Smallholder Horticulture Empowerment & Promotion Project for Local and Up-Scaling (SHEP PLUS)

“Changing Farmers’ Mindset from “Grow and Sell” to ”Grow to Sell””

BULB ONION PRODUCTION

Prepared by SHEP PLUS

Photos: SHEP PLUS
Training Title: Bulb Onion Production
Objective: To provide a guideline on production of Bulb Onions
Specific Objective:
- To provide basic information on production, post-harvest handling, and marketing of Bulb Onion

Contents:
1. Introduction: Background, Common Varieties and Optimal Ecological Requirements
2. Pre-Cultivation Preparation 1 – 5
3. Cultural Practices 1- 9
4. Harvest
5. Post-Harvest Handling
6. Cost & Income Analysis
7. Post-Training Evaluation Exercise

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Preface
- This training material applies the fundamental practices essential for crop production and successful marketing to put into perspective the case of horticultural crop production.
- The fundamental practices are categorized into seven (7) broad topics and twenty (20) sub-topics; the twenty sub-topics are referred to as the General Horticulture Crop Production and Post-Harvest Handling Techniques (GHCP&PHHT20). This categorization is based on the Smallholder Horticulture Empowerment & Promotion Unit Project (SHEP UP) experience in mitigating production and marketing challenges facing smallholder horticultural farmers.
- The seven (7) broad topics are: Pre-Cultivation Preparation; Land Preparation; Crop Establishment (Planting/Transplanting); Crop Management; Harvest; Post-Harvest Handling: and Cost and Income Analysis.
- The sub-topics under each topic are as follows: Pre-Cultivation Preparation (market survey, crop planting calendar(s), soil sampling & analysis, composting, and quality seed/planting material(s)); Land Preparation (land preparation practices, incorporation of crop residues, and basal application); Crop Establishment (raising seedlings, planting/transplanting, fertilizer application); Crop Management (water requirement, managing of weeds, top-dressing, pests & diseases management practices, and safe & effective use of pesticides); Harvest (harvesting indices); Post-Harvest Handling (appropriate containers/standard packaging materials, and value addition techniques); and Cost and Income Analysis (cost and income analysis).
- The issues outlined in the twenty (20) sub-topics might not necessarily be applicable in all cases. But where applicable, it is recommended that the instructions issued be given due consideration.
1. Introduction:
1.1 Background

Bulb Onion (Kitunguu Maji)
1. Introduction:
1.1 Background

- Bulb Onion is one of the most widely grown & consumed vegetables in Kenya
- It is a biennial plant but considered an annual because it is harvested in its first growing stage
- It is a profitable crop. However, it requires a lot of labour during transplanting and weeding
- It is an important spice for foods when cooked or served raw
- Used to make pickles or chutneys
- It is rich in Calcium, Iron, Potassium, Vitamin B6 & B9, Vitamin E and has medicinal properties
1.2 Some Common Varieties

“Bombay Red”

“Red Creole”
1.2 Some Common Varieties

“Bombay Red”

• Variety for dry and warmer conditions
• Produces small to medium sized bulbs, which are globe shaped, Deep purple red colour and very pungent
• Maturity: 150 days from transplanting
• Yield Potential: 16,000kg per acre

“Red Creole”

• A popular variety which produces red, flat-round, globular bulbs
• It has very pungent taste
• Maturity: 150 days after transplanting
• Excellent in storage
• Yield Potential: 16,000kg per acre

“Bombay Red” and “Red Creole” are the most common varieties in Kenya.
1.2 Some Common Varieties

“Red Star F1”

“Neptune F1”
1.2 Some Common Varieties

“Bombay Red” and “Red Creole” are the most common varieties in Kenya.

“Red Star F1”
- Matures in 110-120 days after transplanting
- Very high yielding 25,000kg per acre
- Globe shape, uniform medium to big bulbs
- Excellent bulb colour; deep dark red
- Good field holding capacity
- Stores up to 5 months
- Tolerant to neck rot and purple blotch diseases

“Neptune F1”
- High yielding
- Firm shinning red bulbs, good pungency
- Good for salads, red-skin, flattened globe-shape
- Mid-late maturing, (110-120 days)
- 5-6 months storage period
- Pink root resistant

Photo: https://www.easeed.com/2015-07-16-12-56-29/vegetables/vegetables-6-137

Photo: Amiran seed catalogue
1.2 Some Common Varieties

Cont’

“Texas Grano”

“Tropicana F1”

Information Source: http://www.royalseed.biz/onions.php

1.2 Some Common Varieties Cont’

“Texas Grano”:
- White colour with golden exterior
- Bulbs large
- Maturity 120 days from transplanting
- Does Not store well.
- It has mild pungency, which is good for salad
- Yield: 21,000kg per acre

“Tropicana F1”:
- Very productive and produces large red, thick flat bulbs with firm pungent taste
- Yield Potential: 25 tons per acre
- Maturity 90 -100 days after transplanting

Other varieties grown in Kenya:

“Jambar F1”:
- Dark red globe bulbs easy to cure
- Can be grown in open field and greenhouses
- Yield: 23,000kg per acre

“Red Passion F1”:
- Deep red
- Stores up to 5 months
- Tolerant to Pink Root and Purple Blotch
- Yield Potential: 23,000kg per acre

“Red Pinoy F1”
- Deep red attractive bulbs
- Maturity only 90 days from transplanting
- Strong pungency
- Long shelf life of up to 6 months at room temp
- Tolerant to Downy Mildew and Purple Blotch
- Yield: 30 tones per acre
## 1.3 Optimal Ecological Requirements

<table>
<thead>
<tr>
<th>Altitude</th>
<th>0 – 1,900 metres above sea level</th>
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<tbody>
<tr>
<td>Rainfall</td>
<td>500 – 700 mm of rainfall annually</td>
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<tr>
<td>Growing Temperature</td>
<td>15 – 30 °C</td>
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<tr>
<td>Soils</td>
<td>• Fertile and well drained soil</td>
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<td>• pH range 6.0 – 6.8</td>
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## 1.3 Optimal Ecological Requirements

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<td></td>
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</tbody>
</table>

**1.3 Optimal Ecological Requirements**

- **Altitude:** Onion can be cultivated up to 1,900 m above sea level.
- **Rainfall:** Onions require well-distributed rainfall of between 500 and 700 mm during the growing period. Dry spell is needed at maturity.
- **Temperature:** The optimum temperature for growth is 15 – 30 °C. If the temperature exceeds 30 °C, maturity is hastened & small bulbs are produced, consequently lowering the yields. When the temperature is low, growth is slowed or the plant may result to flowering. Cold weather is also associated with increased leaf diseases.
- **Soil:** Onions require fertile and well-drained soil. The optimum pH range is 6.0 – 6.8. Sandy to silty loams with fine tilth are adequate.
2. G20 technologies

1. Market survey
2. Crop planting calendar
3. Soil testing
4. Composting
5. Use of quality planting materials
6. Recommended land preparation practices
7. Incorporating crop residues
8. Basal application of compost/ manure
9. Recommended practices of seedling preparation/ seedlings from registered nursery
2. G20 technologies

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[G20 Technologies]
Make sure to support farmers carry out G20 techniques for any crop
2. G20 technologies

10. Recommended spacing
11. Recommended fertilizer application rate
12. Supplementing water
13. Timely weeding
14. Top-dressing
15. IPM practices
16. Safe and effective use of pesticides
17. Use of harvesting indices
18. Appropriate post harvest handling containers
19. Value addition techniques
20. Keeping farm records
2. G20 technologies

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[G20 Technologies]
Make sure to support farmers carry out G20 techniques for any crop
2.1 Crop Planting Calendar

A Sample of a Bulb Onion Planting Calendar

<table>
<thead>
<tr>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
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</thead>
<tbody>
<tr>
<td>Land preparation</td>
<td></td>
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<tr>
<td>Sowing in nursery bed: 0.8 – 1.2 kg of seed/acre</td>
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<tr>
<td>Control of damping-off diseases &amp; cutworms</td>
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<tr>
<td>Transplant 40 – 50 days after seed Sowing</td>
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<tr>
<td>Spacing 30 cm x 10 cm (133,000 plants/acre)</td>
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<tr>
<td>Fertilizer (DAP/ TSP) Application 80 kg/acre (15 g/m of a row=3 bottle tops/m)</td>
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<td>Weed, pests &amp; diseases control</td>
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<td>Unearthing of bulbs</td>
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<tr>
<td>Stem bending</td>
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</tr>
<tr>
<td>Harvesting starts 90-150 days after transplanting</td>
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<tr>
<td>Bulb curing</td>
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<tr>
<td>Sorting &amp; grading</td>
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<tr>
<td>Yields 16,000-23,000kg Per acre</td>
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<tr>
<td>Marketing</td>
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</tbody>
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Peak demand for Bulb Onion

MOALF/SHEP PLUS
2.1 Crop Planting Calendar

A Sample of a Bulb Onion Planting Calendar:

Targeting a peak market demand beginning just after the beginning of January

Procedure:
1. Determine from the market survey results (2.1) when there is peak demand for Bulb Onion
2. Work backwards from the month when there is peak demand to prepare a monthly farm activities preceding the peak period
3. Use the monthly activities preceding the peak as a procurement plan for farm inputs and a guide for farm operations

Notes:
• To meet the peak demand period of the market, there may be need of supplemental irrigation
2.2 Composting

Photo: SHEP PLUS

Manure preparation through composting
2.2 Composting

During compost making, the organic matter need to be covered to prevent leaching of nutrients.

Bulb Onion is a heavy feeder and does well in soils with high organic content (manure).

Based on the results of the soil analysis, prepare adequate compost for application.

The recommended rate of application ranges from 10 – 16 tons per acre for Bulb Onion.

Manure preparation through composting
3.1 Basal Application

Manure incorporation as a basal application

Photo: SHEP PLUS
3.1 Basal Application

• The manure/compost should be broadcasted (10 – 16 tons per acre) then worked into the soil (incorporated) preferably using a hoe

• Manure/compost should be applied at least 1 – 2 weeks before transplanting the Bulb Onions

• Onions respond very well to well decomposed organic manure

Manure incorporation as a basal application
3.2 Raising Seedlings

A Bulb Onion nursery
3.2 Raising Seedlings

A Bulb Onion nursery

3.2 Raising Seedlings (GHCP&PHHT20: Q9)

- Onion is propagated by seed (fresh)
- Seed rate is 0.8 – 1.2 kg per acre and is sown in a nursery under a mulch cover

Nursery Establishment:
- Prepare beds maximum 1 m wide and incorporate well-decomposed compost /FYM 20 kg/m² and add DAP/TSP 20 g/m²
- Make rows about 15 cm apart, drill the seed thinly in 1 cm furrows and cover lightly with soil and mulch
- Germination takes 7-10 days

Nursery Management:
- Irrigate the nursery bed regularly
- After the seed emerges, remove the mulch
- Prepare a raised cover
- Manage weeds, pests and diseases
### 3.3 Transplanting

Recently transplanted Bulb Onion seedlings
3.3 Transplanting

3.3.1 Appropriate Time
- Seedlings are transplanted 6 – 8 weeks after sowing or at 3-5 well formed leaves when base is pencil thick.

3.3.2 Recommended Spacing (GHCP&PHHT20: Q10)
- The seedlings are transplanted in 2.5 – 3 cm deep trenches at a spacing of 30 cm between rows and 8 – 10 cm between plants (when using furrow irrigation).

3.3.2 Transplanting Method
- Soil analysis results should be used to determine the nutrient requirements of the soil prior to planting.
- Irrigate the seedbed prior to pulling out the seedlings.
- Apply 80 kg/acre of TSP.
- Irrigate field well a day before transplanting.
- Carefully pull out the seedlings to avoid damage.
- Cut off 50 per cent of the green tops to hasten take off.
- When planting onion sets, don’t bury them more than one inch under the soil.

Recently Transplanted Bulb Onion seedlings
3.4 Water Requirement

Bulb Onion Seedlings Under Irrigation
3.4 Water Requirement

- Onions require light and frequent irrigation:
  - At the growing stage: excessive moisture must be avoided
  - At the bulbing stage: need a substantial amount of water
  - Watering should be reduced/discontinued towards bulb maturity
- Lighter soils need more frequent water applications, but less water applied per application
- Increase the water application as plants and roots increase in size
- Proper moisture management is important in
  - Alleviating "Pink Root" problems (Refer to the page No. 21/26)
  - General root health
  - Vigorous bulb growth
- Drought stress will cause splitting or formation of double/multiple bulbs
3.5 Top-dressing

Strip/banding top-dressing of Bulb Onions
3.5 Top-dressing

3.5 Top-dressing (GHCP&PHHT20: Q14)
- Soil analysis results should be used to know the nutrient requirements of the soil prior to planting
- Top-dressing can be done in 2 splits
  - 1st Top-dressing: 30 days after transplanting at 40 kg/acre of CAN
  - 2nd Top-dressing: 45 days after transplanting at 80 kg/acre of CAN
- Strip/banding method is preferred over broadcasting as it is more effective
- Too much nitrogen results in thick necks
- Top-dressing should be completed before initiation of bulbing

Unearthing:
- **Unearthing** is removal of excess soil around the bulb/loosening soil to allow the bulb to expand or develop well
- **Unearthing** can also facilitate the colouring and curing
- If the soil is hard during bulb formation, loosen the soil to allow bulbs to develop well
- Unearthing is carried out during 2nd and subsequent weeding and is done by removal of the soil from the bulbs by hand
- Watch out not to damage or expose the roots

Strip/banding top-dressing of Bulb Onions
3.6.1 Major Pests
3.6.1 Major Pests

- Pest damage causes a reduction in quality and quantity of produce
- The following are the major pests of Bulb Onion in Kenya:
  A. Onion Thrips
  B. Onion Fly
3.6.1.A: Onion Thrips

Damage by Onion Thrips on Bulb Onion leaves

Photo: © A. M. Varela, icipe
http://infonet-biovision.org/PlantHealth/Crops/Onion(CC BY-NC-SA 3.0)
3.6.1.A: Onion Thrips

Identification:
- Adult thrips are small (0.5 – 2.0 mm), slender and winged
- Wings are long, narrow and fringed with long hairs
- Nymphs are white or yellow
- Both adults and nymphs feed on the base of the plant within the leaf sheaths

Damages:
- Attacked leaves have sunken silvery patches
- Under severe attack, the entire plant appears silvery and later the leaves wither, dry up and die
- The pest excreta appears as black spots on the silvery leaves

Control:
- Keep plants well irrigated since water stressed plants are more susceptible to thrips damage
- Maintain weed-free plots
- Rogue heavily infested plants
- Neem extracts can be sprayed on attacked plants
- Spray with insecticide, such as Spinosad (Tracer®), Abamectin + Acetamiprid (AMAZING TOP 100 WDG® PHI:21days), Acephate (ASATAF SP® PHI: 3-7days)
3.6.1.B: Onion Flies

Damage by an onion fly larva

Photo: © Jarmo Holopainen http://infonet-biovision.org/PlantHealth/Crops/Onion (CC BY-NC-SA 3.0)
3.6.1.B: Onion Flies

Identification:
- The onion fly maggots measure 8 mm long and are white cream in color
- They are the most destructive stage of the fly

Damages:
- They eat the lateral roots causing tunnels into the taproot, plants become shriveled or eventually die
- They are also found inside developing onion bulbs and their feeding exposes the plant to infection by diseases like Bacterial Soft Rot

Control:
- Practice crop rotation
- Use well decomposed manure/compost
- Practice field sanitation: remove and destroy infested plants
- Carefully plough in crop residues immediately after harvest

Damage by an onion fly larva

Photo: © Jarmo Holopainen
http://infonet-biovision.org/PlantHealth/Crops/Onion (CC BY-NC-SA 3.0)
3.6.2 Major Diseases
3.6.2 Major Diseases

- Disease infection leads to reduction in quality and quantity of produce
- The following are the major diseases of Bulb Onion in Kenya:
  a. Onion Downy Mildew 
  b. Purple Blotch 
  c. Rust 
  d. Pink Root 
  e. Neck Rot
3.6.2.a: Onion Downy Mildew

Symptoms of “Onion Downy Mildew” infection on a Bulb Onion leaf

Photo: Howard F. Schwartz, Colorado State University, Bugwood.org (CC BY 3.0 US)
3.6.2.a: Onion Downey Mildew

General Descriptions:
- The disease is caused by a fungus
- It is prevalent in cool, humid and poor drainage conditions

Symptoms:
- Formation of lesions near the tips of the older leaves,
- Yellow patches covered with grey wet fields
- Leaf tips shrink, turn pale brown and later die

Control:
- Field hygiene
- Crop rotation
- Use tolerant varieties e.g. Red Pinoy F1
- Use of fungicides e.g.) Mancozeb (Cadilac®, Dithane M45® etc.)
3.6.2.b: Purple Blotch

Symptoms of “Purple Blotch” infection on a Bulb Onion leaf

Source: Howard F. Schwartz, Colorado State University, Bugwood.org (CC BY 3.0 US)
3.6.2.b: Purple Blotch

General Description:
• The disease is caused by a fungus

Symptoms:
• Small white spots on the foliage
• Under moist condition, the spots rapidly increase to large purplish blotches often surrounded by a yellow to orange border
• Lesions extend to girdle the leaf which leads to its collapse
• Infection may spread to the bulb, where it may cause a wet, orange rot starting at the neck

Control:
• Use resistant varieties e.g. Red Passion F1 and Red Pinoy F1
• Crop rotation
• Field Sanitation: remove crop remains after harvest, do not leave volunteer plants in the field
• Avoid over fertilization
• Recommended spacing and good drainage to decrease humidity in the plant stand
• Use of fungicides such as Mancozeb (Dithane M45®), Difenoconazole (Domain 25% EC®), Propineb + Cymoxanil (Milraz WP 76®), Eugenol (e.g. Explorer 0.3 SL®)

Source: Howard F. Schwartz, Colorado State University, Bugwood.org (CC BY 3.0 US)
3.6.2.c: Rust

Symptoms of “Rust” infection on a leaf of Bulb Onion

Photo: © A. M. Varela, icipe http://infonet-biovision.org/PlantHealth/Crops/Onion (CC BY-NC-SA 3.0)
3.6.2.c: Rust

General Description:
- The disease is caused by a fungus
- High humidity, high temperatures and dense plant population favor the disease development

Symptoms:
- Small reddish dusty spots (pustules) on leaves
- Heavily infected leaves turn yellow and die prematurely

Control:
- Crop rotation
- Application of proper agronomic practices: proper nutrition and spacing
- Use of fungicides:
  - Mancozeb (Dithane M45)
  - Difenoconazole (Domain 25% EC®)
  - Eugenol (Explorer 0.3 SL®)

Symptoms of “Rust” infection on a leaf of Bulb Onion
3.6.2.d: Pink Root

Symptoms of “Pink Rot” infection on Bulb Onion roots
3.6.2.d: Pink Root

Symptoms:
• Similar to nutrient deficiencies or stress associated with extremely dry conditions
• Light pink to yellowish-brown discoloration on roots that becomes dark pink then red and eventually purple
• Under advanced stages, roots eventually shrivel, become brittle and die

Control:
• Good management practices that reduce plant stress
• Crop rotation
• Use tolerant cultivars e.g. Red Passion F1 (Refer to page No. 3/26)

Symptoms of “Pink Rot” infection on a Bulb Onion roots & leaves
3.6.2.e: Neck Rot

Symptoms of “Neck Rot” infection on Bulb Onion
3.6.2.e: Neck Rot

General Descriptions:

- Disease visible when onions are in store
- Caused by a **fungus** which enters the onions through wounds or cracks in the fleshy neck part of the bulb.

Symptoms:

- Top part of the bulb will turn brown and the skin will be darker brown.
- Top of the bulb will be softer than the lower parts.
- Grey mold and sometimes speckled with small black spots will appear, and the bulbs will deteriorate even further.

Control:

- Use fungicide treated seeds or sets
- Avoid damaging onion bulbs at or during harvest
- Don't bend over foliage to hasten drying out
- Only harvest onions when the necks have ripened and fallen over on their own accord.
- Avoid using high nitrogen fertilizers
- Crop rotation at least 3 years
- Dry the bulbs out thoroughly after harvest
- Good ventilation is important in the drying process than sun.
- Store only bulbs with dried out thin necks
- Store bulbs in a cool and dry place
- Sort out bulbs which show signs of rot.
4. Harvest

Harvested Bulb Onions
4. Harvest

4.1 Harvesting Indices (GHCP&PHHT20: Q17)

- Harvesting can be done 90 – 150 days after transplanting depending on the variety.
- Bulb Onions are ready for harvesting when the leaves collapse or when 75% of the tops of the crop have dried and fallen over.
- Leaf tops begin to discolor, bend and dry towards the ground.
- Reduced thickness of sheath leaves surrounding the bulbs (papery membranous cover).

Harvested Bulb Onions
5. Post-Harvest Handling

5.1 Curing

Field Curing
5. Post-Harvest Handling
5.1 Curing

What is “Curing”?
• Curing is a process intended to dry off the necks and outer leaves of bulbs
• The main objective is to prolong shelf life by preventing moisture loss and attack by diseases
• It can be done in the field or in a protected environment away from adverse weather conditions, such as rain or direct sunlight

5.1.1 Field Curing
• Curing can be done in the field if the maturity and harvesting coincides with dry months
• Harvested onions are placed in rows with leaves partially covering the bulbs to prevent sunburn or greening
• Onions are then left in the field until the outer leaves and neck are completely dry and papery
• Field curing can take 2 – 3 weeks depending on the environmental condition

5.1.2 Protected Curing
Drying of Onions in a protected environment
• Curing is done in a warm, dry and well ventilated location protected from direct sunlight and rain
• The process involves the following:
  – Removal of excess soil
  – Trimming of foliage leaving 2.5cm of section of stem at neck
  – Placing onions in single layer in large flat tray
• Onions can also be cured by tying tops of bulbs in bunches and hanging on a horizontal pole in well ventilated shade
5.2 Value Addition Techniques

Bulb Onions packed in the nets
5.2 Value Addition Techniques

5.2.1 Sorting
• Before storage, Bulb Onions are sorted to remove the following:
  – Onions with thick necks
  – Onions which have bolted
  – Injured onions
  – Decayed onions
  – Doubles and small bulbs

5.2.2 Grading
• Grading should be done before & after storage
• For domestic market onions are put into 3 Grades: large, medium and small
• Bulbs must be:
  – Intact with firm flesh which is not exposed
  – Clean and free from visible foreign matter
  – Sufficiently dry with the first two outer skin and stem fully dry
  – Free from abnormal external moisture
  – Free from foul smell

5.2.3 Containers & Packaging Materials
• Store/package Bulb Onions in well ventilated containers such as onion nets