

SEMESTER II

PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS- BULB CROPS

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ONION

Common name – Onion

Scientific name – Allium Cepa

Family – Alliaceae

Origin – Asia

Chromosome Number : $2n = 2x = 16$

INTRODUCTION

Onion is one of the oldest known and most important commercial vegetable crop grown in India. India is the second largest onion growing country in the world. Indian onions are famous for their pungency and are available round the year. Origin place of onion is reported to be Central Asia and Mediterranean region. It is a cool season vegetable. The common onion contains 88.6-92.8% moisture, 0.9-1.6% protein, 0.2% fat, 5.2-9.0% carbohydrates, 50-51mg sulphur and 23-28 calories energy per 100 g of edible portion.

BOTANY AND TAXONOMY

Onion is herbaceous annual for the edible bulb production and biennial for seed production having bisexual flower and is a highly cross pollinated crop. The flower is an umbel. It is pollinated by bees and other insects. The reason for cross pollination is heteromorphism and male sterility. Flowers are protandrous. The edible portion is a modified stem called bulb and develops underground. Its pungency is due to the presence of a volatile oil called allyl propyl sulphide and red color is because of the pigment anthocyanin and yellow color due to Quercetin. Anti-fungal activities in onion is due to a phenolic factor i.e., Catechol. Modern varieties typically grow to a height of 15 to 45 cm (6 to 18 in). The leaves are yellowish- to bluish green and grow alternately in a flattened, fan-shaped swathe. From the underside of the disc, a bundle of fibrous roots extends for a short way into the soil. As the onion matures, food reserves begin to accumulate in the leaf bases and the bulb of the onion swells.

Kingdom : Plantae

Division : Angiosperms

Genus : Allium

Class : Monocots

Order : Asparagales

Family : Amaryllidaceae

Species : cepa

Item	Value	Item	Value
Protein	1.1g	Energy	166 KJ
Water	89.11g	Carbohydrates	9.34g
Thiamine (B1)	0.046mg	Sugars	4.24g
Riboflavin (B2)	0.027mg	Dietary fibres	1.7g
Niacin (B3)	0.116mg	fat	0.1g

SOIL

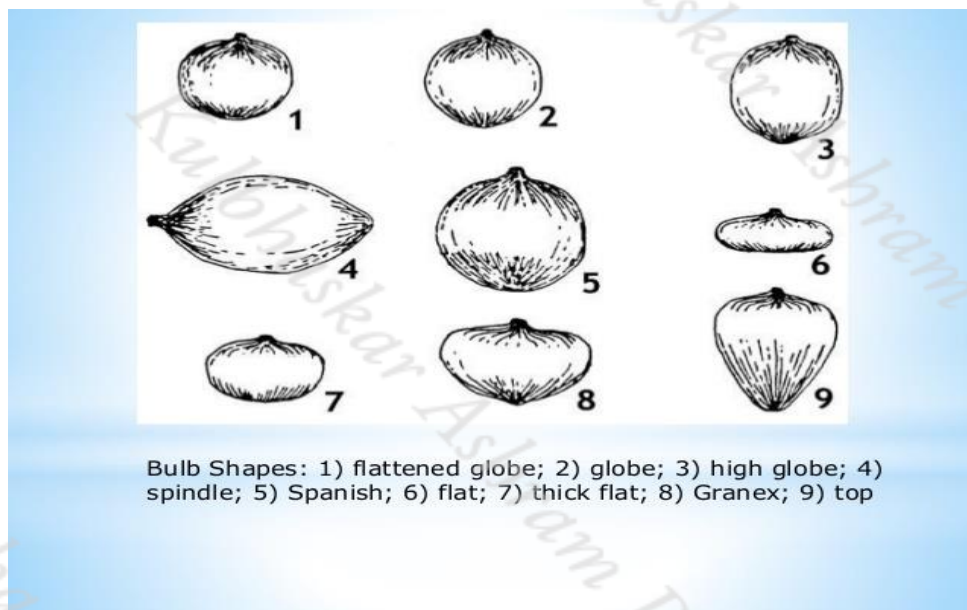
Onion prefers to grow well and form good size of bulbs in light soil rich in humus, friable, well-drained with ability to retain soil moisture. Avoid always too heavy soils for onion cultivation. For obtaining higher yields, care should be taken that onion is not planted in soil having high acidity and alkalinity

- ❖ Well drained, loose & friable
- ❖ Rich in humus
- ❖ Highly sensitive to acidity & alkalinity
- ❖ Ph:5.8-6.5
- ❖ Clay soils are not preferred due to small and deformed bulbs are produced .

CLIMATE

The onion thrives better in cool season; long days favour bulb formation. However, varietal response to the requirement of temperature is different. Some cultivars grow well in mild climatic conditions during kharif season as well, particularly in Maharashtra and in some parts of Gujarat state. It appears, therefore, that under particular set of climatic conditions, a group of certain cultivars should be selected and acclimatized. For ripening, dry weather is favourable. Drought conditions are very harmful for plant growth and bulb formation. Long days are beneficial in the formation of bulbs. Besides length of the days (photoperiod), other factors play important role in the formation of bulbs are light intensity and quality, temperature, planting time, plant growth, availability of nutrients, cultivars, presence of growth substances either endogenously or application of their artificially for raising crop and management practices including plant protection measures. Kharif onion varieties require day length of 10-11 hrs where as rabi varieties relatively higher temperature and 12-13 hrs of day length. Temperature is more imp. than day length in seed production while photoperiod is more important than temperature for bulb formation.

- Cool and moist
- Average rainfall : 75-100mm.
- Optimum temperature: vegetative growth :12.8-23°C bulb formation:20.25°C.
- Long day type cultivated in hilly tracks.
- Short day type cultivated in plains.
- Low temperature in early stage cause bolting whereas high temperature results in small sield bulb .



VARIETIES OF ONION

Red onions- They have a mild sweet flavour and suitable for raw consumption in salads and Pickles.

- **Pusa Red** -Bulbs medium, average weight 70-90g, bronze in colour, flat to globular shape, less pungent, less bolting, good keeping quality. Maturity 125-140 days after transplant. Yields 250- 300q/ha.
- **Pusa Ratnar** - Bulbs oblate to flat, globular, larger, less pungent, neck dropping and bronze deep-red coloured. Fair in storage quality. Produce 300-400q/ha.
- **Pusa Madhavi** - Bulbs medium to large, light red and flattish- round. Maturity in 130-135 days after transplanting. Keeping quality is good. Yield potential is 300q/ha.
- **Pusa Riddhi** - Suitable for kharif and rabi seasons having compact, flat globe, and dark red colour bulbs. Bulb weight ranges from 70- 100g and produce 310q yield/ha. Pungent and rich in antioxidant (quercetin 107.42mg/100 g). Also suitable for storage and export.
- **Arka Kalyan** -Bulbs globular with deep pink coloured outer scales and fleshy succulent concentric internal scales, weighting 100-190g and give 335q/ha. Tolerant to purple blotch disease. It can be grown successfully in kharif.
- **Arka Bindu** - Bulbs are small in size (2.5-3.5cm), deep pink, flattish globe, pungent, high TSS (14-16%), early maturity. Free from early bolting and splitting. Suitable for export particularly to Malaysia to Singapore. Produce 250q yield/ha.
- **Bangalore rose -do-** Bulbs are small sized and uniform in colour and size. Suitable for export and yields 150q/ha.
- **Arka Kirtiman (F1)** -An F1 hybrid with red bulbs, firm texture, light red flesh, TSS 10%. Shelf life 5 months, good for transport, free from split and bolters. Resistant to biotic stresses. Maturity 120-125 days. Best for AP, Eastern MP and Orissa. Yield ranges from 300-375q/ha.
- **Arka Lalima (F1)** - Hybrid which produce 500q/ha variety. Bulbs deep red, globe with firm texture, light red flesh, TSS 12%. Shelf life 5 months, good for transport, free from split & bolters. Resistant to biotic stresses. Maturity 130-135 days.

✚ **White onions**- They have a white or off white skin and are a little less pungent as compared to yellow onions. They are majorly used for processing and in Mexican cuisines. .

- **Pusa White round** -Bulbs are white and roundish flat with TSS 12-13%. Suitable for dehydration. Yields up to 300q/ha.
- **Pusa White flat** - Bulbs are white, flat and medium to large in size with TSS 12- 14%. Suitable for dehydration
- **Bhima Shweta** -Suitable for rabi season. Bulbs are attractive white in colour, round in shape, very less number of bolters and doubles less than 3%, thin neck, TSS 11.5%, matures in 110-115 day after transplanting and medium in keeping quality up to 3 months. Tolerant to thrips. Yields 350 q/ha.
- **Bhima Shubra** -do- Suitable for kharif and late kharif season. Bulbs attractive white in colour, oval to round in shape, thin neck, TSS 10.4-11.7% and matures in 112-125. Stored for 2-3 months during latekharif. It has capacity to tolerate environmental fluctuation, hence can be cultivated in all the three seasons. Give yield 240 q/ha (kharif) and 380 q/ha (late kharif).
- **Agrifound** -Bulbs are white, round, diameter 4-5 cm with TSS 14-15%. Good storage quality and suitable for dehydration. Matures in 160-165 days. Yield ranges from 200-250q/ha.
- **Punjab-48 (S-48)** -Bulbs are white, flatish round, very good texture & flavour. Good keeping and storage quality. Suitable for dehydration.
- **Punjab White** - Bulbs are large, round with white neck. It has high TSS (15%) and suitable for dehydration. Average yield between 250-300q/ha
- **N-257-9-1** -Bulbs globe-shaped, white. High yield potential with good keeping quality. Suitable as a rabi crop. Suitable for dehydration.

✚ **Yellow onions** - The most popular cooking onions because they add excellent flavor to most stews, soups, and meat dishes. They have a sulfur content and are the most pungent.

- **Early Grano** -Bulbs are globe shaped, 7-8 cm in diameter and less pungent. Low in TSS (6-7%) but it has good keeping quality with 300-350q yield/ha. Early and harvested 95 days after planting. Suitable for hills. Free from bolting.
- **Brown Spanish** -A medium long day type variety suitable for hilly areas. Bulbs are thick skinned, less pungent and has excellent storability. It has 13-14% TSS. Average yield is 250-300q/ha.
- **Arka Pitamber**- Bulbs uniform, yellow, globe shape, high TSS, firm, good keeping quality, free from splits, bolters and internal doubles. High stable bulb yield.
- **Phule Swarna** -Less pungent, 11.5% TSS having 4-6 months storage life. Suitable for export to Europe, Australia and America. Yield up to 240q/ha.

In India, the cultivation of onion is mainly done in two seasons' viz., kharif and rabi. Among the above described varieties, the varieties like Pusa Ridhi, Arka Kalyan, Agrifound Dark Red, Agrifound Rose, N-53, Baswant-780, Bhima Raj, Bhima Red, Bhima Super, Bhima Shubra and Bhima Super are recommended for kharif season cultivation.

METHODS OF SOWING

There are three methods used in sowing onions-

1. **Broadcasting /drilling of seeds** - • Direct sowing @ 30cm • Saves labour for transplanting • High seed requirement -25kg/ha • Weeding should be done at intervals of 10days • When bulbs are 6-8 weeks old, seedling should be thinned to proper distance

2. **Transplanting method** - • Most common method practiced for irrigated crops • In plains seeds are sown during October- November for a rabi crop • In hills seed are sown during March-June • Seeds are sown in well prepared nursery bed of 1.2mt width ,7.5-10cm height and conventional length • Seed rate -8-10kg/ha • Seedlings can be transplanted after 8 weeks, seedlings should be 15cm height and 0.8cm neck diameter is ideal • seedlings transplanted at spacing of 15*10cm
3. **Planting of bulbs** - • This method practiced in hill slope and terrace cultivation • Medium to small sized bulbs are used for planting ,large sized bulbs results in early bolting and high cost • Medium sized bulbs obtained from june crop used for planting in September-October • Bulbs are dribbled at 45*15cm • 1-1.2t of bulbs are required for planting .

IRRIGATION

Just after transplanting of seedlings light irrigation is essential. Subsequent irrigations should be given as per need of the crop. The quantity of water and its frequency of application depends on crop growth; soil types, planting season, etc. Irrigation should be withheld 15 to 20 days before commencement of maturity; otherwise it will delay the maturity and reduce the quality of bulbs. Critical stages for irrigation in onion are bulb formation and enlargement stages, the irrigations during this period should be attended to carefully. The splitting of the outer scales may be observed when dry spell is followed by irrigation.

- In kharif 8-10 days interval irrigations
- Late kharif crops requires 12-15 days interval irrigation.
- In rabi season 15-20 days interval irrigation.

WEEDING AND INTERCULTURE

Weeds are to be kept down to get a good yield of onion. Onion is a poor competitor of weeds. Weedicides can be profitably used for control of weeds. Weeds are controlled by Teronan @2.5kg/ha 3-5 weeks after transplanting. Application of Basalin 1 L/ha immediately after transplanting helps control the weeds. Stomp @ 3.35 l/ha applied immediately after transplanting and before first irrigation with one hand weeding gives the best results.

- Herbicides used for control are Tenoran @ 2.5 Kg/ha 3-5 weeks after transplanting Applications of Basalin @ 1 L/ha immediately
- **After transplanting Stomp @ 3.35 l/ha** before first irrigation with one hand weeding.

MANURES AND FERTILISERS

About 200 to 250 quintals of farmyard manure should be incorporated during field preparation. Nitrogen at 60 to 80 kg, phosphorus 40 to 50 kg and potassium 60 to 80 kg per hectare are required for higher yields. Application of whole dose of phosphorus and potassium and half dose of nitrogen is done just before transplanting. The remaining half dose of nitrogen should be top dressed about 25 to 30 days after transplanting when seedlings are well established and growing • 20-25t of FYM at time of ploughing

- 60-100kg N,25-45 kg P,45-80 Kg K.
- Entire dose of p & k are applied at time of final land preparation
- Nitrogen to be top-dressed in 2 splits first half at 3-4 weeks after transplanting ,second half at 2 months after transplanting.

HARVESTING

The harvesting is done by pulling the bulbs. Help of khurpi may be taken. On large scale modified potato digger can be used. • 3-5 months after transplanting depending on variety • Best time for harvesting of Rabi onion is one week after 50-70% neck fall • Kharif since tops

do not fall but after colour of leaves changes to slightly yellow, tops start drying. Harvesting of onion depends on its type and purposes--

1. **ONION FOR GREENS:** when they are about diameter of lead pencil and a small bulb is formed. The purpose of this type of onion is to get high quality green leaves. Plants are pulled when bulb formation starts.
2. **IMMATURE BULB:** As per need for the home consumption and supply to the market, immature onion plants are pulled along with bulbs.
3. **MATURE BULBS:** When bulbs become ripe and firm, fully mature, the maturity is indicated by drooping of the tops just above the bulb known as neck fall and the leaves are still green. The tops may be made down manually before 8 to 10 days of harvesting.

YIELD

The average yield of big sized onion is 25-30 t/ha, small sized common onion is 16-20t/ha and multiplier onion is 15-18t/ha. The seed yield is 6 to 8 quintals per hectare in case of bulb to seed method and 8 to 10 quintals in case of seed to seed method.

DISEASE AND PESTS

PESTS

- ❖ **Onion thrips** (*Thrips tabaci*): Affected leaves show silvery white blotches which later become brownish. Spring- summer crop affected much by thrips. A long spell of dry weather is favourable for its rapid multiplication whereas heavy rains and humid weather adversely affect its development and multiplication.

Control measures:

1. Collect the debris, affected leaves and weeds and destroy them.
2. Follow crop rotation.
3. In the areas where thrips infestation is severe, grow resistant varieties like Nasik Red and Spanish White.
4. Apply Malathion at 0.1 per cent or Phorate 10 G at 1 kg per hectare.

- ❖ **Onion maggot** (*Hylemia antiquay*): It attacks the tender portion of the bulb remain hiding in the base of the plant and or in the cracks of the soil where they also lay the eggs. Affected plants become yellow to brown and later they dry away.

Control measures:

1. Soil application of Thimet 10 G is beneficial.
2. Spray Malathion at 0.05 per cent.
3. Follow crop rotation.

- ❖ **Mites** (*Rhizoglyphus sp*): These are very small insects. They remain mostly on the under surface of the leaves. They suck the sap of leaves. Affected plants become pale yellow. Crop infested with mites gives sickly appearance.

Control measures:

1. Expose infested bulbs to sun for about two-days.
2. Dust the crop with sulphur at the rate of 20 to 25 kg per hectare.

- ❖ **Red spider mite** (*Tetranychus spp.*)

DISEASES

- ❖ **Downy mildew** (*Peronospora destructor Casp.*): In humid atmosphere the downy growth of the fungus develops over the entire leaf surface and seed stalk. In dry weather, only white spots appear on older leaves and the infection spreads to the sheath and seed stalk. Plant growth stunted, leaves become distorted and pale green.

Control measures:

1. Use disease free bulbs.
2. Destroy wild onions and plant debris.

3. Provide proper drainage.
4. Spray the crop with any fungicides like Zineb, Mancozeb and Nabam, Dithane-M-45 (0.2%) Ditolatan (0.1%) after about 20 days of transplanting of seedlings and repeat the spray at 10 to 12 days interval.

❖ **Onion Smut** (*Urocystis cepulae* Frost): This disease is more prevalent in temperate regions. The fungus lives in soil. The fungus attacks at all the stage of plant growth. Dark-brown streaks are seen on leaves and stems. The bending and twisting of earlier infected leaves also occurs. Plants die within three to four weeks after emergence. The linear black lesions most commonly appear near the base of the bulb and grow up to fourth scale deep.

Control measures:

1. Treat the seed with Thiram or Captan (2 to 3 g/kg seed).
2. Apply Thiram and Captan in furrows just before sowing the seeds.
3. Treat the soil with fumigants like Methyl bromide (1 kg/25 sq meter) or formaldehyde.

❖ **Purple blotch** (*Alternaria porri*): Incidence starts with appearance of water soaked areas on leaves and seed stalks and soon they become brown in colour and later purplish in centres. Moist weather conditions are favourable. Severity of disease causes falling leaves and seed stalks without forming seeds. The bulbs of the affected plants may rot later.

Control measures:

1. Follow long crop rotation.
2. Gave a provision of draining excess water from the field.
3. Prior to sowing, treat the seed with fungicide like Thiram (2.5 g/kg seed).
4. Spray the crop with Meneb, Nabam, Zineb at 0.25 per cent at 10 to 12 days interval. Three sprays will control the disease.
5. Control thrips with regular spray of Malathion 0.2 per cent as infection may set in by *A. porri* through wounds made by thrips.

❖ **Onion smudge** (*Colletotrichum circinans*): This is fungal disease. White onion in temperate regions affected much. Most of the red cultivars are resistant. The disease may affect onion in field, storage and during transportation. At seedling stage, it may cause damping off. Subcuticular, dark green to black smudge (the minute stroma of the fungus) appears on the bulb, neck or green leaves.

Control measures:

1. Proper curing of the bulbs after harvesting is essential.
2. Bulbs may be treated with 0.2 per cent suspension of Thiram, Captan or Difolaton. It is better if such bulbs are used for planting and avoid for human consumption
3. Spray crop with 0.2 per cent Zineb or Maneb at 7 to 10 days interval.

Pink root of onion: This disease is caused by a soil inhabiting fungus (*Pyrenochaeta terrestris* Gorenz.). Generally, incidence of disease is noticed when crop reaches maturity though infection took place much earlier through roots. Infected roots become pink then turn to red, purple, brown and black. In severe cases, foliage turns white yellow or brown and ultimately plants die. Bulb formation and enlargement are affected badly.

Control measures:

1. Do not grow seedlings in the nursery bed in which soil having inoculums.

2. Follow long term crop rotation, taking care that crop does not grow of the onion family.
3. If possible, soil may be disinfected.

❖ **Black mould of onion:** This disease causes great loss to onion bulbs in storage. The causal organism is *Aspergillus* spp. The infection starts from the top i.e. cut portion above the neck and any injury present on the bulb. The affected tissue becomes water soaked and at first a white mould develops between the scales which follows development of black spores on stalks which can be seen with naked eyes and this mass remains on exterior of the scales and can easily be rubbed off.

Control measures:

1. Avoid bulb injury during harvesting, curing, transportation and storage.
2. Sort out all the bulbs showing any wound, green and thick neck, doubles etc., and allow only perfectly healthy bulbs for storage.
3. Clean the stores properly and check for sufficient ventilation. The temperature should be below 15°C. Neither any variety is resistant to black mould nor any effective method is available to check the infection in the field.

❖ **Aster yellow:** It is a virus disease. The onion inflorescence when affected becomes abnormal in appearance. Plant growth stunted, leaves become yellow, flattened and crinkle.

Control measures:

1. Control insect vector by regular spray of Rogor or Malathion.
2. Select only healthy bulbs for seed production.
3. Sow only healthy seeds.

❖ **Bloat or nematode rot:** The causal organism of this malady is nematode (*Ditylenchus dipsaci*). Bloat is one of the important seed borne nematodes. Onion crop may be affected at any stage. When seedling is attacked by this nematode it becomes pale, white, twisted and stunted in growth. Leaves become thick and swell which results in splitting of the epidermis. Bulbs also carry nematodes when they are planted for seed crop, new leaves show yellowish specks and remain stunted. Tip of the leaves become necrotic. Infected scales show frosty appearance. Cracks appear in the bulb.

Control measures:

1. Provide good drainage.
2. Obtain clean and healthy seed.
3. Follow long crop rotation.
4. Sow the seeds or bulbs after giving hot water treatment at 46°C for one hour.
5. Fumigate seeds with Methyl bromide for 24 hours at 24°C that will eradicate the larvae from seed surface.
6. Plough the field during hot summer season.

❖ **Bottom rot / basal rot :** *Fusarium oxysporum* • Soil borne disease • Yellowing and dying back from the tips of leaves • Follow crop rotations upto 4 years • 2-3 times summer ploughing • Store the bulbs @ 0-1c • Soil drenching with captaf or thiram @0.2%