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### Assessment of onion varieties for *Kharif* in Vonipenta region of Andhra Pradesh

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#### Abstract

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops cultivated in India and is also among the oldest known domesticated vegetables. Believed to have originated in Central Asia, it is now extensively grown worldwide, with major production concentrated in China, India, the Netherlands, Pakistan, Bangladesh, and Australia. India ranks as the second-largest producer of onion, cultivating 1.293 million hectares with a total production of 21.718 million tonnes. In Andhra Pradesh, onion occupies 44,600 hectares, contributing an annual production of 5.13 lakh MT. Productivity during the *kharif* season remains markedly lower than that of the *Rabi* crop. Enhanced productivity can be achieved through the adoption of suitable varieties, balanced nutrient management, optimal irrigation practices, and timely plant protection measures. Among these, the selection of an appropriate variety plays a pivotal role in improving both yield and production stability. Ensuring a continuous supply of onion throughout the year necessitates the adoption of *kharif* and late-*kharif* cultivation. Recognizing the importance of varietal suitability in *kharif* onion production, an On-Farm Testing (OFT) programme was undertaken by Dr. YSRHU – Krishi Vigyan Kendra (KVK), Vonipenta during 2022–23 and 2023–24 across farmers' fields in the villages of Madirepalli, Sunkulagaripalle, Mittamanupalle, Vonipenta, and G.V. Satram. The objective was to evaluate the field performance of promising *kharif* onion varieties. Results from the OFT revealed that the variety NHRDF Fursungi consistently outperformed other tested varieties NHRDF Red-3, Agrifound Light Red, and the local farmers' variety (KP onion) with respect to yield and key growth parameters.

**Keywords:** Onion, KVK, NHRDF, *Kharif*

#### Introduction

Onion is the most important vegetable crop among the various *Allium* species cultivated in India. It is a staple ingredient used daily in households across the country in vegetables, soups, and curries. In India, onion cultivation is predominantly concentrated in the *rabi* season (about 60%), followed by *kharif* and late *kharif* seasons (20% each) (Tripathy *et al.*, 2022) [8]. The country has 12.93 lakh hectares under onion cultivation, producing 5.13 lakh metric tonnes with an average productivity of 16.8 MT ha<sup>-1</sup> (NHB, 2023). Maharashtra is the leading onion-producing state, whereas Gujarat records the highest productivity. Over the past few decades, both the area and production of onions have shown a steady upward trend. *Kharif* onion alone is grown on nearly one lakh hectares across India. The major *kharif* onion-producing states include Karnataka, Andhra Pradesh, Rajasthan, Tamil Nadu, and Maharashtra. In Andhra Pradesh, onion is cultivated over 44,600 hectares, producing 3.54 lakh tonnes annually, with the highest productivity of 18,456 kg ha<sup>-1</sup> recorded in Kurnool district. Horticultural development has consistently contributed to enhancing the economic status of farmers. Historically,

onion prices have surged sharply between October and January, largely due to spoilage of *kharif* produce caused by unpredictable monsoon conditions. Erratic and unseasonal rainfall often damages *kharif* and late *kharif* crops as well as *rabi* nurseries. Therefore, to ensure sustainable income from *kharif* onion and to reduce market price fluctuations, farmers must adopt appropriate soil and crop management strategies. Water logging is a major abiotic stress that severely limits onion productivity. Bulb size and yield key economic traits are significantly affected by frequent flooding events during the *kharif* season. Moreover, suitable varieties specifically adapted for *kharif* cultivation remain limited. Shah *et al.*, (2021) [5] also reported that varietal differences in onion arise primarily due to genetic variability.

#### Materials and Methods

The present investigation was conducted over two consecutive years (*kharif* 2022–23 and 2023–24) by the Krishi Vigyan Kendra, Dr. YSR Horticultural University, Vonipenta. The study was undertaken in farmers' fields across five villages viz., Madirepalli, Sunkulagaripalle,

Mittamanupalle, Vonipenta and G.V. Satram. Three improved onion varieties, namely NHRDF Fursungi, NHRDF Red-3, Agrifound Light Red, and the local farmers' cultivar (KP onion), were evaluated over a total area of 0.4 ha. A comprehensive description of these varieties is presented in Table 1.

Seedlings of each variety were initially raised under polyhouse conditions. After attaining the transplantable stage (45–60 days after sowing), the seedlings were distributed to the beneficiaries participating in the On-Farm Testing (OFT) programme. All varieties were cultivated following the full recommended package of practices prescribed by the NHRDF, New Delhi, to ensure optimal crop performance. The soils of the selected villages are characterized as clay loam with adequate nitrogen, phosphorus, and potassium levels but low organic carbon content.

For data collection, twenty plants were randomly selected from each entry to record observations on growth, yield, quality parameters, and pest and disease incidence. Bulb yield was measured on a plot basis. Economic analysis was carried out using prevailing market prices of inputs and outputs to determine the cost-effectiveness of the evaluated technologies. Mean data collected across the two years were subjected to standard statistical procedures to assess the economic viability of the interventions. Incidence of Stemphylium blight and purple blotch was quantified using the per cent disease index (PDI), calculated according to the formula proposed by Wheeler (1969) [9].

$$\text{PDI for severity} = \frac{\text{Sum of all disease ratings}}{\text{Total number of leaves}} \times 100$$

Disease assessments were recorded using the 0–5 rating scale proposed by Sharma (1986) [6]. Observations for both onion thrips infestation and purple blotch incidence were taken at 15-day intervals, beginning 30 days after transplanting. Based on the disease scores obtained, the varieties were subsequently classified into distinct resistance or susceptibility categories as outlined in Table 2.

According to the assessment scale proposed by Singh (2004) [7], the percentage of leaf surface affected by the disease was quantified. The infection severity on individual leaves was evaluated using a 0–9 rating scale, based on the extent of disease incidence or intensity as detailed in Table 3. Disease incidence was subsequently calculated as the percentage ratio of the infected leaf area to the total leaf area.

## Results and Discussion

A perusal of the data clearly indicates that the onion varieties exerted a significant influence on the growth and yield attributes (Tables 4 and 5). The highest marketable

bulb yield was recorded in the variety NHRDF Fursungi (399.5 q ha<sup>-1</sup>), followed by NHRDF Red-3 (290.5 q ha<sup>-1</sup>), Agrifound Light Red (287.5 q ha<sup>-1</sup>) and KP Onion (114.5 q ha<sup>-1</sup>). The yield advantage of NHRDF Fursungi over NHRDF Red-3, Agrifound Light Red and KP Onion was 47.67%, 38.94% and 248.84%, respectively. The superior performance of NHRDF Fursungi may be attributed to its enhanced growth and yield traits, such as greater plant height (53.97 cm), higher number of leaves per plant (6.02), increased leaf diameter (1.36 cm) and larger bulb dimensions (polar diameter: 46.22 mm; equatorial diameter: 49.36 mm).

Variation in bulb yield among onion varieties has also been documented by Kerure *et al.*, (2021) [3] in Karnataka, Lawande *et al.*, (2020) [4] in Maharashtra and Tripathy *et al.*, (2021) [8] under Odisha conditions. In addition to these growth and yield attributes, NHRDF Fursungi exhibited the lowest incidence of pests and diseases, particularly thrips (12.65%), purple leaf blotch (26.82%) and Stemphylium blight (18.90%), compared with NHRDF Red-3, Agrifound Light Red and KP Onion (Table 6).

The year-wise economic analysis of onion under on-farm testing was carried out, and the results are presented in Table 5. The pooled economic data revealed that the NHRDF Fursungi variety achieved the highest gross returns (Rs. 4,00,400 ha<sup>-1</sup>), net returns (Rs. 3,30,125 ha<sup>-1</sup>) and benefit–cost ratio (5.69), outperforming NHRDF Red-3, Agrifound Light Red and KP Onion.

Farmers perceived and ranked NHRDF Fursungi as the most preferred variety owing to its desirable bulb characteristics, including larger size, attractive shape, appealing skin colour, higher yield potential, superior keeping quality (extended shelf-life) and strong consumer acceptance. Agrifound Light Red was placed second in overall preference. In contrast, KP Onion received the lowest ranking, as farmers expressed dissatisfaction with its smaller bulb size, inferior shape and skin colour, reduced yield, limited market acceptability and its pronounced susceptibility to Stemphylium blight.

However, when assessed on the basis of seed viability for the current season's crop production, the traditional variety KP Onion ranked first among the four varieties. With respect to tolerance against Stemphylium blight, NHRDF Fursungi secured the top position due to its moderately resistant reaction. Considering the overall varietal characteristics and market preferences, farmers rated NHRDF Fursungi as the most suitable variety, followed by NHRDF Red-3, Agrifound Light Red and KP Onion. Comparable evaluations of onion varieties for productivity performance were reported by Hiremath *et al.*, (2020) [2].

Hence, it may be concluded that the adoption of NHRDF Fursungi during the *kharif* season can substantially enhance the yield potential of onion, enabling farmers to achieve significantly higher productivity and profitability.

**Table 1:** Details of varieties evaluated during *kharif*

| S. No. | Technological Options      | Entries             | Source           | Year of release |
|--------|----------------------------|---------------------|------------------|-----------------|
| 1.     | TO 1: Farmers Practice     | KP Onion            | Local land race  | -----           |
| 2.     | TO 2: Recommended practice | NHRDF Fursungi      | NHRDF, New Delhi | 2022            |
| 3.     | TO 3: Recommended practice | NHRDF RED – 3       | NHRDF, New Delhi | 2021            |
| 4.     | TO 4: Recommended practice | Agrifound light red | NHRDF, New Delhi | 2000            |

**Table 2:** Scale of categorizing the varieties against the stemphylium blight in onion

| Score | Disease severity (%) | Disease reaction            |
|-------|----------------------|-----------------------------|
| 0     | < 5                  | Immune (I)                  |
| 1     | 6 – 10               | Resistant (R)               |
| 2     | 11 – 20              | Moderately Resistant (MR)   |
| 3     | 21 – 40              | Moderately Susceptible (MS) |
| 4     | 41 – 60              | Susceptible (S)             |
| 5     | > 60                 | Highly Susceptible (HS)     |

**Table 3:** Scale for categorizing the varieties against the purple blotch of onion

| S. No. | Percent leaf area covered | Grade (X) |
|--------|---------------------------|-----------|
| 1      | 2                         | 0         |
| 2      | 1                         | 1         |
| 3      | 2 – 10                    | 3         |
| 4      | 11 – 25                   | 5         |
| 5      | 26 – 50                   | 7         |
| 6      | 50 >                      | 9         |

**Table 4:** Biometric parameters of different varieties of onion in the trial

| Technology Options |                                   |           |           |       |                |           |       |               |           |       |                     |           |       |
|--------------------|-----------------------------------|-----------|-----------|-------|----------------|-----------|-------|---------------|-----------|-------|---------------------|-----------|-------|
| S. No.             | Parameters                        | KP Onion  |           |       | NHRDF Fursungi |           |       | NHRDF RED – 3 |           |       | Agrifound light red |           |       |
|                    |                                   | 2022 – 23 | 2023 – 24 | Mean  | 2022 – 23      | 2023 – 24 | Mean  | 2022 - 23     | 2023 – 24 | Mean  | 2022 – 23           | 2023 - 24 | Mean  |
| 1                  | Plant height (cm)                 | 49.67     | 50.78     | 50.22 | 52.19          | 55.76     | 53.97 | 48.74         | 46.12     | 47.43 | 40.81               | 45.74     | 43.27 |
| 2                  | No. of leaves plant <sup>-1</sup> | 4.89      | 5.12      | 5.00  | 5.88           | 6.16      | 6.02  | 3.41          | 4.19      | 3.80  | 5.10                | 5.35      | 5.22  |
| 3                  | Pseudostem length (cm)            | 3.56      | 3.81      | 3.68  | 5.45           | 5.67      | 5.56  | 4.86          | 4.91      | 4.88  | 4.26                | 5.72      | 4.99  |
| 4                  | Leaf diameter (cm)                | 1.12      | 1.05      | 1.08  | 1.25           | 1.48      | 1.36  | 1.74          | 1.28      | 1.51  | 1.45                | 1.98      | 1.71  |
| 5                  | Polar diameter (mm)               | 34.21     | 32.82     | 33.51 | 48.15          | 44.29     | 46.22 | 42.68         | 44.76     | 43.72 | 38.54               | 40.55     | 39.54 |
| 6                  | Equatorial diameter (mm)          | 32.18     | 34.77     | 33.47 | 50.28          | 48.45     | 49.36 | 44.32         | 45.58     | 44.95 | 48.66               | 40.00     | 44.33 |
| 7                  | Days to harvest (DAT)             | 85        | 95        | 90    | 100            | 105       | 102.5 | 105           | 98        | 101.5 | 110                 | 100       | 105   |

**Table 5:** Yield and Economics of onion in the trial

| Technology Options |                                     |           |           |        |                |           |        |               |           |        |                     |           |        |
|--------------------|-------------------------------------|-----------|-----------|--------|----------------|-----------|--------|---------------|-----------|--------|---------------------|-----------|--------|
| S. No.             | Parameters                          | KP Onion  |           |        | NHRDF Fursungi |           |        | NHRDF RED – 3 |           |        | Agrifound light red |           |        |
|                    |                                     | 2022 – 23 | 2023 – 24 | Mean   | 2022 – 23      | 2023 – 24 | Mean   | 2022 – 23     | 2023 – 24 | Mean   | 2022 – 23           | 2023 - 24 | Mean   |
| 1                  | Total yield (q ha <sup>-1</sup> )   | 105       | 124       | 114.5  | 408            | 391       | 399.5  | 264           | 317       | 290.5  | 277                 | 298       | 287.5  |
| 2                  | Gross cost (Rs ha <sup>-1</sup> )   | 41210     | 47320     | 44265  | 68970          | 71580     | 70275  | 51290         | 53350     | 52320  | 59760               | 48230     | 53995  |
| 3                  | Gross return (Rs ha <sup>-1</sup> ) | 152000    | 212500    | 182250 | 395000         | 405800    | 400400 | 343000        | 298000    | 320500 | 212500              | 245000    | 228750 |
| 4                  | Net return (Rs ha <sup>-1</sup> )   | 110790    | 165180    | 137985 | 326030         | 334220    | 330125 | 291710        | 244650    | 268180 | 152740              | 196770    | 174755 |
| 5                  | B:C ratio                           | 3.68      | 4.49      | 4.08   | 5.72           | 5.66      | 5.69   | 6.68          | 5.58      | 6.13   | 3.55                | 5.07      | 4.31   |

**Table 6:** Reactions of pest and diseases incidence of onion varieties under natural field condition

| Technology Options |                                  |                        |           |       |                      |           |       |                      |           |       |                        |           |       |
|--------------------|----------------------------------|------------------------|-----------|-------|----------------------|-----------|-------|----------------------|-----------|-------|------------------------|-----------|-------|
| S. No.             | Parameters                       | KP Onion               |           |       | NHRDF Fursungi       |           |       | NHRDF RED – 3        |           |       | Agrifound light red    |           |       |
|                    |                                  | 2022 - 23              | 2023 – 24 | Mean  | 2022 - 23            | 2023 – 24 | Mean  | 2022 – 23            | 2023 - 24 | Mean  | 2022 – 23              | 2023 - 24 | Mean  |
| 1                  | Thrips incidence (%)             | 15.44                  | 15.96     | 15.70 | 12.38                | 12.93     | 12.65 | 14.22                | 14.77     | 14.49 | 15.78                  | 14.91     | 15.34 |
| 2                  | Purple Leaf blotch incidence (%) | 39.28                  | 35.64     | 37.46 | 25.27                | 28.37     | 26.82 | 28.43                | 29.72     | 29.07 | 31.23                  | 30.44     | 30.83 |
| 3                  | Stemphylium blight (%)           | 41.55                  | 40.39     | 40.97 | 18.28                | 19.53     | 18.90 | 19.66                | 20.11     | 19.88 | 27.32                  | 29.67     | 28.49 |
| 4                  | Reaction to Stemphylium blight   | Moderately susceptible |           |       | Moderately resistant |           |       | Moderately resistant |           |       | Moderately susceptible |           |       |

**Table 7:** Varietal performance and farmers feedback on various characters of onion

| S. No. | Variety             | Size | Shape | Colour | Skin | Yield | Market preference | Availability of seeds | Total points | Ranking |
|--------|---------------------|------|-------|--------|------|-------|-------------------|-----------------------|--------------|---------|
| 1      | KP Onion            | 3    | 4     | 3      | 4    | 5     | 4                 | 2                     | 25           | III     |
| 2      | NHRDF Fursungi      | 1    | 1     | 1      | 1    | 1     | 1                 | 5                     | 11           | I       |
| 3      | NHRDF RED – 3       | 2    | 3     | 1      | 2    | 2     | 2                 | 2                     | 14           | II      |
| 4      | Agrifound light red | 2    | 3     | 1      | 2    | 2     | 2                 | 2                     | 14           | II      |

Preference scale: 1- 6 (1 – highest preference and 6 – lowest preference)

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