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Original article**Cultivating *Rabi* Onion in North Gujarat Region****Dr. Sable P A¹ , K Z Vaghela¹ and Piyush Verma²**¹Assistant Professor and ²Principal and dean

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ABSTRACT

In India, onion is cultivated in three seasons i.e. *kharif*, late *kharif* and *rabi*. The average yields of 25-35 t/ ha can be obtained from *rabi* onion crop. During the *rabi* season of 2023-24, about 60 days old healthy seedlings were transplanted at a spacing of 15 cm x 10 cm on the farm of College of Horticulture, S. D. Agricultural University, Jagudan, Dist. Mehsana on 20 December, 2023 and crop was harvested about 126 DAT on 25 April, 2024. The total fresh marketable average yield of 39.11 t/ ha was obtained under Mehsana region falls in North Gujarat Agro-climatic Zone – IV from sandy loam soils with poor in fertility and water holding capacity, low OC and N, medium P₂O₅ and high K₂O. The climatic condition of the area represents the tropical conditions with semi-arid climate. The article highlights the performance of *rabi* onion for this region under integrated crop management practices.

1. INTRODUCTION

Onion (*Allium cepa* L., Family: Alliaceae) is one of the most important vegetable, salad and spice of the world, having important place in vegetable cultivation. In India, onion is cultivated in three seasons i.e. *kharif*, late *kharif* and *rabi* (Tripathy *et al.*, 2013; Ganie *et al.*, 2019). Main season is *rabi* which accounts about 50 % of production, whereas, 20 % is from *kharif* and 30 % from late *kharif*. The productivity of late *kharif* and *rabi* onion is around 25 t /ha, whereas, of *kharif* is 8-10 t/ ha. During 2020-21, total area under onion was 1.62 million hectares with a total production of 26.64 million metric tonnes and productivity 16.40 t/ ha (Anon., 2022 and Sable *et al.*, 2024). States Maharashtra, Madhya Pradesh, Karnataka, Gujarat, Rajasthan, Bihar have been showed in descending order of per cent share in production during 2021-22 as 39 %, 17 %, 10 %, 6.0 %, 5.0 %, 5.0 %, respectively, (Dept. of Agriculture and Farmers Welfare, 2022). India's 26 % area, 29 % production and almost 90 % export alone come from Maharashtra. Stored onions during May to November used for domestic use and export market. *Rabi* onion variety NHRDF Red 4 was cultivated during the *rabi* season of 2023-24 on the farm of College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. Mehsana, Gujarat to experience the performance of

rabi onion under this region falls in North Gujarat Agro-climatic Zone – IV. The location lies at longitude 74°.43E, latitude 23°53' N and altitude 90.6 m. MSL with an average annual rainfall of 550 mm. The climatic condition of the area represents the tropical conditions with semi-arid climate. Sandy loam soils with poor in fertility and water holding capacity, pH 7.3-7.9, EC 0.25 dS/m, available N 250.5 kg /ha (low), P₂O₅ 49.5 kg /ha (medium), K₂O 436.8 kg/ ha (high) and organic carbon 0.33 % (low). The seed was sown in the nursery bed on 18 October, 2023 for raising the onion nursery. About eight week old healthy seedlings were transplanted at a spacing of 15 cm x 10 cm in main field on 20 December, 2023. Recommended cultural practices were followed timely to raise the crop successfully. The article highlights the performance of *rabi* onion for this region under integrated crop management practices.

2. Varieties

NHRDF Red 4

The season wise recommended varieties selection is most important factor for onion production. NHRDF Red 4 is becoming popular among the farmers due to its yield, better adaptability, attractive bulb colour and storage life. The bulbs are dark red, globular round (5.5-6.25 cm in diameter) has thin neck. Bulb has TSS 12-14 °B and 13-14 % dry matter. Bulb keeping quality is good. This variety is recommended for *rabi* season, bulbs matures in around 110-120 DAT. Aaverage 35.0-40.0 tonnes of bulbs are expected from one hectare. This variety was tested in *rabi* season of 2020-21, 2023-24 under Khedbrahma, Mehsana region of North Gujarat, respectively. Fresh bulb yield 51.70 t /ha was obtained under Khedbrahma region in medium black soil, while, 39.11 t/ ha under Mehsana region.

NHRDF Red 3 (L-652)

This variety is released by NHRDF and recommended for *rabi* season all over the country. Generally bulbs mature in about 120-130 DAT and about 35-40 tonnes of bulbs are expected from one hectare (Sable and Sonpure, 2023).

Agrifound Light Red (ALR)

This variety is released by NHRDF in 1988 and recommended for *rabi* season all over the country. Generally bulbs mature in about 100-120 DAT and about 30-32.50 tonnes of bulbs are expected from one hectare (Sable and Sonpure, 2023).

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.

Bhima Raj

It is recommended for kharif and late kharif in Gujarat, Karnataka and Maharashtra and for *rabi* in Delhi, Gujarat, Haryana and Rajasthan.



NHRDF Red 4



NHRDF Red 3



ALR



Bhima Shakti



Bhima Raj

3. Soil and climate

Onion can be grown in all types of soils. However deep, friable loam and alluvial soils with pH 6.0 - 7.5, EC 4.0 dS /m, good drainage, water holding capacity and organic matter content is the best. Addition of well decomposed organic manure helps in improving soil fertility status besides improving the soil physical properties and availability of microorganisms. Onions are very much sensitive to the effects of high water table so well drained soils are best. Crop is more sensitive to

highly acidic, alkali, saline soils and water logging condition. Onions do not thrive in soils having pH below 6.0 because of trace element deficiencies or occasionally, Al or Mn toxicity. Soil rich in NPK with sulphur help for getting more and quality bulb yield. Onion is a cool season crop, however, it can be grown under a wide range of climatic conditions like temperate, tropical and subtropical climate. It prefers a mild climate without the extremes of cold, heat and excessive rainfall. However, onion plant is hardy and in the young stage can withstand freezing temperature also. Short-day onion is grown in the plains of India, which requires 10-12 hrs day length. The onion cultivated in hills is long-day type, which requires 13-14 hrs day length. Lower temperature along with short photoperiod requires for vegetative growth, whereas, relatively higher temperature with longer photoperiod requires for bulb development and maturity. Temperature 13-24°C and 16-25°C, respectively, are the best for vegetative phase and bulb development, while, about 70 % relative humidity requires for good growth. Onion grows well in 650-770 mm uniformly distributed rainfall during monsoon period.

4. Nursery management and transplanting in *rabi* onion

As water stagnation during nursery stage favours fungal diseases infection, well drained sandy loam soil rich in organic matter with sufficient land slope was selected for onion nursery raising. The land was prepared well in advance with repeated ploughing and harrowing to obtain a fine tilth. Seed rate varies for raising the onion nursery as per season and ratio between nursery area and main field is about 1: 20-25 (Around 5 guntha nursery area requires to produce seedlings for transplanting on 1 ha main field area).



Nursery bed and sprinkler irrigation

Seed can be sown in nursery on well prepared nursery raised bed of 15 cm height or flat nursery bed of about common 2-3 m length and 1-1.5 m width. However, drip and sprinkler irrigation facility was available so seed was sown on raised beds. Seedbeds are to be covered with net till germination. After seed germination net covering is to be removed immediately.



First irrigation in nursery

Well decomposed FYM 500 kg and 2:1:1 kg NPK/ 5 guntha were applied before seed sowing as basal dose and 1 kg N 20 DAS. Eco friendly biofungicides like *Trichoderma* 1.25 and *Pseudomonas fluorescens* 2.5-5 kg/ ha was applied with 125 kg vermicompost after 10 days enrichment process. As higher level of humidity is required for effectiveness of the biofungicides, biopesticides and biofertilizers products, these should be applied after enrichment with organic manures and the field should be irrigated immediately after the application. For transplanting on 1 ha main field area, about 5-6 kg onion seed is sufficient for *rabi* season. While, on the basis of experience about 3.750-4.375 kg freshly produced seed was used for nursery raising under proper nursery management practices which was sufficient for transplanting on 1 ha area. For obtaining healthy seedlings, seeds are to be treated with captan or carbendazim @ 2-3 g/ kg of seed. Seed of NHRDF Red 4 was procured from National Horticulture Research and Development Foundation (NHRDF) office, Mahuva, Gujarat so seed treatment was not required for already treated and packed seeds. Sprinkler system was used to irrigate raised beds. The weed management is one of the serious problems, two hand weeding were found effective for weed management in onion nursery. Pendimethalin spray 2 ml /lit of water before onion seed germination followed by hand weeding at 20-25 DAS was found effective. Onion seedlings in nursery can be attacked by different insect pests and diseases. Thrips is a major pest of onion. Fipronil 5 SC at 1 ml and carbosulfan 25 % EC 2 ml/ lit of water alternatively at fortnightly interval reduces thrips population. Drenching of copper oxychloride 3 g/ lit of water

between the rows reduces root rot disease. While, Drenching of metalaxyl 4 % + mancozeb 64 % @ 2 g/ lit of water between the rows reduces wilt disease (Sable and Patel, 2023). Integrated approach was adapted for disease management which descriptions are given below.

Nursery stage

- Crop rotation was followed.
- Previous plants residues were removed from the field.
- Application of *Trichoderma* @ 1.25 kg and *Pseudomonas* 2.5 kg /ha.
- Well drained soil was selected.
- Drenching of fungicides as per mentioned above.
- Fungicides spray (per litre of water):
 1. At 15-20 day after sowing: Mancozeb 2.5 g.
 2. 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-IV.

After transplanting stage (DAT)

- At 3-5 DAT: Application of *Trichoderma* 1.25 kg and *Pseudomonas* 2.5 kg/ ha.
- Fungicides and insecticides spray (per lit of water)
 - 1 At 30 DAT: Mancozeb 2.5 g + fipronil 5 SC 1 ml.
 - 2 At 45 DAT: Propiconazole 25 % EC 1 ml + carbosulfan 25 % EC 2 ml.
 - 3 At 60 DAT: Copper oxychloride 2.5 g + profenofos 1 ml.
- Water soluble fertilizers and micronutrients spray (per litre of water):

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 %).

5. Transplanting

Rabi onion can be transplanted on flat bed, whereas, raised bed with drip irrigations is the best method. About 60 days old healthy seedlings were transplanted at a spacing of 15 cm x 10 cm in main field. One third top portion of the seedlings was cut at the time of transplanting.



Onion nursery



Uprooting of seedlings for transplanting

Seedlings were transplanted after dipping its root portion in the solution of carbendazim 1 g and carbosulfan 2 ml/ lit of water to manage pest and diseases.

6. Nutrient management

Fertilizer dosages vary with soil type and its nutrients content, region and variety. Vermicompost 7.5 t/ ha was applied at the time of final land preparation. Bio-fertilizers and bio fungicides *Azotobacter* 5 kg, *Phosphorus solubilizing bacteria* (PSB) 5 kg and *Trichoderma* 1.25 kg /ha were applied with 125 kg vermicompost after 10 days of enrichment. Research evidences revealed that, well decomposed FYM 25 t or poultry manure 7.5 t/ ha can be used as an alternative source of organic manures. Recommendations for fertilizer application in onion vary from region to region. The recommended dose of fertilizers 100:50:60:20 kg NPKS/ ha was applied. Half of

recommended N and full dose of P_2O_5 , K_2O and S were applied at the time of planting, while, remaining half N was applied in two equal splits at 30 and 45 DAT. Water soluble fertilizers 19:19:19 @ 0.5 % at 30 and 45 DAT and 13:00:45 or 00:00:50 @ 0.5 % during 60-70 DAT can be sprayed in nutrient deficient soils to enhance the yield. Micronutrients deficiency can be corrected by spraying with Grade-IV (Zn 6 %, Fe 4 %, Mn 1 %, Cu 0.5 % and B 0.5 %) @ 0.2 % at 30-45 and 45-60 DAT.

Fertigation

Drip irrigation at 100 % Pan Evaporation (PE) can improve the marketable bulb yield 15-25 % per unit area as compared to flood irrigation. Transplanting is to be done at a spacing of 10 x 15 cm on a broad bed furrow/ raised bed of 15 cm height and 120 cm top width with 45 cm furrow for fertigation. Each BBF should have two drip laterals of size 16 mm at 60 cm distance with emitters at around 30-50 cm distance having discharge capacity 4 l/ hr. Whereas, the distance between two laterals of size 20 mm should be 6 m having discharge capacity 135 l/hr in case of micro sprinkler. Application of fertilizers @ 40:40:60 kg NPK /ha as basal and the remaining 70 kg N in seven splits through drip irrigation is recommended for higher bulb yield.



View of rabi onion research plot

7. Weed management

Spray of oxyfluorfen 23.5 % EC @ 1-1.5 ml/ lit of water on 3rd day of transplanting followed by one hand weeding at 30- 45 DAT have been found effective in controlling weed infestation (Sable et al., 2013).



Bulb size in control plot



Bulb size in IWM plot

8. Harvesting, neck cutting and bulb yield

Duration of *rabi* onion crop varies as per several factors like variety, soil, climate etc.



Crop indicating maturity

Onion crop is harvested by pulling out the plants generally after 50 % neck fall, when leaves starts yellowing about 110-130 DAT. The tops are to be cut leaving the neck about 2.5 cm above the bulb after field curing and drying.



Neck cutting



Harvested onion bulbs

The average yields of 25-35 t/ ha can be obtained from *rabi* onion crop. During the *rabi* season of 2023-24, about 60 days old healthy seedlings were transplanted at a spacing of 15 cm x 10 cm on the farm of College of Horticulture, S. D. Agricultural University, Jagudan, Dist. Mehsana on 20 December, 2023 and crop was harvested about 126 DAT on 25 April, 2024. The total fresh marketable average yield of 39.11 t/ ha was obtained under Mehsana region falls in North Gujarat Agro-climatic Zone – IV from sandy loam soils with poor in fertility and water holding capacity, low OC and N, medium P₂O₅ and high K₂O. The climatic condition of the area represents the tropical conditions with semi-arid climate.

9. Disease and pest management

Thrips (*Thrips tabaci*) is major pests of onion. Diseases like damping off/ root rot (*Fusarium oxysporum* f.sp.epae; *Pythium* sp.; *Sclerotium rolfsii*), wilt, *Chlototrichum* blight (*Colletotrichum*

gleosporiodes), purple blotch (*Alternaria porri*), stemphyllium leaf blight (*Stemphyllium vesicarium*), Irish yellow spot virus and onion yellow dwarf virus (OYDV) etc. are severe diseases of onion. Thrips, wilt, *Cholototrichum* blight, purple blotch, stemphyllium blight can be managed by adapting plant protection measures given in nursery stage and after transplanting stage part. Suitable plant protection measures can be taken to minimize yield losses, while, adapting plant protection measures some points need to be considered viz. start foliar sprays of pesticide from 30 DAT or as soon as pest and disease appears in the field; interval 10-15 days depending upon the intensity of pest and disease; spreader to be added @ 0.5 % while spraying and avoid repeated application of pesticides belonging to the same group. For effective management of OYDV, IPDM strategies should be followed viz. selection of OYDV resistant variety, aphid management as aphid is the vector, spray of insecticides like profenofos @ 0.1 % or carbosulfan @ 0.2 % or fipronil @ 0.1 % for aphid management. Iris yellow spot disease (virus) transmitted through onion thrips and can be managed by adapting thrips management practices.

CONCLUSION

The improved nursery management and production technology (INM, IWM and IPDM) of *rabi* onion variety NHRDF Red 4 has found best for getting higher *rabi* onion yield and income in Mehsana region of North Gujarat.

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