LECTURE 10: BULB VEGETABLES

Included in this group are:

- Onion - *Allium cepa* var. *cepax*  
- Shallots/Multiplier onion - *Allium cepa* / *Allium ascalonicum* / *A. aggregatum*  
- Leeks - *Allium ampeloprasum* / *porrum* or var. *porrum*  
- Garlic - *allium sativum* (313)  
- Japanese bunching onion *Allium fistulosum*  
- Rakkyo - *Allium chinense* (china)

**Alliums-Genus**
- Characteristic onion smell/odour  
- Biennials grown as annuals  
- Bulbs are the storage organs  
- Leaves arise from underground stems with long sheathing bases-give stem appearance-pseudostem  
- Weakly competetive  

**Onions (*Allium cepa* var *cepax*)**

**Classification, origin and History**
- Belongs to *Alliaceae* family (formerly *amaryllidaceae* and *liliaceae* families  
- There are about 300 widely scattered species in the genus Allium and many of them have the characteristic onion flavour and odour  
- Onion has been used by man as far back as history records (3500 BC)  
- The cultivated species are probably native to the general area of S/E Asia  
- The ancient Egyptians thought highly of them and were used as offerings to their gods  
- Large quantities were eaten, used as medicine and mummification  
- The Romas gave the name onion deried from the Latin word unionem or unio meaning single-refering to the single bulb

**Botanical description**
- A half hardy biennial herb, normally grown for its bulb as an annual and only carried forward into a second year when seeds are required  
- Bulb-truncate formed from thickened leaf bases (sheaths) outer layers are thin and fibrous  
- Leaves alternate, and are produced from a flattened conical basal stem, they are cylindrical and and leaf blades are hollow  
- Flowers are greenish white  
- Seeds are smooth black, wrinkled when dry  
- Stem- cone shaped from where leaves arise

**Climatic/Environmental requirements**
- Cool season crop that will grow well over a wide range of temperatures optimal temperatures are 13-29°C  
- Onion plant performs well(quantity and quality) when temperatures are cool during the early stages and warm temperatures towards the end of the growth period.  
- Adry atmosphere at harvest is desirable to obtain satisfactory curing of the bulbs
Requires high moisture during the vegetative growth, does well under irrigation
Altitudes above 300 m asl
Temperature and photoperiod affects flowering and bulbing
Bulbing is the process of swelling of leaf bases, cessation of leaf primordial initiation
Bulbing mainly affected by daylength, the required daylengths depends on varieties/cultivars
Onion is a LDP with respect to bulbing, premature bulbing can occur at longer daylengths
Tropical cultivars (9-12 hrs), temperate cultivars 15-16 hrs
Temperature is vital in flowering-vernialization-initiate and daylength affects development of flowerstalk.
When selecting cultivars consider daylength requirement
Soils: onions can grow in practically all types of soil but prefer sandy loam, alluvial clay soils, friable, fertile, well supplied with humus and well drained, Ph 5.8-6.8

**Cultivars**
Classified according to: daylength requirement, bulb colour and maturity period
Cultivars grown in Kenya
  - Red bulbing varieties -red creole, Bombay red, red Tropicana
  - White bulbing varieties-white creole, Texas Grano and Tropicana F1 Hybrid
  - Yellow cultivars: yellow BERMUDA-does not store well, has mild flavour ideal for salads
  - Green bunching onion-non bulbing spring onion

**Propagation:**
Onion is normally transplanted but can also be directly sown. Ensure proper seedbed preparation into pulverized and smooth
Do not sow seed deep
Planting can also be done from sets
Spacing 30x10 cm
If direct seeding, the thinnings are used as spring onion

**Cultural practices**
Weeding and Earthing up-sensitive to weeds since it has very small amount of foliage and sensitive to weed competition and has shallow roots
Moisture: moisture supply at bulbing stage is very critical. It needs plenty of water for retranslocation of assimilates to the leaf sheaths
Fertilizers: The onion responds well to fertilizers, 200kg/ha of TSP when planting or transplanting; 6 weeks after transplanting top-dress with N fertilizer 100kg CAN/ha; maure 10-20 tons/ha. N protes leaf growth and may delay the bulbing process and cause thick necks or bull necks which lowes the quality of the bulbs

**Harvesting:**
Can harvest during green stage when the seedlings are about to bulb as spring onions
It can be done at maturity stage when the tops fall over (maturity index)
Harvest a crop stand when 25-50% of the tops have fallen over-curing
In cool weather wait till >75% of the plants have their tops fallen
Pull the plants and leave them to dry in the field in windrows for about 14-20 days when there is no rain to avoid sprouting
Yields of 15-20 tons/ha, USA 40 tons/ha have been reported

Application of sprout suppressant:
Chemicals applied to prevent sprouting. Maleic hydrazide can be applied when 50% of the tops have fallen over efore harvesting and this will prevent sprouting in storage

Grading and packing
Remove the tops, clean and grade according to size

Storing:
Cultivars vary considerably in their storage characteristics
Onion bulbs can be stored at 0°C and low R/H 65-75% and with adequate ventilation, can store for 6.5 months

Pests and Diseases

Pests:
Onion thrips (Thrips tabaci)
- The most important onion pest
- Feeds at the base of the plant within the leaf sheaths
- Infested leaves have sunken, silvery patches
- When severe te entire plant appears silversy and later the leaves wither, dry up and die.
- Hot dry weather favours a rapid increase in thrips numbers
- Control- spray with Dimethoate, cabaryl etc

Diseases
Downey mildew - Peronospora destructor
- Lesions are formed near tips of older leaves and can be seen as elongated yellowish patches covered in a purplish-grey weft of fungus
- The leaf tip shrinks and death of the leaf proceeds towards the base and extends to younger leaves
- Dithiocarbamates fungicides such as zineb and Dithan M45, use resistant red varieties

Purple blotch (Alternaria porri)
- Initially small white spots on the foliage, which under moist conditions rapidly increase to produce large purplish blotches often surrounded by a yellow to orange border. The lesions then become covered with a sooty deposit of spores. The infection may spread to the bulb. Control: crop rotation, field hygiene use f fungicides like benomyl

Neck rot: Botrytis allii
- ASeed borne disease of bulb onions during storage
- Infection occurs at the neck or in the wounds on the bulbs during harvest
- Greyish mold on the surface of the infected area.
- Bulbs often decay while in storage or in transit
Proper curing and storing, bulbs should be well dried especially at the neck
Plant health sets

**Onion smut** *(Urocytis cepulae)*
- The disease is caused by soil borne fungus
- Infection occurs only in seedlings before the first leaf has made full growth
- Onion sets are resistant
- Seed pelleting with a fungicide like thiram

**Onion rust** *(Puccinia pori)*
- Rust occurs on leaves as brown spots, control y using Triadimefon

**Uses and composition**
- Bulbs are usually boiled in soups and stews, fried or eaten raw.
- Leaves are also used in salads particularly of the spring or bunching onion
- In some tropical areas, onions have been selected for their dry matter yield and used for dehydration.
- Protein (1.5%), Ca (30mg/100g, iron 0.5mg/100g, Ascorbic acid 10mg/100g
- Alliums are characterized by the remarkable sulphur containing cpds that give them their distinctive smell and pungency
- **Volatile flavour compounds**
  - Occur in the form of various protein amino acids which include the precursors of the volatile flavour compounds
  - These precursors are odourless, non-volatile amino acids (cystein sulphoxides)
  - When the tissue is rapture, flavour precursors react under the control of the enzyme allinase to give sulfenic acids +ammonia+pyruvate
  - The highly reactive sulfenic acids once released, proceed to undergo spontaneous rearrangement and inter-reactions to produce a wide range of volatile strongly smelling products
  - Propenyl sulfenic acid produced in onions spontaneously reaarranges its chemical structure to form tear inducing thiopropanal S-oxide
  - In garlic allinase catalyses the formation of allcin which gives fresh garlic its characteristic smell
  - Medicinal properties attributed to flavour inducing sulphur compounds
Shallots (*Allium cepa*) \ var. aggregatum/ascolonicum

**History**
- The shallot is an ancient universally distributed onion like plant
- Native of W. Asia

**Characteristics:**
- The plant is a perennial that seldom produces seeds
- Must be propagated by division of its compound bulbs which are made up of several bulblets or cloves held together at the base.
- The bulbs are not encased by a sheath as is garlic

**Uses:**
- The flavour of shallots is somewhat milder than that of onions.
- The chief use is for flavouring both leaves and cloves being used.
- Most of the crop is produced for sale in the green state but some dry bulbs are used.

**Cultural Practices:**
- Loose sand soils with a high level of organic matter.
- Plants are very tolerant to high temperatures
- Spacing 25-30 by 12 – 15cm
- Excessive N may lead to delayed bulb formation.

**Harvesting, grading and packaging** (same as onion)

**Leeks: (*Allium porrum\empeloprasum*) (GROUP PRESENATION)**
- Resembles the onion in its adaptability and cultural requirements. Instead of farming a bulb it produces a thick fleshy cylinder like (pseudostem). Leeks are propagated from seeds like onions.
- Leeks are ready for use any time after they reach the right size, depending on the market demand.
- Native of Mediterranean region

**Botanical Description:**
- A biennial, no bulb formation
- Leaves flattened, variable in length.

**Environmental response:**
- Deeply cultivated soils, well drained, high in organic matter
- Cool conditions favour optimum growth
- Day temperatures above 24oC reduce the yield of some cultivars.
- Spacing 20 x 20 cm
- Earthing up to 1 – 2 weeks ensure blanching of the leaf basis
- 200kg \ha\ double superphosphate 100kg CAN

**Harvesting:**
- Mature plants may be harvested 120 – 150 days from transplanting (25 – 30cm length) Diameter 4-5cm
The base of the stalks should be white and the upper part of the leaves should be turgid and green.
The upper portion of the leaves should be trimmed with a knife and the outer skin may be removed.
Plans are tied in bunches for sale
Storage O°C RH 90-95% store for 28-80 days.
Wrapping in perforated film will delay wilting.

Nutritional composition:
The swollen, overlapping bases of the leaves are cooked, the upper portions of the leaves are rarely used.
Ca mg 70 mg, Fe mg (7.5mg), P 53mg B-carotene (1827)μg, Thiamine mg- 0.07
Riboflavin mg 0.11mg, Niacin (mg) 0.87, Ascorbic acid 29mg

Japanese bunching onion, Welsh, Green Bunching onion, spacing onion
(Allium fistulosum)

Introduction
Origin: Tropical Asia
Grown as an annual herb rarely producing bulbs, basal lateral buds develop to form many offshoots.
Leaves are hollow circular in cross section 15-30cm in length.

Environmental and Cultural Response:
Well drained loams with high level of organic material
Cool season >25°C not conducive
Altitude 1000 – 2000 m asl ideal
Seeds are sown in containers or in a seedbed and the seedlings transplanted
Spacing 30 x 20 or 20 x 20
Propagation by decision of the basal shoots possible

Harvesting:
Harvesting may be spread over a long period by detaching the outer leafy shoots from the man cluster
Mature 60 – 120 days from planting

Packing:
The leaves should be turgid crisp, clean and free from discolouration.
The roots should be trimmed, without damaging the condensed stem base before the plants are tied into bunches.

Use and Nutritional Composition
The leaves are used as flavouring in soups or eaten raw as salad.
Composition: Protein (1.8%), Ca(40mg/100g fw), Fe(3.0 mg/100g), B-carotene(328μg/100g, Vit C(50mg/100g)