

How to get high yield from *rabi* onion?

Onion covers an area of 1.62 million hectares in India with a production of 26.64 million tonnes (2020-21) and productivity of 16.40 t/ha. The major onion growing states are Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Rajasthan, Bihar, etc. Onion is grown all over the country in three seasons, i.e. *kharif*, late *kharif* and *rabi*. It is predominantly cultivated during *rabi* season. Hence, the average productivity of Indian onion depends on the *rabi* onion. This article describes the production technology, plant protection, storage and economics of *rabi* onion crop.

ONION (*Allium cepa* L.) is one of the most important commercial vegetable used as salad, vegetable and spice all over the world. It belongs to the family Alliaceae. India is second largest onion producing country in the world after China.

Soil

Soil for onion cultivation should be light, deep friable and highly fertile. Sandy soil needs more and frequent irrigation along with additional supplement of FYM or compost. In general, sandy loam to clay loam soil with pH 6.0-7.5 is more suitable. Highly alkaline and saline soils are not suitable for onion cultivation. Addition of well decomposed organic manure helps in improving fertility status of soil, besides improving the soil physical conditions and availability of microorganisms. Onions are very much sensitive to the effects of high watertable, so, well drained soils are best.

Varieties of *rabi* onion

The selection of suitable variety is most important. Some suitable onion varieties for *rabi* season are given below.

Bhima Red: This variety is released by Indian Council of Agricultural Research- Directorate of Onion and Garlic Research (ICAR-DOGR), Rajgurunagar, Pune, Maharashtra and recommended as *rabi* variety for Maharashtra and Madhya Pradesh. Crop duration varies due to season, climatic conditions, soil type, etc. Duration

of this variety is 110-120 days after transplanting (DAT). Average total yield of 30-32 t/ha can be obtained from this variety.

Bhima Shakti: This variety is released by ICAR-DOGR, Rajgurunagar, Pune in 2011 and recommended for *rabi* season in Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan and Uttar Pradesh.

Agrifound Light Red: This variety was released by National Horticultural Research and Development Foundation (NHRDF) in 1988 and recommended for *rabi* season all over the country. Generally about 100-120 days are required for harvest after transplanting. Average yield of 30-32.50 t/ha can be obtained from this variety.

NHRDF Red-2 (L-355): This variety is released by National Horticultural Research and Development Foundation (NHRDF). It is recommended as *rabi* variety for zone-III (Delhi, Uttar Pradesh, Haryana, Bihar and Punjab), zone-IV (Rajasthan and Gujarat) and zone-VI (Maharashtra, Karnataka and Andhra Pradesh). Duration of this variety is 100-120 DAT. Average yield of 30-35 t/ha can be obtained from this variety.

NHRDF Red-3 (L-652): This variety is released by National Horticultural Research and Development Foundation (NHRDF) and recommended for *rabi* season all over the country. Duration of this variety is 120-130 DAT. Average yield of 35-40 t/ha can be obtained from this variety.



Bhima Red



Bhima Shakti



NHRDF Red-2 (L-355)



NHRDF Red-3 (L-652)



Agrifound Light Red



N-2-4-1

N-2-4-1: This variety was released by Department of Agriculture, Government of Maharashtra in 1985 and recommended for late *kharif* and *rabi* season.

Nursery management and transplanting in *rabi* onion

Avoid onion mono cropping in heavily fungal diseases infected area. Well drained sandy loam soil rich in organic matter with sufficient land slope to be preferred for onion nursery raising. Water stagnation during nursery stage favours fungal diseases infection. The land should be prepared well in advance with repeated ploughing and harrowing to obtain a fine tilth. Tillage operation allows birds to kill the exposed pest stages. To produce seedlings for transplanting on 1 acre area, requires approximately 4-5 gunth as area for nursery raising. Seed can be sown on raised bed of 15 cm height or flat nursery bed of about common 2-3 m length and 1-1.5 m width. However, in case availability of drip and sprinkler irrigation, sowing can be taken up on raised beds. Approximately about 8-10 kg well decomposed farmyard manure (FYM), 100-150 g of 19:19:19 (NPK fertilizer) and copper oxychloride 50 g can be applied per bed uniformly at the time of bed preparation. Copper oxychloride can be mixed with sand and applied uniformly on the bed followed by light irrigation. White grub's egg and dirty white coloured 'C' shaped larva enters into the onion nursery field through farm yard manures (FYM) and compost. Natural pest enemies entomopathogenic fungi, *Beauveria bassiana* and *Metarhizium anisopliae* (5 kg or lit each per ha) may be mixed with neem cake or well decomposed organic manures at optimum moisture and applied in beds before sowing. These bio-pesticides in liquid form may be applied through drip irrigation or drenching. Or fipronil (0.3 % granules) 1 kg can be mixed per cart load to kill the egg and grub stages in FYM and compost and then apply in the field. During the summer, make the heaps of FYM/compost in the field. Drenching of fipronil 40% + imidacloprid 40% WG @ 0.5 ml/litre of water can be done at sowing time at proper soil moisture stage. *Trichoderma* @ 1.25 kg, *Pseudomonas* 2.5 kg and *Bacillus* 2.5 kg per hectare can be applied one week after application of basal recommended dose of fertilizer and chemical insecticides to obtain healthy seedlings. For transplanting on one hectare area, about 8-10 kg seed is recommended for nursery raising. As per experience of some onion growers, if the nursery is managed properly about 3.750-4.375 kg seed is sufficient for 1 hectare. Before sowing, the seeds are to be treated with captan or carbendazim @ 2-3 g/kg of seed. Treated and packed seeds do not require

treatment again. Two hand weedings are found effective to control the weed population in onion nursery. In case of weedicide, it is advised to spray pendimethalin at 2 ml/litre of water before onion seed germination followed by hand weeding at 20-25 days after sowing (DAS).

Onion seedlings in nursery can be attacked by different insect pests and diseases. So some control measures are to be taken for getting healthy, pest and diseases free seedlings. Thrips is a major pest of onion. Fipronil 5 SC at 1 ml/litre of water or carbosulfan 25% EC at 2 ml/litre of water can be sprayed to manage thrips population. Sticker is to be used during rainy season. Cloudy weather and dew formation favours fungal diseases like root rot, damping off, wilt, *Cholototrichum* blight, etc. Stagnation of water and inadequate drainage favours seedling root rot in nursery. Root rot can be managed by drenching of copper oxychloride at 3 g/litre of water. Drenching of metalaxyl 4% + mancozeb 64 % at 2 g/litre of water between the rows can manage wilt disease.

Since 2 years onion is heavily infected by blight disease caused by *Cholototrichum gloeosporioides* fungus in nursery and after transplanting also.

Integrated approach to be followed for disease management is given below.

Nursery stage

- Maize crop is to be sown as border crop 15 days before onion nursery sowing and transplanting.
- Crop rotation should be followed.
- Removal of previous plants residues from the field.
- Application of *Trichoderma* @ 1.25 kg, *Pseudomonas* 2.5 kg and *Bacillus* 2.5 kg/ha.
- Seed treatment with captan or carbendazim @ 2-3 g/kg of seed.
- Prefer well drained soil.
- In case of continuous rain drenching (per litre of water): Use Metalaxyl 4% + mancozeb 64% @ 2 g, Captan @ 2 g + potassium humate 1 g.
- Fungicides are to be sprayed (per litre of water): At 15-20 day after sowing: Mancozeb 2.5 g; At 25-30 day after sowing: Hexaconazole 1 g
- Water soluble fertilizers and micronutrients spray (per litre of water): At 20 DAS: 19:19:19 @ 2.5 g and 1 g Grade-II (Zn 3%, Fe 2.5 %, Mn 1%, Cu 1% and B 0.5%).

Transplanting stage (TP): Seedling root dipping treatment
Root dipping in solution: Fungicide carbendazim 1 g and insecticide carbosulfan 2 ml/litre of water.



Onion transplanting on flat bed



Onion transplanting on raised bed

After transplanting stage (DAT)

- At 3-5 DAT: Application of *Trichoderma* @ 1.25 kg, *Pseudomonas* 2.5 kg, *Bacillus* 2.5 kg and *Mycorrhiza* 250 g per hectare.
- Fungicides and insecticides are to be sprayed per litre of water as per need and infection intensity:
At 30 DAT: Mancozeb 2.5 g + fipronil 5 SC 1 ml;
At 45 DAT: Propiconazole 25% EC 1 ml + carbosulfan 25% EC 2 ml; At 60 DAT: Azoxystrobin 0.5-1 ml
- Water soluble fertilizers and micronutrients spray (per litre of water): At 30 and 45 DAT: 19:19:19 @ 5 g and 2 g Grade-IV (Zn 6%, Fe 4%, Mn 1%, Cu 0.5% and B 0.5%).

Transplanting

The transplanting time of *rabi* onion varies from November to December in different *rabi* onion producing states. *Rabi* onion can be transplanted on flat bed whereas, some farmers also prefer transplanting on raised bed for efficient use of fertilizers through drip irrigation. White grub's dirty white coloured 'C'shaped larva enters into the onion main field through farm yard manures (FYM) and compost. Bio-pesticides in liquid form may be applied through drip irrigation or drenching; or fipronil (0.3% granules) 25 kg/ha can be applied into the soil before transplanting to kill larvae. About 50-55 days old seedlings are to be transplanted in the main field at 15 cm × 10 cm spacing. One third top portion of the seedlings is to be cut at the time of transplanting. Onion seedling's root dipping into solution of fungicide carbendazim 1 g/litre of water and insecticide carbosulfan 2 ml/litre of water is recommended before transplanting to control pest and diseases. The duration of seedlings root dipping varies as per recommendations of State Agricultural Universities, ICAR-Institutes, etc. (15 min- 2 hrs) can be confirmed from the experts.

Nutrient management

The dose of manures and fertilizer depends upon the soil health and nutrients content so it may be changed as per soil test report and region-to-region. Recommended dose of fertilizers to be applied when nutrient content of soil (kg/ha) is medium. When nutrient content of soil (kg/ha) is extremely low then 50% more dose of recommended dose of fertilizers (RDF) needs to be applied. When nutrient content of soil (kg/ha) is low then

25% more dose of RDF needs to be applied. At the stage of extremely high soil nutrient content, 50% less dose of RDF to be applied and at high soil nutrient content stage, 25% less dose of RDF should be applied. Well rotten organic manure preferably farmyard manure (FYM) or compost @ 25-30 t/ha is recommended at the time of final land preparation or vermicompost @ 10 t/ha can be incorporated one week before transplanting. Neem cake @ 250 kg/ha can be applied in soil before transplanting as preventive measure against nematode infestation. Bio-fertilizers are input containing microorganisms capable of mobilizing and solubilization of nutrients through biological processes. They are less expensive, eco-friendly and sustainable. Research evidences are uncourageous towards the integrated use of organic + inorganic + bio-fertilizers which improve the soil productivity and onion yield. Bio-fertilizers can be applied for their positive effect on the soil fertility status and nutrient uptake. Bio-fertilizers like *Azotobacter* 5 kg/ha, *Phosphorus solubilizing bacteria (PSB)* 5 kg/ha and *Trichoderma* 1.25-1.5 kg/ha can be applied with vermicompost or well decomposed farm yard manure. Bio-fertilizers in liquid form can be preferred for easy application through drip irrigation after one week of recommended dose of fertilizers application. The biological inputs should not be used with chemical fertilizers or any agrochemicals. When nutrient content of soil (kg/ha) is medium, NPK at 100:50:50 kg/ha is recommended. First dose of NPK 50:50:50 kg/ha is to be given at the time of transplanting whereas remaining N (50 kg/ha) to be given in 2 equal splits at 30 and 45 days after transplanting, respectively. Sulphur (45 kg/ha) is recommended before transplanting.

Sixty days after transplanting, no any nitrogen containing fertilizers should be applied. Apart from major



Sulphur application into soil before onion transplanting

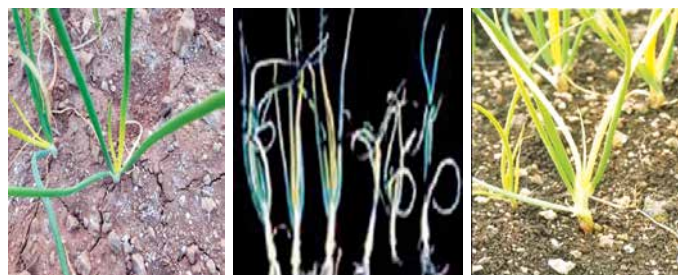
nutrients soil application, water soluble fertilizers and micronutrients can be sprayed to enhance growth and yield of onion crop. At 30 and 45 days after transplanting (DAT), 0.5% spray of 19:19:19 (NPK) and one spray of 0.5% 13:00:45 or 00:00:50 during 60-70 DAT enhances crop growth and yield.

If soils are deficient in micronutrients and plant shows particular micronutrient's deficiency symptoms



then particular micronutrient to be given for rectify the problem. Micronutrients mixture Grade-II (Zn 3%, Fe 2.5%, Mn 1%, Cu 1% and B 0.5%) @ 0.5% or Grade-IV (Zn 6%, Fe 4%, Mn 1%, Cu 0.5% and B 0.5%) @ 0.2% to be sprayed at 30 and 45 days after transplanting based on soil test report or when plant show deficiency symptoms.

Weed management



Fe deficiency

Zn deficiency

Mn deficiency

As onion plants are closely spaced and shallow rooted crops, it is essential to keep the crop weed free, especially 30-45 days from transplanting. Crop weed competition is recorded higher from transplanting till almost 45 days, it may reduce yield by up to 60%. Application of weedicide oxyfluorfen 23.5% EC @ 1-1.5 ml/litre of water before transplanting or within week after transplanting by using flat nozzle sprayers followed by one hand weeding (HW) at 30 days after transplanting (DAT) efficiently controls weeds in onion. Or spray of oxyfluorfen 23.5 % EC at 1 ml/litre of water with quizalofop ethyl 5% EC at 1 ml/litre of water at 25 DAT followed by one hand weeding at 45 DAT can also give good results.

Disease and pest management

Onion crop can be attacked by different insect pests and diseases. Thrips, onion maggot, etc. are major pest of onion. Fungal diseases like damping off, wilt, *Colletotrichum* blight (twister), purple blotch, stemphyllium leaf blight,



Purple blotch

Colletotrichum blight

Onion maggot infestation

etc. are severe problems of onion. For management of thrips, damping off, wilt and *Colletotrichum* blight (twister) refer nursery management part (after transplanting stage).

Purple blotch can be managed by difenaconazole 25% EC @ 40 ml in 200 litre of water spray. *Stemphyllium* leaf blight can be managed by mancozeb 2.5 g/litre of water spray. Iris yellow spot disease (Virus) transmitted through onion thrips and can be managed by adapting thrips management practices.

Onion maggot management practices

- Avoid successive planting of onion in the same field and follow crop rotation.
- Use well decomposed cow dung manure.
- Soils that are rich in un-decomposed matter should be avoided.
- Avoid close planting of onions to reduce movement of maggots in the nearby areas.
- Drenching of the chlorpyrifos with irrigation at 1.6-2 litre/acre is to be done before transplanting or when infestation starts to appear.
- After hand weeding, fipronil 80% WG can be applied in the soil at 1 kg/acre followed by irrigation.

Harvesting, cutting and bulb yield

Duration of *rabi* onion crop varies due to several factors, viz. variety, soil, climate, etc. Generally a bulb matures at about 110-130 days after transplanting and harvested one week after 50% neck fall. For sale as dried bulbs or for storage, onions are ready to harvest when the tops start to turn yellow and die. The most important thing to remember at bulbs harvesting that outer protective layer is not to be damaged. If outer layer is damaged, it allows them expose to disease and dryness. The leaves are to be cut leaving about 2-2.5 cm tops above the bulb after complete drying. The average yields of 25-35 t/ha can be obtained from *rabi* onion crop.

Shri. Ganesh Appa Sable, a youth farmer of Ahmednagar district of Maharashtra taken total fresh bulb yield 62.50 t/ha of *rabi* onion cv. NHRDF Red-3 in 2020-21 with integrated crop management practices at a spacing 15 cm × 10 cm.

Curing and storage

Generally a farmer prefer to store *rabi* onion bulb produce when price is less at the harvest time. Blue mould disease in storage can be managed by pre-harvest spray of carbendazim @ 1 g/litre of water at 30 and 10 days before crop harvest. Mostly diseases like bacterial brown rot, plate rot, neck rot, black mould, etc. can spread from



Onion storage structure

field to storage, owing to which some precautions are to be taken for long time storage and more shelf life of onion bulbs. When bulbs are completely dried, the neck region

is cut-off to about 2-3 cm length and the bulbs intended for storage need to be cured (dried out) by making thin layer in shade for 15 days. Bulbs harvested during rain are not preferred for storage. Storage structure is to be prepared at proper height, away from wet land, at well aerated location.

For long term storage and more shelf life, humidity (65-70%) and temperature (25-30 C) needs to be maintained inside the storage structure. Before storage, empty structure surfaces should be sprayed with fungicide carbendazim @ 2 g/litre of water. Bulbs are to be filled up to height 3-4 feet in storage structure.

For further interaction, please write to:

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Electronic nose (e-Nose) for real-time health monitoring of onion, potato and tomato under storage

An electronic sensing system (e-Nose) has been developed in collaboration with C-DAC, Kolkata for the real-time health monitoring of the onions, potatoes and tomatoes in storage. The system consists of 8 metal oxide semiconductor sensors (MOS), equipped as an array, signal conditioning system, amplifier, Analog - to - Digital Converter, 32-bit ARM processor - based board and other auxiliary accessories. The developed system has been tested at ICAR-CIAE, Bhopal. During test operation, the user needs to select the appropriate commodity on the touchscreen display and feed in the necessary information related to the test. After that, the system automatically activates the appropriate MOS sensors assigned for a particular crop. Furthermore, the Volatile Organic Compounds (VOC) gets sniffed from the storage unit, passes through the auxiliary heating chamber and then through the sensor array. The respective sensor detects the VOC concentration and expresses it in numeric form. The values of the 8 sensors further generate a single index value through which the condition of the crop can be judged. The whole cycle of the measurement, computation and result output is completed in 7 min. The system can distinguish the differences based on VOC for all 3 commodities as the sensor readings and index value change with respect to the storage period following the specific trend.



Source: ICAR Annual Report 2022-23

Movable screens in rose production

- Use movable screen, an important tool for rose cultivation.
- It can help growers manipulate environment conditions — lowers temperature, changes humidity and influences production numbers.
- The movable screens can be used year-round and in a variety of climates — from the Netherlands to India.