

BUILDING AN ECONOMICALLY SUSTAINABLE AND INTEGRATED CASSAVA SEED SYSTEM (BASICS-II)

Training Manual on SAH Cassava Stem Nursery Field Establishment

2020/2021



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INTRODUCTION

The processor-led model component of the Building an Economically Sustainable and Integrated Cassava Seed System project (BASICS-II) is focused on establishing an innovative and economically viable commercial stem business model that will serve high quality cassava value chains led by integrated cassava processors.

A rapid propagation technology, known as Semi-Autotrophic Hydroponics, is being implemented to improve the economic viability of stem production and generate processor buy-in by improving supply assurance of high-quality, high starch content cassava roots from its outgrowers and commercial growers.

The integration of a macro-propagation technology into the seed value chain will lower production cost, accelerate the launch of new varieties to markets and encourage the use of other existing improved varieties by smallholder farmers. Also, the use of rapid propagation technology will improve seed production efficiency and enable an economically sustainable cassava seed system.

BASICS-II is the second phase of the four-year BASICS project and IITA is leading implementation of program activities in collaboration with several partners in the public sector and private sector. Sahel Consulting Agriculture and Nutrition Limited is leading the implementation of the processor-led model component. Sahel developed this training manual as a set of curricula on best practices in the management of SAH anchored seed production operations. It is important to mention that these curricula build on the existing body of work developed in the first phase of the BASICS project when Context Global Development led the processor-led model component with support from Sahel Consulting. These best practices curricula are developed around three key areas: business, agronomy, and quality. Business encapsulates the financial aspects of running a financially sound and profitable seed business unit, while agronomy and quality captures the proper multiplication and production practices for quality cassava stems from the SAH laboratory to the field.

The three core curriculum pieces are augmented by a repository of process documentation and specific reports which are developed as tools for helping to standardize operating procedures in accordance with best practices training.

This manual focuses on the agronomy component of the SAH cassava stem nursery and highlights the main activities involved in establishing, managing, and certifying the nursery field.

The planting of cassava plantlets multiplied in the SAH laboratory to the nursery field marks the first stage of stem production. The class of cassava seed produced at this stage is foundation seed. The nursery is structured in blocks and an isolation distance of about 5m is maintained between blocks to provide a space for field operations and avoid varietal mix-up.

PROCESS FLOW FOR CASSAVA STEM NURSERY FIELD SETUP

This manual discusses agronomic activities relating to the establishment, maintenance and harvesting of a cassava stem nursery field within the SAH cassava seed production unit. The key activities are presented in the chart below and discussed in detail in the different sections of the manual.

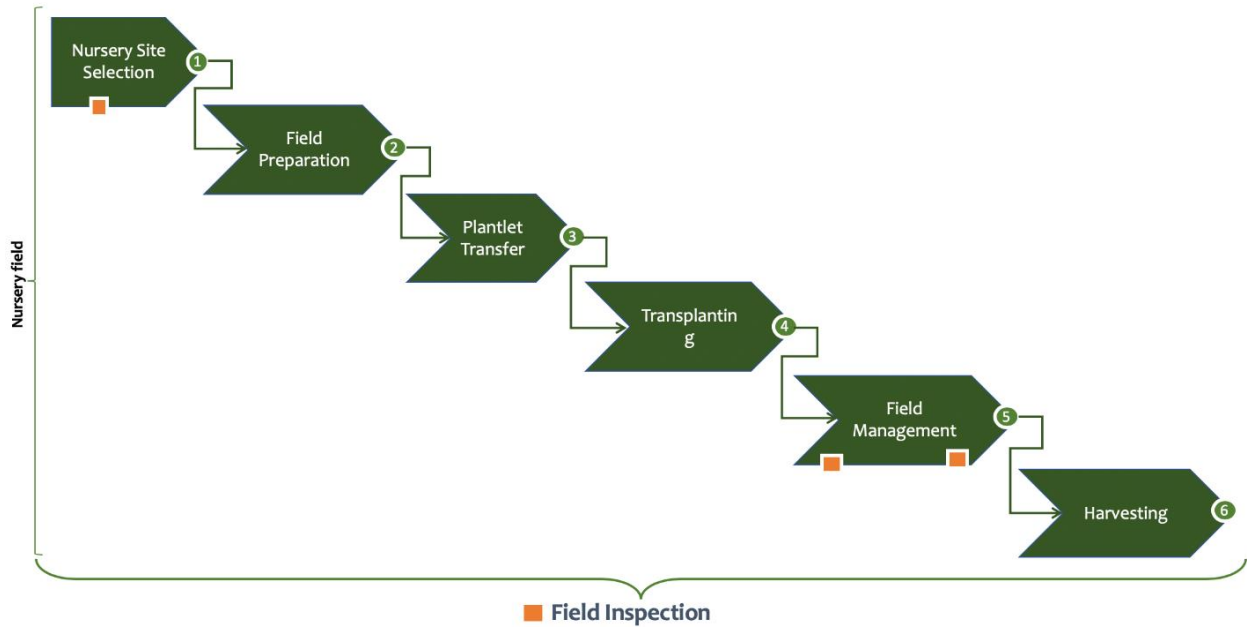


Figure 1. Activity Flow for the Setup of the Nursery Field

SELECTION OF CASSAVA NURSERY SITE

Roles

Management Team, Field Supervisor and National Agricultural Seeds Council (NASC)

Officials

Management Team: The management team is responsible for overseeing the site selection activities and approving final site selected for field cultivation.

Field Supervisor: The field supervisor is responsible for carrying out all on-field activities involved in the site selection process.

NASC Officials: The NASC officials are responsible for inspecting and certifying the cassava stem nursery site.

Activities / Processes

Site selection is the first major activity carried out when establishing a nursery for cassava stem production. The condition of the selected site for nursery use can influence the production output from the nursery. Several factors determine the performance of a nursery field.

The main activities involved during field selection include:

1. Mapping out the current farm layout to understand the areas available and the most suitable farmland area based on required size of the nursery, topography and soil type and proximity to water source.
2. Examine the pre-selected area of land to ascertain that it is in recommended proximity to other crop fields on the farm.

The following factors ensures the most suitable farmland portion is selected for Cassava stem nursery:

- **Proximity to SAH Laboratory:** It is advisable to have the nursery field located close to the SAH lab/shade area. The National Agricultural Seeds Council (NASC) recommends 100m interval between fields of the same or different seeds.
- **Size of the Nursery to be Established:** The size of the field should take into consideration the growing output capacity of the SAH lab. As the SAH lab produces more plantlets ready to be transplanted to the field, more nursery field will be required to accommodate the plantlets on the field. The SAH officer and the field supervisor should work together to ensure an expandable field area capable of accommodating growth is selected.
- **Topography and Soil Type:** Well-drained soils with relatively flat surfaces are best for cassava root and stem cultivation. Soil testing is advised to ensure that the necessary nutrients are present in the right quantity.
- **Proximity to Water Source:** The nursery site should be irrigated. Having a natural water source close to the nursery will ensure consistent and sufficient availability of water for the plantlets at the early stage of the transplant.
- **Nursery Site Positioning:** The cassava stem nursery should be situated 100-200m from other cassava fields. This is to prevent spread of pests and diseases from infected farms to the plantlets. The nursery should also be a distance from major roads capable of accumulating dust particles on the plantlets' transplanted.

Standard Tools and Operating Procedures (STOPs)

Objective: Cassava Stem Nursery Site Selection

1. Map out the current farm layout to understand the portions under cultivation and the available areas on the farm.
2. Analyse the available areas of the farm to discover where the required size of nursery can possibly fit.
3. After identifying all the possible locations on the farm where the intended nursery can fit based on the hectarage requirement, subject all the identified options to the factors listed above under the Activity/Process section and select the best fit.
4. Retrieve the history of the selected farmland area/portion through research (from the farm's records, questioning the farm supervisor who have been with the company for the longest time). Data to be retrieved includes but not limited to the following: crops grown on the pre-selected area in the last 5 years, past disease outbreaks and pest attacks, type of fertilizers and chemicals applied to the farm area in the past 5 years or less.
5. Engage a soil expert to obtain samples of the soil for laboratory analysis to determine the soil type, alkalinity, acidity, and nutrient composition. If the result from the soil test indicates that the field cannot be used, eliminate the field selected from your list of options and repeat step 2.
6. After the soil test results indicates that the pre-selected field is suitable for cassava nursery, record all data relating to the plot's size and exact location (GPS), soil type and nutrient composition,
7. Invite the National Agricultural Seeds Council (NASC) to inspect the proposed cassava stem nursery site and accredit it for use.

PREPARATION OF CASSAVA NURSERY FIELD

Roles

Field Supervisor, Field Workers and Tractor Operators

Field Supervisor: The field supervisor is responsible for overseeing the field preparation process.

Field Workers: The field workers are responsible for carrying out field mapping exercises under the supervision of the field supervisor.

Tractor Operators: Tractor operators are responsible for operating the tractors with attached mechanical implements for ploughing, harrowing, and ridging. The tractor operators are also responsible for creating demarcations and inter-block isolation distances, and contours which will help to reduce the impact of erosion on the field.

Activities / Processes

The next step after the nursery site has been selected and confirmed for cultivation is land preparation. The nursery site should be prepared close to the date when the field will be established with plantlets from the SAH laboratory or shade area. This is important because when the site is prepared way ahead of the field establishment date, it is likely the land preparation exercise will have to be done again (to a certain extent) due to weed growth.

The major activities involved in land preparation are land clearing, tilling and field mapping and sectioning.

Land Clearing

The type of vegetation on the field determines the tractor to be used for clearing. A grassland requires tractor-mounted slashers or brush cutters while a forest vegetation requires equipment such as:

- a. Bulldozers – used to push down trees and shrubs.
- b. Monkey winch – used to fell trees and pull-out roots of trees.
- c. Chain saw – used to cut down trees and shrubs.

Tillage

After land clearing, the field should be properly tilled. Tillage helps to reduce weed growth and loosen up the soil in the planting area to support root development. Tillage can be achieved through ploughing, harrowing and/or ridging.

Field Mapping and Sectioning

The field is mapped and structured in blocks. The blocks structure the nursery field into mini blocks which helps manage the batches of plantlets established on the nursery per time.

The field should be mapped out following the layout design and inter-block spacing should be created for easy access to the varietal blocks. The following materials are needed for the field mapping exercise:

- a. Long tape measure (100ft) – used to measure the blocks accurately.
- b. Long ropes (100ft) – used to align the tapes on a straight line.
- c. Stakes/poles (20-100) – used in demarcating the blocks and make the spaces between and with blocks more pronounced and visible.

TRANSFER OF SAH CASSAVA PLANTLETS

Roles

SAH Officer, Field Supervisor and Field Workers

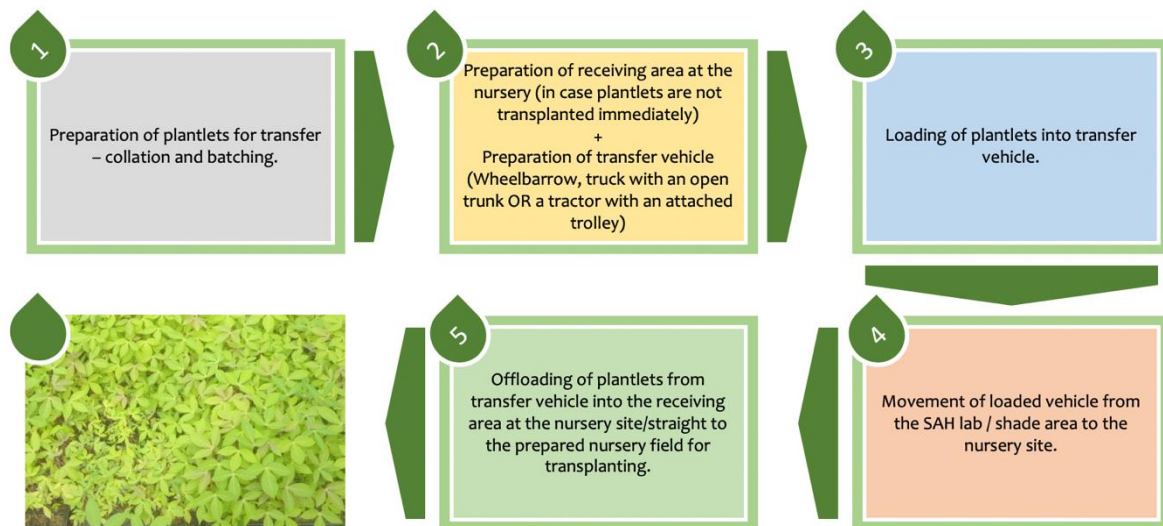
SAH Officer: The SAH Officer is responsible for aggregating plantlets that are ready for transplanting at the SAH lab/shade area and managing the process of transfer to the nursery.

Field Supervisor: The field supervisor is responsible for receiving the plantlets at the nursery and handling plantlets till the time of transplant.

Field Workers: The field workers are responsible for receiving the plantlets upon arrival at the nursery and transplanting or arranging in the shed prepared for plantlet reception.

Activities / Processes

The process of transferring plantlets from the SAH lab / shade area to the nursery field involves five (5) steps as described in the chart below:



Preparation of Plantlets for Transfer

The first step in the process of transferring cassava plantlets from the SAH lab/shade area to the nursery site for nursery establishment is collation and batching of field-ready plantlets. This process sometimes occurs for a long time depending on the time it takes to attain a critical mass within the lab and in the shade area. The SAH Officer manages this process and ensures the quantity of plantlets available for nursery establishment matches the field prepared nursery field. The number of plantlets that are available for transplanting and hectareage of nursery field ready for transplant are important data to capture at this stage.

Preparation of Transfer Vehicle and Reception Area at the Nursery Site

A truck with an open trunk, a wheelbarrow (for distances about 100m) or a tractor with an attached trolley is ideal for the transfer of plantlets from the SAH lab/shade area to the nursery site. It is important to clean the transfer vehicle and ensure that it is free of any contamination prior to the transfer of plantlets. Solutions like Tween 20 can be used to fumigate the carriage area of the transfer vehicle before use.

A receiving area should be prepared near the nursery site (less than 5-10m away) to temporary keep the plantlets before transplanting. The receiving area is recommended to be at a cool

temperature with some shade to prevent direct sunlight from reaching the plantlets prior to planting.

Loading of Plantlets into Transfer Vehicle

Plantlets should be carefully handled when transferring from the SAH lab/shade area into the transfer vehicle. Except in growth boxes, plantlets should not be kept on top of each other especially when transferred in seed trays. It is important to ensure the truck is never overloaded when transferring plantlets from the SAH lab/shade area to the nursery site. Proper plantlet handling will reduce the plantlets' exposure to stress.

Movement of Plantlet Transfer Vehicle from the SAH lab/Shade area to the Nursery Site

The vehicle should be carefully steered from the plantlets' pick-up location (SAH lab/Shade area) to the nursery site. It is important to ensure that the plantlet transfer process occurs during low temperatures early in the morning and late in the evening. Caution should be applied while driving or moving the plantlets to reduce stress on the plantlets. Regular vehicular checks like engine working conditions, fuel level, tyre condition etc. should be done to avoid breakdown of the transfer vehicle midway into the journey. It is necessary to ensure that the field supervisor is at the nursery site prepared to receive the plantlets. When possible, the plantlets should be accompanied by the SAH officer during vehicular transfers from the SAH lab/shade area to the nursery site.

Offloading of Plantlets from Transfer Vehicle to the Reception Area at the Nursery Site.

On arrival of the transfer vehicle at the nursery site, the plantlets are carefully offloaded to the reception area prepared at the nursery site. The seed trays are placed on the elevated platform within the receiving area prior to transplanting. The plantlets should be grouped according to varieties and demarcations should be made in the reception area to isolate different varieties (in cases where multiple varieties are being transported to the nursery site).

Standard Tools and Operating Procedures (STOPs)

Objective: Plantlet Handling

1. Unload the plantlets on arrival at the nursery field/shed around the nursery field.
2. The plantlets can either be transplanted immediately (recommended) or stored for as long as 2-3 days maximum before transplanting to the nursery field.
3. The seed trays should be kept in an upright position and protected from rain and direct sunlight. The temperature under the shed should not be above 40°C.
4. The field supervisor should be in-charge of the temporary shed to avoid varietal mix-up. The field supervisor should be solely responsible for handing the seed trays to other field workers during transplanting to the field.

Potential Pitfalls and Mitigating Strategies

Pitfall	Mitigation Strategy
Planting delays due to the unavailable field workers.	<ul style="list-style-type: none"> • Ensure the right number of field workers are hired. • Forecast and hire field workers ahead of time.

TRANSPLANTING OF SAH CASSAVA PLANTLETS TO THE NURSERY

Roles

Field Supervisor and Field Workers

Field Supervisor: The field supervisor is responsible for overseeing the transplanting process from the arrival of the plantlets on the nursery field/receiving area.

Field Workers: The field workers are responsible for unloading the plantlets from the truck and transplanting to the nursery field as directed by the field supervisor.

Activities / Processes

Planting

Planting should be done using 1.0m x 0.4m spacing. The plot should be marked according to the spacing specification before transplanting. Plantlets from growth boxes should be transplanted with proper care along the spacing marked on the field. Transplanting should occur in March/April to ensure adequate water supply to the plantlets and optimum soil condition for root establishment. However, the availability of irrigation facility will allow for year-round stem production on the nursery. Transplanting to the field should occur in the morning or evening to enable plants recover from the stress of transportation to the nursery site. If the weather has been hot and the soil dry prior to the commencement of transplanting, water should be applied to the planting area the day before transplanting.

Plot Labelling

The blocks on the nursery should be labelled with pegs/information plates to clearly distinguish the varieties planted, planting date, and the source of the planting materials. The blocks can be allocated serial numbers for easy referencing. The peg and information plate should be placed at a consistent side of the blocks across all the blocks. After fixing all information plates, always cross-check the field to make sure there are no duplicates and no mix-up of pegs/information plates. Plot labelling should be done immediately after planting each plot.

Standard Tools and Operating Procedures (STOPs)

Objective: Transplanting plantlets to the nursery field

1. Move the plantlets from the receiving area to the prepared field.
2. Moisten the seed trays/growth boxes before lifting the plantlets to ensure the roots do not get damaged during the removal process from the containers.
3. Dig up the soil and create a pit of approximately 10cm depth to sit the root of the plantlet.
4. Establish the plantlet into the dug pit and fill the pit with soil to firm up the plantlet in an upright position.
5. Transplant one seed tray completely before picking up another seed tray. Plantlets should be planted once they are removed from the tray to avoid mix-up.
6. Compact the soil around the roots to create a slight space around the base of the transplant to hold water around the root zone.

Potential Pitfalls and Mitigating Strategies

Pitfall	Mitigating Strategy
<p>Mix-up of varieties due to poor handling during transplanting</p>	<ul style="list-style-type: none"> • Ensure the seed trays are properly labelled and differentiated by using markers to clearly indicate the variety name, age of plantlets, date of transfer etc. • The field supervisor should solely manage plantlets in the temporary holding shed beside the nursery. • Enlighten field workers on the importance and sensitivity involved in managing plantlets and avoiding varietal mix-ups.
<p>Delayed planting due to harsh weather or unavailability of field workers</p>	<ul style="list-style-type: none"> • Check the weather forecast before deciding on the planting date. • Hire field workers two days to the planting date. • Ensure the field workers get paid as agreed to avoid their withdrawal.

MANAGEMENT OF CASSAVA NURSERY FIELD

Roles

SAH Officer, Field Supervisor and Field Workers

SAH Officer: The SAH officer is responsible for overseeing the nursery field maintenance activities.

Field Supervisor: The field supervisor is responsible for sending list of chemicals and items needed for post-planting operations, requesting for funds from the management for purchasing the items and collecting the disease and vegetative data of the plants.

Field Workers: The field workers are responsible for weeding the nursery field, irrigating the plants, earthing-up exposed roots, spraying herbicides and reporting observations to the field supervisor.

Activities / Processes

Fertilizer Application

Fertilizer application during cassava nursery cultivation helps to improve the crops' germination and plant establishment. The recommended fertilizer rate is NPK at 20:10:10 kilogram per hectare. More Nitrogen is required for vegetative growth because the cassava stem nursery is specifically for stem production. Fertilizer should be applied three weeks after planting. Ring method¹ of fertilizer application can be adopted.

Weed Management

Weeds compete with plants for space, water, and available nutrients in the soil. Recommended time for manual weed control is three to four months after planting. Post emergence herbicide² should be applied to the nursery field between four to eight weeks after field establishment.

Irrigation

The nursery field should be watered at least once every two days during the dry season or in the absence of rainfall for more than seven days. As much as possible, the watering pattern should be even. In cases where irrigation facilities are not setup, manual watering should be adopted. Tractor-driven tanks can be used to irrigate the field. Caution should be placed on the tractor's tracks to avoid trampling on cassava plants on the nursery field.

Data Collection

Details on the plant vigour and height, pests and disease symptoms, varietal differences across plantlets on the field should be documented on a weekly basis. A register containing columns of all the records should be kept for accurate and easy data referencing. The SAH officer should provide the field supervisor with a notebook register to collect the information on the field weekly and retrieve the register from the field supervisor monthly to transfer into an electronic form (an excel workbook suitably).

¹ Ring method involves applying the fertilizer to the base of the cassava plantlet in a band-wise manner around it.

² Use Fusillade Forte 150EC at 5–6 litres per hectare twelve weeks after planting, for grasses. Apply Diuron + Paraquat at 7 litres per hectare (directed spray) four to eight weeks after planting (early post emergence) for broad-leaved weeds.

CERTIFICATION OF THE NURSERY FIELD

Roles

Management, Field Supervisor, SAH Officer and NASC Officials

Management Team: The management team is responsible for inviting NASC to inspect and certify the field. The management also ensures the necessary information about the field is well documented ahead of the NASC's inspection.

Field Supervisor: The Field Supervisor is responsible for keeping the field in good condition.

SAH Officer: The SAH Officer is responsible for providing the management with all the supporting documents as required by NASC for the inspection and certification process.

NASC Officials: The NASC Officials are responsible for conducting field inspection visits and certifying fields and cassava stems.

Activities / Processes

NASC field inspection occurs three times between site selection and harvesting. The stages of NASC field inspection are below:

- **Pre-planting/Site Selection Inspection:** This occurs two weeks before planting to understand the cropping history of the site. Information from this inspection will guide the farm management on nutrient requirement, knowledge on prevailing diseases in the selected location and how they can be managed.
- **Vegetative Stage Inspection:** This occurs between 16 and 20 weeks after field establishment. Inspection at this stage could be multiple times depending on the condition of the field as identified by the inspection officer.
- **Pre-harvest Inspection:** This occurs between 7-9 months after field establishment.

The major activities to be carried out by the management team, field supervisor, and SAH officer include:

- **Application to NASC for Field Inspection and Certification:** The management team will be required to officially invite NASC for field inspection and certification.
- **Prepare the Field for NASC Visit:** The field supervisor should ensure that the field is in good condition ahead of each NASC visit. In addition, the SAH Officer should ensure that necessary information on the cropping history of the nursery site and recommended isolation distance is available ahead of the first NASC visit. Usually, an isolation distance of between 5 – 10 meters inter varietal blocks is recommended. In addition, a distance of at least 100 meters is required between two cassava fields to reduce the chances of pest and disease transfer by pathogens.

Potential Pitfalls and Mitigating Strategies

Pitfall	Mitigation Strategy
Delay in field inspection by NASC	<ul style="list-style-type: none"> • The SAH Officer should develop an activity plan for nursery management indicating timeline of activities, personnel responsible and touchpoints, and share with the management, and subsequently upon approval, NASC. • The management, through the SAH Officer should follow-up with NASC Certification Officer to ensure prompt inspections of the fields.

HARVESTING OF THE NURSERY FIELD

Roles

SAH officer, Field Supervisor and Field Workers

SAH Officer: The SAH officer is responsible for instructing the field supervisor on the appropriate time to harvest and ensures the right data is collected during the harvesting process.

Field Supervisor: The field supervisor oversees the harvesting process and ensures the stems are ratooned at the right heights.

Field Workers: Field workers are responsible for carrying out ratooning of the cassava plantlets on the field as directed by the field supervisor.

Activities / Processes

Pre-harvesting Preparations

Prior to the harvesting period, the SAH officer should coordinate the hiring of field workers to carry out harvesting activities on the nursery field. Adequate farm implements like cutlasses, hoes and other materials required to support bundling of stems should be made available ahead of time.

The SAH Officer should also calculate the work rate of the field workers to be engaged to understand the number of days for harvesting and the associated cost. This will provide a fair understanding of the overall cost of engaging the field workers for the entire period of harvesting.

Harvesting and Storage

The cassava stems on the nursery field should be harvested from 6–7 months after field establishment via ratooning. The stems should be cut at about 15-20cm from the ground. The harvested stems should be tied together in bundles of 50 stems, each 1m long and transferred to a cool area for storage. When storing, place the ratooned stems in an upright position (bud facing upward) under a well-ventilated shed or under a tree providing good shade.



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