

Kharif onion production: An economic security for western rajasthan growers

Onion (*Allium cepa* L.) is extremely important for its savour and spiciness as vegetable and spice crop not only for internal consumption but also as highest foreign exchange earner among the fresh agricultural produce. The country has three onion growing seasons, out of which *kharif* and late *kharif* season accounts for 40% of total onion production. The *kharif* production is highly vulnerable to erratic monsoon, cloudy weather, continuous drizzling which creates the problem of foliar as well as soil-borne diseases, but in western Rajasthan, all these problems are limited due to low rainfall and sandy soil condition. The produce of *rabi* season is stored for consumption in summer but due to non-congenial storage conditions and spoilage in the monsoon season, the availability of onion becomes less. Hence, production of onion during *kharif* is required for fulfilling the gap of consumers demand and stabilizing the prices of onion in our country.

ONION is rich a source of flavonoids and associated with reduced threat of cancer, heart disease, diabetes and it is also known for anti-bacterial, antiviral, anti-allergenic and anti-inflammatory potential. The spiciness in onion is due to the presence of sulphur bearing compound in the volatile oil known as allyl-propyl disulphide ($C_6H_{12}S_2$). During 2020-21, country has exported 15.78 lakhs MT of fresh onion to the world worth 2826.5 crores/378.49 USD million. The world onion bulbs production in 2017 was about 978 lakhs tonnes from 52.01 lakhs hectares of land with an average yield of 18.80 tonnes/ha. India is the second biggest producer of onion in the world after China with 26.64 million tonnes production from 1.62 million hectares area in 2021-22. Productivity of onion in India is extremely low *i.e.* 16.44 tonnes as compared to the China and other countries like, the Republic of Korea (66.15 t/ha), USA (56.13 t/ha), Netherlands (51.64 t/ha),

Japan (46.64 t/ha) and Egypt (36.16 t/ha). Among the onion producing states, Maharashtra placed first followed by Karnataka, Gujarat, Bihar, Madhya Pradesh, Andhra Pradesh, Rajasthan, Haryana, Uttar Pradesh and Tamil Nadu. The estimated total area under onion in Rajasthan is 74.61 thousand hectares, from which 1241.78 thousand tonnes were produced in 2020-21. The productivity of onion in Rajasthan is 16.64 tonnes, which is lower than the world average of 18.80 tonnes.

Climate

Onion is a cool season vegetable and grows well under mild climate without extreme heat or cold or excessive rainfall. Basically, onion is a cool season crop and hardy to frost but less sensitive to heat, extra high temperature during maturation induces bolting. The ideal temperature during maturation induces bolting. The ideal temperature for vegetative growth is 12.8–23°C and for



kharif onion nursery covering



Ideal seedling for transplanting

Table 1. Effect of different shedding material use for onion nursery on vegetative growth parameters of onion seedling

Shedding material	Germination (%)	Seedling height (cm)	No. of leaves per plant	Number of roots per plant	Damping off infestation (%)	Bulb weight (10 bulbs, g)	Seedling survival (%)
Open	20	32.4	3.5	19.6	2.0	20.1	90.0
Fertilizer bag	62	25.3	3.0	13.0	5.0	14.5	68.0
Jute bag	80	22.7	3.0	12.5	15.0	12.7	61.0
Agro shed net	75	30.0	3.1	12.9	7.0	15.6	75.5
Anti-insect net	68	33.5	3.3	15.5	6.0	18.0	80.0
CD 5%	3.50	1.22	0.04	1.33	0.50	1.00	4.01

Source: Bhardwaj (2021).

bulb formation, it requires long days (11-12 hours day length) and still higher temperature (20-25°C). However, successful bulb production is possible in areas where rainfall is less than 300-400 mm during bulb production and clear sunshine at harvest. Due to lower rainfall with full sunlight, the irrigated area of western Rajasthan is most suitable for *kharif* onion production. In this area all climatic vulnerability for *kharif* onion production like heavy and incessant rain, water-logged conditions, high humidity, cloudy weather for long time are least and easy to produce good quality bulb than high rain area. In western Rajasthan, *kharif* onion maturation time also coincides with slightly low environmental temperature and free from rain, which is good for development of better quality bulbs and easy to harvest crop and storage.

Soil

For onion production, soils should be light, deep friable and highly fertile. Sandy soil needs more and frequent irrigation and favour early maturity. In general, sandy loam to clay loam soil is most suitable for best quality bulb production. The optimum pH range is between 6.0 and 7.5. Highly alkaline and saline soils are not suitable for onion cultivation. Additions of well decomposed organic manure helps in improving fertility status of soil besides improving the soil physical conditions are favourable for quality production. Soil rich in NPK with sulphur was helpful for getting more and good quality bulbs. Onions are very much sensitive to the effects of high water table and water logging condition, so well drained soils are best.



kharif onion crop ready for harvest

Varieties

The selection of correct variety is most important for *kharif* onion production. An ideal *kharif* variety should have early bulking, high photosynthetic efficiency, thin neck and resistance to diseases and water stagnation tolerance. The varieties N-53, Agrifound Dark Red, Agrifound Light Red, Baswant-780, Bhima Super, Bhima Dark Red, Bhima Raj, Bhima Shubhra, Arka Kalyan performs better in *kharif* season.

Production of healthy seedlings

For a successful crop, seeds are sown in nursery on a well prepared nursery bed of 90 cm width, 10-15 cm height and convenient length by end of May to first week of June. Seed rate varies from 8 to 10 kg/ha and ratio between nursery area and main field is about 1:25. For obtaining healthy seedlings, freshly produced seeds of selected varieties should be treated with captan or thiram at the rate of 3 g per kg of seed. It is difficult to raise healthy seedling due to scorching heat, high soil temperature, low relative humidity and lack of irrigation water in summer as the seedling mortality is high, poor seed germination and slow initial performance of seedling. Further, after onset of monsoon, the heavy showers, water stagnation and high incidence of diseases which spoil the seedlings are also challenge for farmers to raise healthy nursery. Use different shading material to protect the nursery bed from direct sunlight, heavy rainfall and irrigation through drip or sprinkler saves 40-50% water and ensures 70 to 85% seed germination with good seedling stand. The use of 50% agri shade net



Drum rolling

Table 2. Effect of crop geometry and NKPS fertilizer levels on *kharif* onion

Treatment	Plant height (cm)	No. of leaves per plant	Bulb weight (g)	Bulb yield (t/ha)	Marketable yield (t/ha)	Net Return (₹)	B:C Ratio
<i>Crop geometry</i>							
7.5 × 7.5 cm	57.23	8.16	48.84	57.74	30.04	2.63	2.68
10.0 × 10.0 cm	67.67	10.16	66.48	44.21	39.42	3.75	3.82
12.5 × 12.5 cm	73.81	12.83	76.39	32.51	30.40	2.67	2.72
15.0 × 15.0 cm	85.74	15.33	123.24	36.43	29.75	2.59	2.64
C. D. (p=0.05)	2.452	0.265	2.852	2.638	1.509	0.057	0.057
<i>NPKS fertilizer levels</i>							
F ₁	63.87	10.60	71.62	38.55	30.15	2.66	2.77
F ₂	71.86	11.58	77.41	41.81	33.08	2.99	3.05
F ₃	76.55	12.80	81.75	44.42	34.93	3.19	3.19
C. D. (p=0.05)	4.395	0.479	5.148	1.461	2.724	0.102	0.102

F₁: 100 N: 40 P: 40 K: 20 S; F₂: 120 N: 60 P: 60 K: 30 S; F₃: 140 N: 80 P: 80 K: 40 S kg/ha. Source: Bhardwaj (2021).



Nursery bed



First irrigation in nursery



Raised bed transplanting

or hessian cloth for shading over nursery beds during summer protects young seedlings from scorching sunlight and ensures rapid and higher seed germination. After proper stand of seedlings, shed net should be removed after 40-45 days to avoid etiolation and lanky growth. An experiment was conducted to determine the effect of different shading material for use for onion nursery at Agricultural Research Substation, Sumerpur-Pali and the anti insect net (40 mesh) was most suitable for nursery shedding in respect of all growth parameters and produce healthy seedling during *kharif* season.

Transplanting method

Fifty five days after sowing, three to four green true leaves, vigorous and healthy, 15 cm height seedlings are ideal for transplanting. Seedlings were transplanted to the field from mid-July to end of July after fungicidal dipping treatment. For transplanting, the land is brought to a fine

tilth by thorough ploughing, levelling and breaking clods. During *kharif* season, flat beds should be keeping away to prevent water logging as it favours anthracnose disease which is most distressing during *kharif* season. Raise bed with drip irrigation is the best method for *kharif* onion production because the excess water can be drained out through the furrow. Transplant the seedling during evening at 10 cm × 10 cm, 12.5 cm × 10 cm crop geometry and immediately irrigate to avoiding burning effect due high soil and environment temperature.

Manures and fertilizers

Onion is a heavy feeder of nitrogen, phosphorus, potash and sulphur. Nutrient management in *kharif* onion production is imperative because the leaching and runoff losses are high due to heavy rains. Although *kharif* onion is produced in those areas where the annual rainfall is less than 600 mm but the erratic behaviour of monsoon,



Removing of foliage



Income from sale of produce

which has become a common phenomenon, during *kharif* onion production. Application of 25 tonnes of well decomposed FYM or 12.5 tonnes of vermicompost pre-mixed with *Trichoderma viride* before bed preparation helps in reducing the incidence of soil borne diseases. The recommended dose of fertilizers for *kharif* onion is 140 kg nitrogen, 80 kg phosphorus, 80 kg potassium with 40 kg sulphur per hectare. One third of recommended N and full dose of P_2O_5 , K_2O and sulphur are applied at the time field preparation before transplanting, while remaining two third N is applied in two equal splits at 30 and 60 days after transplanting. An experiment conducted at Agricultural Research Substation, Sumerpur-Pali found out that the *kharif* season onion planted at 10 cm × 10 cm with application of 140 N: 80 P: 80 K: 40 S kg/ha attained maximum marketable yield, gross return, net return and B: C ratio at sandy loam soil in arid climate condition.

Weed management

The management of weed is one of the serious problems during *kharif* season which limits the crop yield and decrease the profits. During early stages of the crop, plants grow slowly and it is essential to remove weeds. For nursery, use of pendimethalin @ 2 ml per litre of water after seed sowing checks weeds up to 30 days. However, for *kharif* crop, pre-transplanting incorporation of Basalin (2 kg a.i./ha) or oxyfluorfen @ 1.5-2.0 ml per litre of water can be sprayed immediately after transplanting of seedlings or just before transplanting of onion followed by immediate irrigation. These weedicides control weeds up to 30-35 days but after that one or two hand weeding with light hoeing should be done for control of weeds, soil loose and to cover the open bulbs.

Water management

Kharif onion crop producing farmers get special benefits of rain water during cropping period, which is highly useful in rapid growth and development of the crop. *Kharif* crop requires less water immediately after establishment of seedlings and consumption goes on increasing with maximum requirement before maturity, around 3 months after transplanting, and thereafter it is reduced. So irrigate the crop at 8-10 days interval

during early stage followed by subsequent irrigations at 4-6 days interval under drip irrigation. Due to rain, the crop in general needs 8-12 irrigations during long dry spell. Excess irrigation is always harmful and dry spell followed by irrigation will result in the splitting of the outer scales and also formation of bolters. Drip irrigation is the most beneficial during *kharif* as irrigation is applied in little amount without causing over irrigation. Fertigation through drip avoids leaching losses of nutrients, which is common in high rainfall conditions.

Disease and pest management

Among the onion diseases, damping off in nursery and anthracnose, purple blotch in field commonly occur in *kharif* season and results in heavy loss in crop. The thrips are the main insect affecting growth and yield of onion.

Damping off: The disease is an important disease during nursery stage of *kharif* season. Fungi, *Rhizoctonia* spp. and *Fusarium* spp., along with the water mold *Pythium* spp. are the most common pathogens. Disease causes delayed seedling emergence in addition to root and basal part become water soaked, thin and finally seedling rot. Once introduced to nursery, the damping off pathogens easily move from plant to plant by growing through the media or in shared irrigation water. For disease management, the nursery bed should be prepared 15 cm raise with good drainage and water to keep it moist but not soggy. Soil solarisation by spreading 250 gauge polythene sheet over the bed for 30 days before sowing and application of *Trichoderma viride* in soil at 4-5 g/m². Seed treat with systemic fungicide @ 3-5g/kg seed.

Anthracnose: This disease in onion is caused by *Colletotrichum gloeosporioides* (*Glomerella cingulata*). The symptoms appear as pale yellow water soaked spots on the leaf, which increase lengthwise covering the whole leaf. Numerous black coloured slightly raised structures are produced in the central portion. The affected leaves shrivel, droop down and finally wither. The pathogen survives on crop refuse, sanitation and destruction of infected plant debris helps in reducing the disease. Clean cultivation, long crop rotation and proper drainage are essential for control of disease. Application of benomyl @ 0.2% as soil treatment, spray of mancozeb @ 0.25%



Harvesting of bulbs



Grading and sorting

carbendazim @ 0.1% and captafol (0.2%) gave good control of the disease.

Purple blotch: It is more common in *kharif* season and caused by *Alternaria porri*. Hot and humid climate with temperature ranging from 21 to 30°C and relative humidity (80 to 90%) favours the development (sporulation) of the disease. Initially, small white sunken spots develop on the leaves and enlarge, become eye shaped under moist conditions, turn to purple colour and are surrounded by a broad chlorotic margin. Lesions may girdle leaves and stalks causing them to drop after 2-3 weeks. Avoid excess doses of nitrogenous fertilizers and lowering the density of transplanted crops causes reduced infection. Frequent sprays of mancozeb or chlorothalonil @ 0.25% at 10 days intervals have been found effective in reducing the disease.

Black mold: The disease is common in onion stored in hot climate where the temperature ranges between 30 to 45°C. It is characterized by the black powdery mass of spores that appear on the exterior of the scales. The black spore masses are also seen on inner scales. It reduces the market value of the bulbs. For effective control of disease, bulb should be left in the field for two-five days and in shade for 10-15 days for drying (curing) before storage. The crops should be sprayed with Carbendazim (0.2%) 10-15 days before harvesting.

Thrips: It is most injurious sucking insect pest of onion. The thrips infested leaves develop spotted appearance which turn pale white blotches. If the infestation comes in early stage of the growth, the bulb formation stops completely and yield loss may be upto 50-60%. Intercropping, adequate soil calcium, lower nitrogen, use of sprinkler irrigation minimise thrips population. The regular application of insecticides such as Malathion @ 0.1% or metasystox @ 0.1% and cypermethrin @ 0.01% or deltamethrin 2.8% @ 20 ml a.i./ha control the insect.

Harvesting and yield

Onion crop should be harvested by pulling out plants when 50% tops are drooping, which is an indicator of crop maturity. However, in *kharif* season, bulbs mature in about 90-110 days, but plants remain in the active growth stage and there will not be any top fall. Development of pigments, bulb size (60-70g) and shape are taken as an index for maturity during *kharif* season. After attaining this condition, top fall can be induced mechanically by

rolling empty barrels two or three days before harvesting. *Kharif* onion produced by raised bed planting with drip irrigation, 30-35 tonnes of bulbs are expected from one hectare of medium fertile sandy loam soils.

Curing

Harvested bulbs may be left in the field for three days for curing which makes bulbs firm and dry. The curing of *kharif* onion is important for better shelf life but high humidity and cloudy weather do not facilitate curing and results in more losses due to bruising, rotting and sprouting. The bulbs should be adequately cured by either in field or in open shade or by artificial means for proper development of skin colour and to remove field heat before storage of bulbs. It is done till the neck is tight and outer scales are dried. This will prevent infection of diseases and minimize shrinkage loss.

Marketing and B: C ratio

The expected average market rate of good quality *kharif* onion bulbs ranges from ₹ 15 to 20 per kg due scarcity in market. Average gross return from *kharif* onion ranges from ₹ 4.50 lakhs to 6.0 lakhs and average cost of cultivation for onion production ranges from ₹ 1.10 lakhs to 1.35 lakhs. Approximate net return received from *kharif* onion is ₹ 3.40 lakhs to 4.65 lakhs with B: C ratio of 3.09 to 3.44 based on market rates.

Conclusion

Kharif onion bulbs are ready for harvest during end of October to end of November and bulbs are available in market during November onwards. Due to consumption and storage spoilage during rainy season, shortage of the *rabi* onion in market during month of October onwards, and the prices increases very rapidly in October and remains high till January-February. Therefore *kharif* onion is most crucial in controlling market prices and high remunerative crop for farmers than all others are grown in western Rajasthan.

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