levelling the tops of the ridges with a rotavator with the back flap down. Storm-diversion drains should be constructed to protect the plot from runoff during heavy rains, particularly if the area is sloping.

Rolling

The rolling of beds with a Cam-

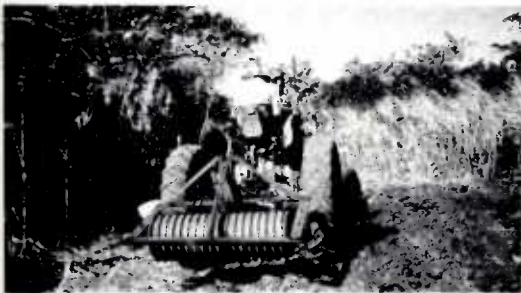


Figure 2 Rolling beds has been shown to improve germination

bridge roller both before and after planting, ensures that the seed and soil come into contact and that seeds do not fall into air spaces between soil particles. Rolling has been shown to improve germination. Tractor speed should be approximately 3 km (1.3 mls) per hr.

Fields coming out of vegetables

If the onion crop is following another vegetable crop, then soil preparation is much simpler since primary preparation would already have been done.

If time is available, the original beds and wheelmarks may be chisel ploughed before re-marking and rolling in preparation for the new planting.

If replanting must be done immediately, the tops of the beds may

be rotavated and the new crop planted the same day.

2. Variety selection and planting times

When selecting varieties, a number of factors must be considered eg. yield, consumer acceptability, shelf-life and the expected market situation at harvest time.

Bulbing in onions is affected by day length and temperature. A long day variety grown under short day conditions will continue to produce leaves without producing a bulb, while a short day variety grown under long day conditions will bulb at a very early stage when the leaf area is small, and therefore a very low bulb yield will be produced. High temperatures increase the rate at which bulbing occurs. Since varieties are bred for specific conditions and therefore have a limited area of adaptation, it is recommended that only varieties which have been tested under local conditions should be planted commercially.

A large proportion of the onion crop in the Caribbean is planted under rainfed conditions during August to October which means that maturity of the main crop takes place over a limited period from December to March and severe competition exists on the market at this time. CARDI is therefore recommending that emphasis should be placed on varieties with a long shelf- life for this planting season.

Although it is always more advisable to plant varieties with a long shelf-life, varieties with poorer storage characteristics but excellent yields may be planted "out-of-season" (November – March) with irrigation since the market at harvest time (May/June) tends to be less competitive, and crops are usually sold promptly after harvest. However, if wet conditions occur at harvest these varieties will be very prone to rotting, and post-harvest losses may be high.

Crops which are planted in June/July will mature in the wet season, and the risk of post-harvest losses is high. Varieties with firm bulbs and a long shelf-life are recommended for this season. The planting seasons for the various countries are described in Figure 3 and the varieties which are currently being grown in the various planting seasons are listed in Table 1.

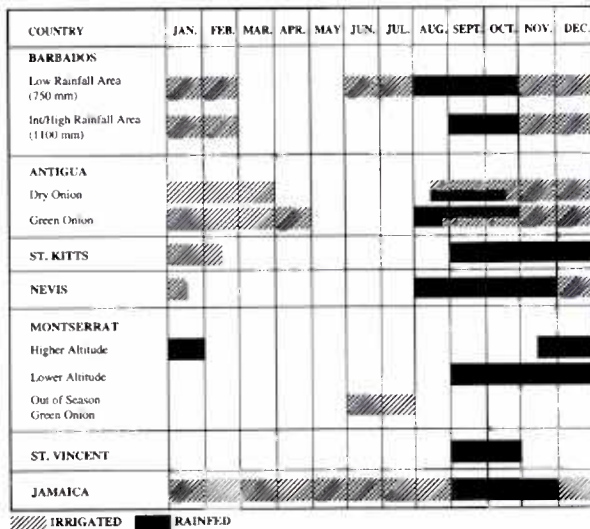
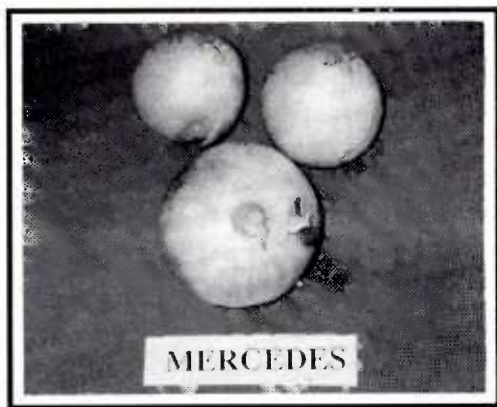


Figure 3 Planting times

Table 1 Onion varieties grown commercially in the various planting seasons in the Caribbean

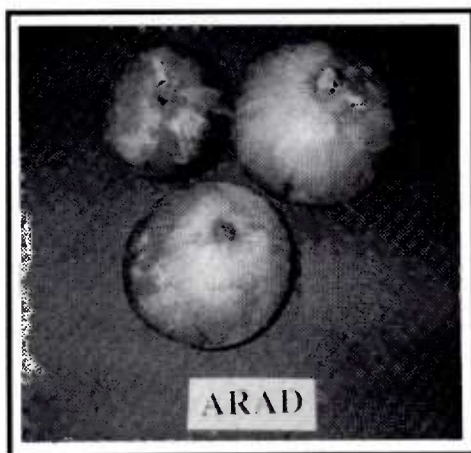
Variety	Description*	Country	Planting Season
Arad (H60) (Hazera Seed Co.)	High yield, flat yellow globe bulbs with thick dark brown scale leaves, mild flavour, good storage	Barbados	January, February, July, August - December
		Antigua	January, February
		Montserrat	September - January June/July (green onion)
Grandstand (H7) (Hazera Seed Co.)	Good yield, firm yellow globe/high globe bulbs, mild taste, excellent storage	Barbados	January, February, August - December
		St Kitts/Nevis	September - February
		Antigua	August - October August - December (green onion)
		Montserrat	September - January
Texas Early Grano 502 (various seed companies)	Moderate yield, relatively large, yellow bulbs, mild taste, short storage life	St Kitts/Nevis	September - December
		Jamaica	Year round
Yellow Grano (various seed companies)	Similar to Texas Early Grano 502	Montserrat	September - December
		St Kitts/Nevis	
		Antigua	January, February August - January (green onion)
Granoble (Sunseed)	Moderate yield medium sized yellow globe bulbs, mild taste, short storage life	St Kitts/Nevis	September - December
Barak (H8) (Hazera Seed Co.)	Moderate yield, medium sized yellow globe bulbs, intermediate shelf-life	Antigua	December, January
Ben Shemen (Hazera Seed Co.)	Intermediate day, yellow variety, long shelf life	Antigua	February, March January - April (green onion)
Red Creole (Sunseed)	Red variety with short shelf-life	Antigua	August - October
El Toro (for green onion only) (Sunseed)	Medium sized white bulbs - poor storage	Antigua	August - January
Nissan (H9) (Hazera Seed Co.)	Good yield, medium to large, yellow bulbs with dark brown scale leaves - good storage	Montserrat	September - January
Mercedes (Petoseed)	Good yield, medium to large, yellow bulbs, light brown scale leaves, good storage	Barbados	September - February, July

*Moderate yield = 40 tonnes/ha; Good yield = 50 tonnes/ha; High yield = 60 tonnes/ha.



Mercedes is the earliest maturing of the varieties. It produces medium to large yellow globe bulbs with light brown scale leaves and long storage life.

Grandstand matures slightly later than Mercedes and produces medium sized yellow bulbs with dark brown scales and long storage life.



Arad is a late maturing high yielding variety producing yellow flattened globe bulbs with dark brown scale leaves and long storage life.

Windbreaks

If fields which are exposed to strong winds must be used, temporary windbreaks of sugarcane, corn or sorghum should be planted at intervals to protect the crop. Observations over several years have shown that windbreaks have favourable effects on plant vigour, tip burn, 'blast' and bulb size. The windbreaks should be planted in advance of sowing the onion crop and should not be allowed to become too tall and to damage the crop by lodging.

3. Seed selection, storage and treatment

Seed should be obtained from a reliable seed company. Seed cost is relatively low compared to the total cost of production of the crop and therefore only good quality seed should be used. Hybrid varieties are more expensive than out-pollinated varieties, but they have the advantage of producing more uniform crops.

Seed should be fresh, and the germination percentage should be checked before planting. This can be done by placing seed on moist absorbent paper in a covered saucer, and counting the germinated seeds after seven days. At least 80% of the seed should germinate. The average viability of onion seed stored in sealed cans under ambient conditions is one year but if conditions of 15°C (60°F) and low relative humidity are used for storage, seed may last an additional season without significant loss of viability.

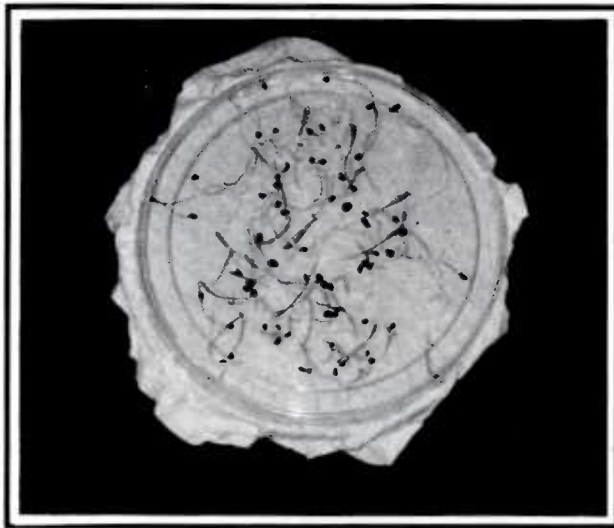


Figure 4 Seed germination should be tested before sowing

Seed should be treated with a fungicide like benomyl (Benlate®) or captan (Captan®) before planting. Seed treatment, in addition to protecting the seed from diseases, also assists in their free flow in the precision seed drill.

Indications are that a sodium hypochlorite (bleach) solution containing 1.0-2.5% chlorine may be beneficial as a seed treatment where bacterial pathogens might be present on the seed.

Seed requirement

Since seed size varies with variety, the seed requirement will vary accordingly. As a guide use 5.6 kg seed/ha when planting five single rows per 165 cm (5.5 ft) wide bed with a spacing of 2.5 cm (1 in) between the seeds within the row. For smaller plots, seed requirement may be roughly calculated at 0.5 g per 30cm (1 ft) of bed if the above spacing is used.

4. Planting

Onion may either be direct-seeded or transplanted. Transplanting is labour-intensive, but may be necessary if weed control is expected to be a problem or if land preparation is less than optimal.

A comparison of production factors for the two planting methods is given in Table 2. The choice of method will depend on available resources.

Table 2 Comparison of production factors for direct seeded and conventionally transplanted onion crop

Production factor	Direct seeded	Transplanted
Equipment	Planter necessary unless area very small. Thinning may be necessary if planter is not used	No equipment needed
Nursery	Not necessary	Nursery must be established
Labour costs	Low	Relatively high
Weed control	Difficult in early stages; pre-emergent herbicides necessary	Easier to manage since seeded area is relatively small
Maturity	Standard time	One to two weeks later
Spacing	Can be irregular - depending on equipment and soil conditions	Precise control over spacing possible; optimum plant populations
Soil conditions	Well prepared land and adequate moisture needed for good germination	Land preparation not as critical
Field survival	Variable	High

Transplanted crop

Growing good seedlings for transplanting

- An area in the vicinity of the field to be planted is forked to 20-25 cm (8-10 in) depth and allowed to weather for 7 days before reforking to produce a fine tilth.
- Slightly raised beds about 6 m x 1.2 m (20 ft x 4 ft) are made.
- A complete NPK fertilizer e.g. 7-14-14 or 12-12-17+2 is broadcast and incorporated, and the bed surface is raked level. All coarse material is removed. Beds are treated with an insecticide such as Diazinon® and watered thoroughly.
- Shallow drills 0.6 cm (0.25 in) in depth are made at 10 cm (4 in) intervals across the width of the beds and seeding is done. Drills are covered and the area is watered.
- Saran shade netting (50%) supported at about 1 m (3 ft) above bed level improves germination and encourages rapid growth of seedlings. The shade is removed when seedlings are about 15 cm (6 in) tall to allow them to harden off.

Transplanting onion seedlings

- Seedlings are transplanted during the late afternoon about 6 weeks after seeding when they are about 15-20 cm (6-8 in) tall. The earlier transplanting is done, the less shock there is to the seedling. Late transplanting is associated with failure to bulb.
- The field is soaked and shallow furrows 8 cm (3 in) deep are made at the required spacing (this will vary slightly from country to country).
- The seedlings are carefully lifted from the nursery bed and placed at 8 cm (3 in) intervals along one side of each open furrow. Pushing the soil from the other side of the furrow draws the seedlings in an upright position. The soil is then firmed from both sides of the planted furrow. Planting too deeply causes poor growth and no bulbing. Seedlings are watered immediately after transplanting.

Direct seeded crop

Small plots may be direct seeded manually or with a handpushed seeder (Figure 5). With the Earthway® Seeder, the seeding mechanism consists of a circular seed plate with holes, fitted to a hub inside the seed hopper. Seed plates are selected according to seed size and required planting distance. A radish seed plate with every other hole blocked gives a good distribution of onion seed. If the percentage germination is below 80, none of the holes should be blocked. A coulter makes a shallow drill in the soil, the seed falls into the drill, and a chain draws soil to cover the seed.

The Stanhay® S870 Precision Seed Drill (Figure 6) is the most commonly used tractor drawn seeder in the Caribbean and is recommended for plots larger than 0.4 ha (1 ac) since planting density is in the vicinity of 1.2 million plants/ha (475,000/ac). It is a belt type seeder, and the number of holes in the seed belt and the gear drive from the master

land wheels govern the distance between seeds when planted. There are four gear ratios permitting four seed spacings for any given belt. The seed is placed in a hopper, and the flow from the hopper into the seed chamber is controlled by a "choke". The underside of the seedbelt is supported by a "spring base" which also helps control seed delivery. Distance between rows is controlled by the mounting of the seeder units on the tool bar. The minimum distance between single rows on a tool bar is 21.5 cm (8.5 in).

A plain rubber belt punched with 90 holes on A pulley will space seed 2.5 cm (1 in) apart, on B pulley 3 cm (1.25 in) apart. Hole size is #10 or #11 depending on the variety. An A2 spring base and T choke are recommended. For double rows, belts with two rows of holes and double coulter shoes are used. Tractor speed should be 3 kmph (2 mph). Seeding depth should be 0.6-1.3 cm (0.25-0.5 in). In rainfed plots where rainfall is uncertain a planting depth of 2.5 cm (1 in) is recommended.

1. Kickstand to hold planter upright
2. Belt
3. Pulley
4. Coulter
5. Cover chain
6. Rear wheel
7. Axle
8. Row marker bracket
9. Handle
10. Seed hopper
11. Row marker shaft
12. Handle bracket.

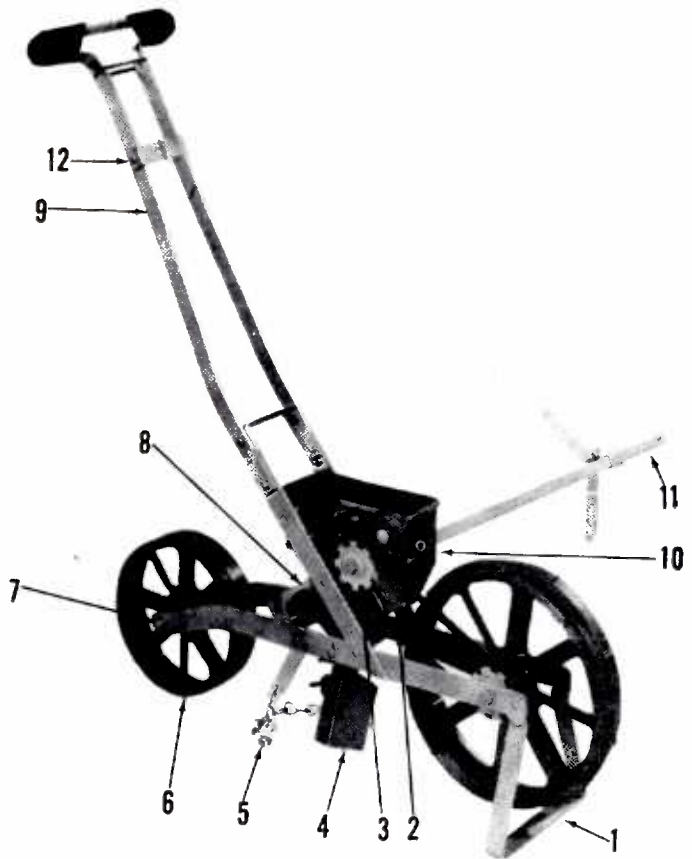


Figure 5 Earthway® Seeder – Model 1001B

Key Chart:

T. Spring Tensioner

V. Pressure Spring

H. Drive Pulley

Y. Clamp Screw

L. Coulter

W. Stop

M. Rear Wheel

K. Knee Joint

C. Chassis Linkage

F. Front Wheel

G. Coverer

S. Scraper

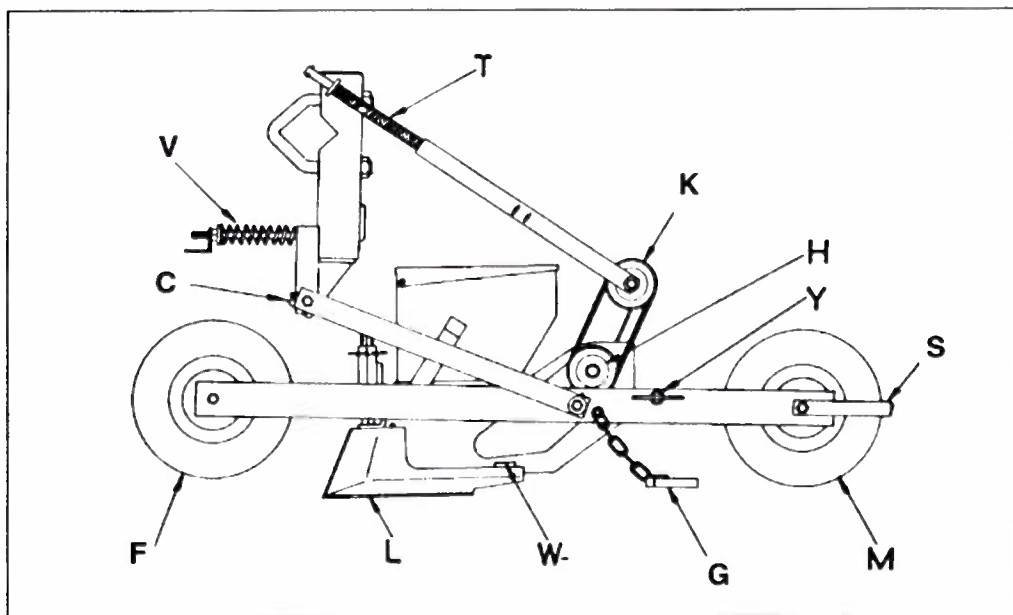


Figure 6 Stanhay® precision seeder (chassis with coulter and knee joint assembly)

Recommended pre-planting checks when direct seeding crops with the Stanhay® precision seed drill.

Since mistakes made at seeding will be carried throughout the life of the crop, the importance of efficient seeding cannot be over emphasised. Before planting, the following checks are recommended to ensure that the machine is operating efficiently:

- Ensure that all drive belts are in good condition and are correctly tensioned.
- Clean seed box and seed chamber in particular. Seed dressing may accumulate under the repeller tyre and repeller wheel.
- Check the condition of the repeller tyre. This keeps the seed circulating and prevents double seeding. Very abrasive seeds like onion seeds may cause wear on the repeller tyre, particularly in the centre. Worn tyres should be replaced.
- Check that the rubber flap in front of seed chamber is in good condition.
- Ensure that the choke is fitted correctly. It should fit flush into the recess provided and not project into the seed chamber since this will cause damage to seed.
- Ensure that the spring base is fitted correctly, i.e. with the short end towards the rear of the seed drill.
- Ensure that all pulleys are running smoothly.
- Check that V-belts from master land wheels are fitted to the required pulley.

Before fitting the seedbelt to the seedbox, carry out the following checks and make the necessary adjustments:

- Spin seeder pulley by hand with cover plate on seedbox. Slacken cover plate screw. If the box runs more freely with the loosened cover plate, it implies that the repeller tyre is binding on the cover plate. To correct, remove the repeller wheel, take off the repeller tyre and sand wheel on both sides lightly until wheel spins freely when cover plate is tightened.
- Check that fixed roller and belt tension roller are spinning freely. If necessary, lubricate with gasoline, but **do not use oil**. If still tight, tap on the spindle to slacken slightly.
- Check spring tensioner setting, i.e. distance between the centre of the fixed roller and the centre of the belt tensioner. This should be 7.9 cm (3.1 in) when no seed belt is fitted. The adjustment may be made by loosening the fixing screws and adjusting the bracket of the tensioner.
- If seeder is still not running freely, the chain guard should be removed and the two chains adjusted so that they run easily without any tight spots.
- Check tracking of the seedbelt. If belt is rubbing on the cover plate or the inside surface of the seedbox, adjust by bending the belt tensioner slightly. If this adjustment is not made, belts will wear at edges, and excessive seeding will occur. Cover plate and seedbox surface will also become scored.

- Select correct belt for the crop to be planted, and ensure that it is fitted correctly.
- When fitting seedbox into coulters, ensure that the pin at the front of the box fits into the hole at the top of the coulters. Hand tighten the screw at the side of the seedbox.
- Check adjustment of master land wheels. This adjustment must take into account the differences between the depth of the seedbed and wheeltrack. Ensure that land wheels are making sufficient contact with the soil surface to turn the seeder mechanism.

The seeding operation



Figure 7 Direct seeding with a Stanhay® seed drill

Using a Stanhay® precision seed drill

- With seed in the seedboxes and the planter raised off the ground, turn the master land wheel slowly in the direction of travel and observe discharge of seed at delivery end of seed box.
- Slowly lower drill into work while driving forward. Depth of planting should be 1.3 cm (0.5 in). Try to avoid jerky movements since these tend to compact seed in the seed chamber and may jam seed belts causing drive belt to slip. Note that filling of seedboxes with seed should be done in the field to avoid similar compaction of seed when the drill travels with seed in boxes. If the machine is lowered into the work when the tractor is stationary, the drills will run backwards and may pick up soil clods in the coulters which could jam the belts. Always keep seed box lids closed when drilling as soil may be thrown up into the boxes by the tractor wheels.
- Some seed drills are fitted with flashing light signals which indicate if the drill unit is not working, as well as a signal which indicates when the seed hoppers are almost empty of seed. However, in spite of these signals, it is advisable to have a reliable person walking behind the drill to clear any obstructions which may block coulters, and ensure that V belts turn consistently. (This is made easier by painting a small white mark on each V belt).

Using an Earthway® seeder



Figure 8 Direct seeding with an Earthway® seeder

- Pour seeds into the seed hopper. Do not fill the hopper above the centre of the seed plate.
- Set the planting depth by adjusting the coulter. There are graduations on the front angles of the seed chute. Move the coulter until the top edge is in line with the desired planting depth. Re-tighten wing nut after adjustment is made.
- Mark out the first row with string and stakes. Lower the row marker shaft and adjust the row marker to the proper width for the next row.
- Lift the kick stand over the front wheel. Be sure that the cover chain follows behind the coulter. Move the planter forward and tilt the seeder to the right as you move down the row to help remove all the seed from the hopper.

Spacing recommendations

Antigua	Five or six rows per 1.5 m (5 ft) wide bed. Spacing within the row should be 2.5 cm (1 in).
Barbados	Five or six single rows per 1.8 m (6 ft) or 1.6m (5.5 ft) wide bed are usually planted 23 cm (9 in) apart. Four or five double rows 5 cm (2 in) apart may also be used to good advantage. Spacing within the row should be 2.5 cm (1 in).
Grenada	Five rows per 1.2 m (4 ft) wide bed. Spacing within the row should be 5 cm (2 in).
Jamaica	<i>Wide spacing technique.</i> Two rows initially at 40 cm (16 in) on a 1 m (3 ft) wide bed with an intermediate row created at thinning. <i>Close spacing technique.</i> Three rows 20 cm (8 in) apart per 1 m (3 ft) wide bed. Spacing within the row should be 5-6 cm (2-3 in).

- | | |
|-----------------------|---|
| Montserrat | Three rows per 1 m (3 ft) wide bed. Five rows should be used on 1.5 m (5 ft) wide beds. Spacing within the row should be 2.5 cm (1 in). |
| St Kitts/Nevis | Five rows 20 -25 cm (8-10 in) apart per 1 m (3 ft) wide bed. Spacing within the row should be 2.5 cm (1 in). |
| St Vincent | Four rows per 1.2 m (4 ft) wide bed. Spacing within the row should be 2.5 cm (1 in). |

5. Germination

As long as viable seed is used, and adequate moisture is available, the crop should emerge in 7-10 days. Daily inspections are recommended during the seedling stage since emerging seedlings are very vulnerable to pests and diseases. Immediate corrective action should be taken if problems occur. Germination and early seedling development problems have been experienced on black soils in Barbados during March and April when mid-afternoon soil temperatures as high as 46°C (115°F) at the soil surface have been observed. Frequent light irrigations will assist in cooling soil surfaces under these conditions.

Identifying causes of a poor crop stand

If the crop stand is disappointing in spite of making all the pre-planting checks recommended earlier for the Stanhay® seed drill, failure may be due to any of the following:

- Poor seedbed preparation - especially over-compaction of soil.
- Failure to centre the machine between wheel tracks by use of stabilising bars or chains. This causes crooked rows and loss of outer rows.
- Stumps, rocks or other obstructions in path of seed drill which prevents efficient covering of seed.
- Soil sticking to rear wheels of the seeder units and dragging the seed.
- Operating the tractor at too fast a speed.
- Failure to use seed dressing. Note that seed dressing ideally should contain both a fungicide and an insecticide. However complete seed dressings are often not available.
- Using seed of low viability. The germination of seed should be checked before planting.
- Too much or too little irrigation. Emerging seedlings are very susceptible to drought, but excessive irrigation will break down the soil surface structure causing crusting which will hinder seedling emergence.
- Heavy rainfall after Dacthal® pre-emergent herbicide treatment. In very rainy weather, it may be advisable to allow seedlings to emerge before applying Dacthal®, since heavy rainfall can leach Dacthal® into the area of the onion seed and prevent its germination.