



**38<sup>th</sup>**

# Annual Report

**2015-16**



**National Horticultural Research and Development Foundation**

**New Delhi**





**38<sup>th</sup>**

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***National Horticultural Research and Development Foundation***

*New Delhi*

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*Acting Director*  
National Horticultural Research and Development Foundation  
"Bagwani Bhavan", 47, Pankha Road, Institutional Area  
Janakpuri, New Delhi - 110058

Phones : (011) 28524150, 28522211  
Telefax : (011) 28525129  
E-mail : delhi@nhrdf.com  
Website : www.nhrdf.com

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*Editor in Chief* : Dr. P.K. Gupta, Acting Director

*Editorial Board* : Dr. R.K. Singh, Assistant Director  
Dr. R.C. Gupta, Assistant Director  
Sh. H.P. Sharma, Dy. Director  
Dr. S.K. Singh, Dy. Director  
Mr. Ramesh Babu P.K., Assistant Director

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# Contents

	Page
<b>PREFACE</b>	vii
<b>1. Introduction</b>	1
<b>2. The Mandate</b>	2
<b>3. Infrastructure</b>	3
<b>4. Executive Summary</b>	5
<b>5. The Recommendations</b>	6
<b>6. Committees</b>	11
Managing Committee	11
Advisory Committee	11
NHRDF Award 2015	11
<b>RESEARCH ACHIEVEMENTS</b>	13
<b>7. Field Studies</b>	14
I. Onion	14
A. Plant Genetic Research & Crop Improvement	14
B. Crop Production System Management	16
C. Plant Health Management	17
D. Pest Harvest Management	21
II. Garlic	23
A. Plant Genetic Research and Crop Improvement	23
B. Crop Production System Management	23
C. Plant Health Management	24
D. Pest Harvest Management	26
III. Frenchbean	27
IV. Cowpea	27
V. Chilli	27
VI. Okra	27
<b>8. Laboratory Studies / Services</b>	28
i. Bio-control Laboratory	28
ii. Entomology Laboratory	28

iii. Geo-Informatics Laboratory	29
iv. Mushroom Spawn Production Laboratory	34
v. Pesticide Residue Analysis Laboratory	34
vi. Plant Pathology Laboratory	35
vii. Plant Physiology Laboratory	35
viii. Seed Testing Laboratory	35
ix. Soil Testing and Biochemistry Laboratory	35
<b>9. Agricultural Economics</b>	<b>37</b>
i. Cost of Production	37
ii. Area and Production of Onion, Garlic and Potato	37
iii. Export of Onion, Garlic And Potato	37
<b>10. Projects Implemented</b>	<b>38</b>
<b>11. Transfer of Technology</b>	<b>39</b>
i. Extension	39
ii. Visit	39
iii. Training	41
<b>12. Production and Distribution of Seed and Planting Material</b>	<b>49</b>
<b>13. Administration and Accounts</b>	<b>50</b>
<b>ANNEXURES</b>	
<b>Annexure I : Cost of Production of Onion &amp; Garlic in different States</b>	
Table 1. Cost of production of common onion bulb during <i>kharif</i>	52
Table 2. Cost of production of common onion bulb during <i>rabi</i>	53
Table 3. Cost of production of onion seed during <i>rabi</i>	54
Table 4. Cost of production of garlic	55
<b>Annexure II</b>	
Table 1. State wise area, production and productivity of onion	56
Table 2. State wise area, production and productivity of garlic	57
Table 3. State wise area, production and productivity of potato	58
<b>Annexure III</b>	
Table 1. Month-wise export of onion	59
Table 2. Month-wise export of garlic	59
Table 3. Month-wise export of potato	60
<b>Annexure IV : NHRDF Publications</b>	<b>61</b>
i. Research Papers	61
ii. Popular Articles/Abstracts	61
iii. Books	61

iv. Technical Bulletins	61
v. Regular Publications	62
vi. DVDs	62
vii. Extension Leaflets	62
<b>Annexure V : Members of Managing Committee</b>	64
<b>Annexure VI : Members of Advisory Committee</b>	65
<b>Annexure VII : Officers and Staff of NHRDF</b>	66
<b>Annexure VIII : NHRDF Centres</b>	71
<b>Annexure IX : Finance &amp; Account</b>	74
<b>Table 1.</b> Income & Expenditure Account (Research & Development)	74
<b>Table 2.</b> Income & Expenditure Account (Seed)	76
<b>Table 3.</b> Statement of Affairs for the year ended 31st March, 2016	77
<b>Annexure X : Meteorological Data</b>	79
<b>Acronyms</b>	80
<b>COLOUR PLATES</b>	
<b>Colour Plates 1 :</b> Onion genotypes under AINRPOG testing	8
<b>Colour Plates 2 :</b> Garlic genotypes under AINRPOG testing	9
<b>Colour Plates 3 :</b> Released Garlic and onion varieties	10
<b>Colour Plates 4 :</b> National and State level Seminars	43
<b>Colour Plates 5 :</b> Trainings imparted to Agriculture/ Horticulture officials and Farmers	45
<b>Colour Plates 6 :</b> NHRDF Centres participated various Agricultures Horticultural Exhibition through its Stall and shown activities to Farming Community	47
<b>Colour Plates 7 :</b> Higher officials visit to NHRDF, Nashik	48





# Preface

It is a matter of great privilege to present the 38<sup>th</sup> Annual Report of the National Horticultural Research and Development Foundation (NHRDF) for the year 2015-16. This report includes research and development activities carried out in the field and laboratories, seed production & its distribution and project implementation.



During this year one onion variety NHRDF-Red-4 (L-744) and one garlic variety Yamuna Safed-9 (G-386) were released by the central sub committee on crop standard notification and release of varieties of horticultural crops, Department of Agricultural Cooperation & Farmer Welfare, Ministry of Agriculture and Farmers Welfare, Government of India for zone-II (Jammu & Kashmir, Punjab, Delhi, Haryana & Rajasthan) and zone-III (Uttar Pradesh, Bihar, West Bengal & Imphal), respectively. This year NHRDF has conducted trials on different crops under All India Co-ordinated Research Project on Vegetable Crops (AICRP-VC) and All India Network Research Project on Onion and Garlic (AINRPOG) undertakes on various aspects viz. Plant Genetic Resources and Crop Improvement, Crop Production System Management, Plant Health Management, Post Harvest Management as well as Seed Production Technology on Onion, Garlic, Potato, Okra, Tomato, Chilli etc. The quality seed of improved and notified varieties of vegetable crops especially Onion, Garlic, Potato, Drumstick, Chilli, Tomato, Okra, Cowpea, Clusterbean etc. were produced and distributed to farming community of this country.

NHRDF also imparted training on improved production technology on onion and garlic to Agriculture/Horticulture Officers, Field Functionaries, Farmers of this country as well as SAARC countries. We have successfully executed various projects granted by different agencies all over the country and achieved the targets.

The Scientific Research Advisory Committee, Management Committee of the NHRDF, have been guiding the NHRDF in the right direction which resulted in its substantial progress. I acknowledge the support and guidance of these committees and profusely thank them on behalf of NHRDF. The NHRDF publishes its Annual Report regularly for the purpose of reference, guidance to research & extension workers, policy-planners, horticulture industries and other stake holders especially working on onion & garlic.

I appreciate and complement the publication committee members for their sincere efforts and feel grateful to all scientific, administrative, accounts and personnel staff of the NHRDF for their valuable inputs to bring out this report timely with high quality.

Date : 07 June, 2017

Place : New Delhi

**(Dr. P.K. Gupta)**

Acting Director



# 1. Introduction

The National Horticultural Research and Development Foundation (NHRDF) was established on 03<sup>rd</sup> November 1977 and registered under the 'Societies Registration Act, 1860' XXI at Delhi. The head office and registered office of NHRDF is located at "Bagwani Bhawan", 47, Pankha Road, Institutional Area, Janakpuri, New Delhi. The NHRDF is a voluntary centre of All India Co-ordinated Research Project on Vegetable Crops and All India Network Research Project on Onion and Garlic of the Indian Council of Agricultural Research. It is also a National Level Agency under Mission for Integrated Development of Horticulture, Department of Agriculture Cooperation and Farmer Welfare, Ministry of Agriculture and Farmer Welfare, Government of India, New Delhi.

The NHRDF provides services to the farmers through research and developmental activities such as seed production of different crops especially vegetable crops, vermicompost, biopesticide production and its distribution, and laboratory services. Through these services some revenue is generated to build up revolving fund for further expansion of research and development activities by NHRDF.

The research and developmental programmes were initially started in 1977 onion and later on garlic was included in the mandate crops. In view of vast export potential, the NHRDF has also extended its R&D programmes on some other exportable vegetable crops like okra, tomato, frenchbean, cowpea, chilli, tomato, potato and drumstick.



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## 2. The Mandate

The mandate of the NHRDF is to:

- Undertake / conduct research or provide facilities in research and scientific investigations for the growth and development of varieties of different export-oriented horticultural crops.
- Establish institutes, laboratories, research centres, model farms, and study teams for promoting better quality and higher yield of horticultural produce, better packaging, suitable transportation and shipping to improve the shelf-life of the produce as also to conduct experiments and provide funds for such research work and to educate farmers and disseminate technical know-how and results derived by conducting training programmes, seminars, farmers' meets *etc.*
- Investigate and conduct research experiments for assessing demands of the horticultural produce of the Indian origin in foreign countries by conducting extensive survey and undertake research and development of horticultural produce with export potential and to motivate farmers to grow such varieties of horticultural produce with the object of further developing horticultural exports from India.
- Prepare, edit, print, publish and circulate books, research papers and periodicals bearing upon the growth and development of horticultural produce or other scientific and research activities connected therewith, and to establish and maintain collections, libraries, statistics, scientific data and other information relating thereto.
- Conduct all aspects of scientific research and developmental activities in the field of horticulture or otherwise conducive to the objectives of the NHRDF provided that none of the activities of NHRDF will be undertaken for profit nor shall it involve any profit motive. However, the NHRDF may receive nominal service charges, wherever found necessary in the interest of maintaining financial stability of the NHRDF
- The NHRDF shall provide extended services to the farmers in the form of research and developmental activities such as seed development, vermicomposting, bio-pesticide production and distribution and other laboratory services for which NHRDF may collect revenue from the farmers so as to establish a revolving fund or credit to corpus fund for further expansion of research and developmental activities.

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### 3. Infrastructure

To fulfill its mission and vision, the NHRDF has created necessary infrastructural facilities to carry out the field and laboratory studies. It has established research stations and extension centres in different states of the country. Presently, NHRDF has 4 Regional Research Stations (RRSs) and 17 Extension Centres (ECs) all over the country. The RRSs are located in Maharashtra, Haryana, Tamil Nadu and Odisha. Whereas the ECs are located in main onion and garlic growing pockets of the country.

The Plant Pathology, Entomology, Plant Physiology, Soil Testing and Biochemistry laboratories are established at Chitegaon Phata, Nashik and Karnal; Laboratories for Pesticides Residue Analysis, Geo informatics Laboratory, and Seed Testing have also been established at Chitegaon Phata, Nashik (Maharashtra). The Pesticide Residue Analysis Laboratory has been accredited by the National Accreditation Board for Testing and Calibration of Laboratories (NABL) and approved by APEDA, AGMARK and monitored by National Referral Laboratories of Indian Council of Agriculture Research (NRI-CAR), National Research Centre of Grape (NRC), Pune.

One Model Post-Harvest Research Complex at Lasalgaon, Nashik having 10 handling sheds of 100 tonnes capacity each and 20 modern storage godowns of 50 tonnes capacity each have been



*Regional Research Station, Chitegaon Phata, Nashik*



*Head office, New Delhi*

established by the NHRDF for training and providing infrastructural support to onion growers, traders and exporters on post-harvest management of onion. The garlic storages have been constructed at Karnal and Indore for storage of garlic seed bulbs. The onion storage structures are constructed at





*Krishi Vigyan Kendra, New Delhi*

RRS, Sinnar and Chitegaon in Maharashtra and Ujwa, Najafgarh in Delhi for storage of onion bulbs. The NHRDF has established seed processing units and temperature and relative humidity controlled seed storage facilities at Lasalgaon, Chitegaon Phata, Nashik, Karnal, Indore, Rajkot and Delhi. The seed processing and seed storage facilities have also been established at Deoria (Uttar Pradesh) and Kurnool (Andhra Pradesh).



*Regional Research Station, Karnal*

The Bio-Control Laboratory has been established at Chitegoan Phata, Nashik under National Horticulture Mission, Govt. of India where large scale production of *Trichoderma viride*, SNPV, *Beaveria basiana* is taken for distributions to the farmers under plant protection services to control pest under organic farmers. The mushroom spawn production unit at Janakpuri and pastuarized compost unit at KVK, Ujwa, Najafgarh, New Delhi has been established by NHRDF to extend services to the farmers and entrepreneurs.

The NHRDF has also established one Krishi Vigyan Kendra at Ujwa, Nazafgarh, Delhi to cater to the need of the farmers of Delhi State and is fully sponsored by ICAR, Department of Agriculture Research and Education (DARE), Ministry of Agriculture & Farmer's Welfare, Govt. of India



*Extension Centre, Indore*

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## 4. Executive Summary

The national scenario of onion and garlic production has shown a considerable increase during the past 39 years after the inception of NHRDF in 1977. The research and developmental programmes were initially started on onion and later on garlic was included in its mandate. In view of the vast export potential, the NHRDF has extended its research and development programmes on other export-oriented horticultural crops. During 2015-16, the research and developmental work was carried out on onion, garlic, potato, okra, frenchbean, tomato, chilli and cowpea etc.

The studies were undertaken for evaluation of onion germplasm, varietal trials, promising lines of red and white onion, bolting behaviour, late *kharif* onion evaluation and exotic onion hybrids under the Plant Genetic Resources and Crop Improvement programme. The research trials were conducted on time and method of planting/transplanting, nutrition, weed control and drip irrigation on onion under Crop Production System Management. The management of diseases, insect and integrated pest management were conducted under Plant Health Management. Storage studies on onion and garlic in different experiments were carried out under Post Harvest Management.

Similarly in garlic, studies were undertaken on evaluation of germplasm, varietal trials, advance lines of garlic under Plant Genetic Resources and Crop Improvement. Nutritional aspects were studied in Crop Production System Management and different promising lines of garlic were screened against diseases and thrips under Plant Health Management. Storage of garlic was studied under Post Harvest Management.

Studies were also taken up on pest control in okra under Plant Health Management, and varietal trials in frenchbean under Plant Genetic Resources and Crop Improvement during the period. Nutrient management and seed production of cowpea were also taken up under Crop Production System Management.

The NHRDF is involved in quality seed production and distribution of improved varieties as a part of developmental activities since its inception, with a view to serve the farming community closely. A total of 27,53,752.33 kgs seeds of improved varieties of different vegetables & spices crops, alongwith paddy, wheat, soybean and maize were distributed during the year 2015-16. The programmes of different projects namely National Horticulture Mission; Effect of Micronutrients on quality and yield of Horticultural Crops especially on onion and garlic under ICAR-IIHR; CHAMAN (Coordinated Programme on Horticulture Assessment and Management using geoinformatics) and Krishi Vigyan Kendra have been successfully implemented during 2015-16.

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## 5. The Recommendations

The NHRDF conducted need-based and location specific research for 2-3 consecutive years and thereafter the field trials exhibiting consistent results and similar trends were discussed finally in the Scientific Advisory Committee Meeting thoroughly twice in a year, before making the recommendations to the farmers and other stakeholders. The findings of the trials concluded at different Regional Research Stations of NHRDF during *kharif* 2015 and *rabi* 2015-16 at Nashik and Karnal are given here in brief :

### Onion

- Soil application of N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O (120:50:50), 50% N as basal, 25% at 20 DAP & 25% at 30 DAP performed better in terms of growth, yield and highest net return in *kharif* onion variety Agrifound Dark Red produced through bulblets and the same recommended under Nashik conditions of Maharashtra.
- The suitable time of bulblet planting of *kharif* onion variety Agrifound Dark Red is 15<sup>th</sup> August with soil application of half the recommended dose of NPK *i.e.* 75:25:25 + 20 t FYM + Azotobacter 10 kg + PSB 10 kg per ha + S @ 45 kg through gypsum + water soluble K (available in market) @ 2% as spray at 15, 30 & 45 days after planting gave better growth, yield and the highest net return and recommended to the farmers of Karnal, Haryana.
- Sprays of Cymoxanil + Mancozeb @ 0.25% at appearance of disease and subsequently at 15 days' intervals were adjudged better for management of stemphylium blight disease with lowest intensity and higher yield of onion variety Agrifound Dark Red during *kharif* season and it was at par with spray of Mancozeb @ 0.25% with higher net return. The same is recommended for the farmers of Karnal, Haryana.
- A better management of stemphylium blight and purple blotch diseases with highest gross and marketable yield and net return was recorded in spray of Propineb @ 0.25% and it was at par with spray of mancozeb @ 0.25% in onion variety Agrifound Dark Red. The same is recommended for Nashik, Maharashtra and Karnal, Haryana during *kharif* season.
- Integrated nutrient management on cowpea variety Kashi Kanchan revealed that application of poultry manure @ 2.5 t/ha + half NPK through fertilizers performed superior in terms of growth, yield and highest net return and recommended under Karnal, Haryana.
- Oxyphosphil @ 150 g a.i./ha + one hand weeding in cowpea variety CP-4 performed better by recording higher green pod yield and net return followed by pendimethaline @ 1 kg a.i./ha + one hand weeding under Karnal, Haryana during *kharif* season.
- Soil application of N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S @ 80:50:65:30 kg/ha along with foliar spray of humic acid @ 7.5 l/ha at 45 & 55 days after transplanting on onion variety NHRDF-Red-2 and NHRDF Red gave highest gross and marketable yield as well as highest Cost: Benefit ratio. The same recommended for Nashik, Maharashtra and Karnal, Haryana.



- Basal application of Chlorantraniliprole 0.4% @10.0 kg /ha followed by Fipronil @ 0.1%, Carbosulfan @ 0.2%, Profenofos @ 0.1% and Spinosad @ 0.03% sequential spray at 10 days interval starting from thrips appearance in onion. The same is recommended to the farmers of Nashik, Maharashtra.

## Garlic

- Soil application of *Pseudomonas fluorescens*

@ 5 kg/ha and foliar sprays of Pyraclostrobin 5% + Metiram 55% @ 0.25% was adjudged overall better for management of stemphylium blight in garlic followed by sprays of Mancozeb @ 0.25% at 30, 60 and 90 DAP. However, the higher cost benefit ratio (1:10.01) was recorded with spray of mancozeb @ 0.25% of low cost of this fungicide. The same could be recommended to the growers of Nashik, Maharashtra.

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**Colour Plate No. 1 :**  
**Onion genotypes under AINRPOG testing**



*L - 819*



*L - 863*



*L - 883*



*L - 857*

**Colour Plate No. 2 :**  
**Garlic genotypes under AINRPOG testing**



G-417



G-404



G-304



G-363



**Colour Plate No. 3 :**

**Garlic and onion varieties released through Central Sub Committee  
Crop Standard Notification and Release of Varieties of Horticulture Crops,  
Department of Agriculture Cooperation & Farmers Welfare, Ministry of  
Agriculture & Farmer Welfare, Govt. of India**



*Yamuna Safed-9 (G-386) released for Zone-II (Jammu & Kashmir, Punjab, Delhi, Haryana and Rajasthan)*



*NHRDF-Red-4 (L-744) released for Zone-III (Uttar Pradesh, Bihar, West Bengal and Imphal)*

## 6. Committees

### Managing Committee

The management of NHRDF vests in the Managing Committee consisting of 4 representatives from NAFED, 9 from Associate Shippers, 4 eminent horticultural scientists and Director, NHRDF as Member Secretary. The list of the Managing Committee Members is given in Annexure VI.



*154<sup>th</sup> Managing Committee meeting*



*73<sup>rd</sup> Scientific Advisory Committee meeting*

### Advisory Committee

The NHRDF has a Scientific Advisory Committee chaired by Deputy Director-General (Horticulture Science), ICAR New Delhi. It consists of eminent horticultural scientists from different institutes of ICAR and State Agricultural Universities (SAUs) in the respective disciplines as Members and Director NHRDF as Member Secretary. This committee meets twice in a year to review the research and development

programmes. This committee also discuss and decide the future technical programmes for *kharif* and *rabi* seasons. The list of members of the Advisory Committee is given in Annexure VII.

### NHRDF Award 2015 conferred to Dr. K.E. Lawande

The first NHRDF Award for Outstanding Research in onion and garlic started by National Horticultural Research and Development Foundation to recognize outstanding contribution in onion and garlic was presented to Dr. K.E. Lawande. The award was given by Dr. Trilocham Mohapatra, Secretary-DARE,

Director General, ICAR, New Delhi on 10<sup>th</sup> May 2016 on the occasion of 34<sup>th</sup> Group Meeting of All India Coordinated Research Project on Vegetable Crops at ICAR-IARI. Dr. K.E. Lawande is Ph.D. in Horticulture and worked in various positions in Agriculture universities and ICAR Institutes and has 24 years teaching experience, in addition to guiding several students of M.Sc. (Agri.) and Ph.D. In his illustrious career, Dr. Lawande worked as Senior Vegetable Breeder in MPKV Rahuri, as Director, DOGR



*Dr. K.E. Lawande (second from left) receiving the NHRDF Award 2015 by Secretary of DARE, Ministry of Agriculture & Farmers Welfare and Director General, ICAR, New Delhi*

(erstwhile NRC for O&G) and as Vice Chancellor of Dr. BSKKV, Dapoli. Dr. Lawande is credited with development and release of 17 varieties of different vegetable crops during 30 years' research in MPKV, Rahuri and ICAR-DOGR, which includes 8 onion and 3 garlic varieties. Dr. Lawande was responsible for developing and disseminating the technologies for use of micro irrigation in vegetable crops which saves water by 40%, labour and fertilizers by 30% and increases yield by 15-20%. He has also developed onion grader and improved onion storage for use of onion farmers.

This award is primarily meant for onion and garlic scientists making outstanding contribution in any discipline of onion and garlic research. The award consists of Rs. 11,000 in cash and a citation.

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# *Research Achievements*



# 7. Field Studies

## I. Onion

### A. Plant Genetic Resources and Crop Improvement

#### *Kharif 2015*

- *Collection, evaluation and utilization*

To select the high yielding varieties over checks, 110 genotypes were evaluated at RRS, Nashik. Among the all genotypes, highest gross yield (253.44 q/ha) and marketable yield (241.11 q/ha) were recorded in collection-863, however among the checks, the highest gross yield (211.11 q/ha) and marketable yield (193.06 q/ha) in Agrifound Dark Red. Maximum TSS (12.68%) in collection-432 and it was at par with collection-581 and 880. The variety release index showed collection-863 getting the highest index value of 14.62 followed by collection-883 (1.80).

- *Varietal Trial (IET)*

The highest gross yield (232.53 q/ha) and marketable yield (226.57 q/ha) were recorded in ON-15-13 and it was at par with ON-15-32. TSS showed non-significant differences among the different lines. The variety release index showed that the line ON-



15-13 got highest index value of 8.60 at Nashik. At Karnal the significantly highest gross yield (238.23 q/ha) and marketable yield (203.31 q/ha) in ON-15-21, maximum TSS (11.94%) in ON-15-27 and it was at par with ON-15-18, ON-15-32, ON-15-45 and ON-15-48. The variety release index showed ON-15-21 getting highest index value of 12.59.

- *Varietal Trial (AVT-I)*

The highest gross yield (236.67 q/ha) and marketable yield (224.89 q/ha) were recorded in the case of ON-14-04 and it was at par with ON-14-15. The variety release index showed ON-14-04 getting the highest index value of 10.91 followed by ON-14-15 (7.34). At Karnal, the highest gross yield (198.81 q/ha) and marketable yield (148.68 q/ha) in Agrifound Dark Red and it was at par with ON-14-04, ON-14-13 and ON-14-23. Maximum TSS (10.83%) in ON-14-09, ON-14-11, ON-14-13 and ON-14-27. All lines showed negative index values.

- *Varietal Trial (AVT-II)*

At Nashik, the highest gross yield (238.10 q/ha) and marketable yield (229.63 q/ha) were recorded in OSK-1320. Highest index value (5.59) was noted in line OSK-1320. At Karnal, the highest gross yield (189.68 q/ha) and marketable yield (148.94 q/ha) in check Agrifound Dark Red. The highest TSS (11.83%) in OSK-1314 and it was at par with OSK-1310. The variety release index showed negative values for all lines.

- *Hybrid varietal trial (AVT-II)*

The highest gross yield (219.70 q/ha) and marketable yield (213.13 q/ha) were recorded in Agrifound Dark Red and it was at par with OSK-1332 and OSK-1339 in respect of gross yield. The TSS showed non-significant differences. The variety release index showed hybrid Arka Kirtiman getting the highest



value of 16 followed by Arka Lalima with 11.64 at Nashik. At Karnal, the highest gross yield (181.22 q/ha) and marketable yield (136.24 q/ha) in Agrifound Dark Red and it was at par with OSK-1335 in respect of gross yield. Highest TSS (11.83%) in OSK-1339 that was at par with OSK-1327. The variety release index showed negative values for all lines.

### **Rabi 2015-16**

- **Collection, evaluation and utilization**

To select the best variety, 115 genotypes were evaluated at RRS Nashik. The highest gross yield (394.74 q/ha) and marketable yield (382.30 q/ha) were recorded in collection-846 followed by 866 (384.67 q/ha & 376.93 q/ha), 703 (379.71 q/ha & 369.57 q/ha) and 848 (377.14 q/ha & 363.81 q/ha). Highest TSS (13.72%) in collection-791 followed by collection-828 (13.44%), 800 (13.16%) and 854 (13.04%).

- **Varietal Trial (IET)**

The highest gross yield (374.54 q/ha) and marketable yield (349.85 q/ha) were recorded in ON-15-37. Highest TSS (15.09%) and dry matter content (16.11%) in ON-15-04 at Nashik. At Karnal, the highest gross yield (211.52 q/ha) and marketable yield (159.33 q/ha) in ON-15-04 and ON-15-37, respectively and these were at par with ON-15-16 and ON-15-18 in respect of marketable yield. Highest TSS (13.20%) in ON-15-06 and it was at par with ON-15-04.

- **Varietal Trial (AVT-I)**

At Nashik, the highest gross yield (379.63 q/ha) and marketable yield (359.83 q/ha) were recorded in ON-14-11. Highest TSS (14.29%) and dry matter content (15.61%) in ON-14-17 and these were at par with ON-14-09, ON-14-25, NHRDF-Red-2, Agrifound Light Red and Arka Kirtiman in respect of TSS, while ON-14-09, ON-14-25, NHRDF-Red-2 Agrifound Light Red and Arka Kirtiman regarding dry matter content. At Karnal, the highest gross yield (111.48 q/ha) and marketable yield (102.00 q/ha) in entry ON-14-25. The TSS exhibited non-significant differences.

- **Varietal Trial (AVT-II)**

The highest gross yield (384.84 q/ha) and marketable yield (368.63 q/ha) were recorded in NHRDF-

Red-4 and it was at par with OSR-1344 regarding marketable yield. Highest TSS (16.97%) and dry matter content (18.41%) in ASRO-1213 at Nashik. At Karnal, the highest gross yield (177.93 q/ha) and marketable yield (164.33 q/ha) in OSR-1347. The TSS showed non-significant differences.

- **Varietal trial hybrid (AVT-II)**

The highest gross yield (387.15 q/ha) and marketable yield (368.29 q/ha) were recorded in OSR-1370 and it was at par with NHRDF-Red-2. Highest TSS (14.28%) and dry matter content (15.92%) were recorded in Arka Kirtiman and it was at par with OSR-1367, OSR-1379, OSR-1381, Arka Lalima, NHRDF-Red-2 and Agrifound Light Red in respect of TSS, and OSR-1367, OSR-1381, Arka Lalima and NHRDF-Red-2 regarding dry matter at Nashik. At Karnal, the highest gross yield (137.30 q/ha) and marketable yield (130.81 q/ha) in OSR-1372 and OSR-1377, respectively and these were at par with OSR-1377 and OSR-1381 in respect of gross yield, and with OSR-1372 regarding marketable yield. The highest TSS (11.33%) was recorded in OSR-1372.

- **Advance lines of white onion**

At Nashik the highest gross yield (353.40 q/ha) and marketable yield (335.65 q/ha) were recorded in line-830 and these were at par with line-869. Highest TSS (15.96%) and dry matter content (17.55%) in Agrifound White and these were at par with lines-424, 784, 798, 810, 838, and 865 in respect of TSS, while being at par with lines-424, 784, 798, 810, 838 and 865 regarding dry matter content. The highest index values (5.28) was recorded in L-830 followed by L-874 (4.17). At Karnal, the highest gross yield (174.41 q/ha) and marketable yield (154.19 q/ha) in line-865 and 830, respectively and these were at par with line-830 in respect of gross yield. Highest TSS (12.75%) it was recorded in line-836 and it was at par with lines-784, 793, 798, 799, 810, 838 and Agrifound White. The highest index value (39.17) was recorded in L-874, followed by L-501 (38.05).

- **Advance lines of red onion**

At Nashik, the highest gross yield (383.68 q/ha) and marketable yield (370.95 q/ha) were recorded in line-683. Highest TSS (15.60%) and dry matter

content (16.65%) in line-735. Highest index value (5.44) was recorded in L-683 followed by L-752 (2.43). At Karnal, the highest gross yield (183.50 q/ha) and marketable yield (170.28 q/ha) in NHRDF-Red and line-683, respectively and these were at par with line-683, 753 and NHRDF-Red-3 in respect of gross yield. However, line-753, NHRDF-Red-3 and NHRDF-Red were also at par regarding marketable yield. Highest TSS (12.22%) in line-735 and it was at par with lines-581, 653, 682, 711, 753, 831, 848, 852, Agrifound Light Red and NHRDF-Red-3. The highest index value (16.29) in L-683, followed by NHRDF-Red-3 (15.22).

- **Performance of exotic onion hybrids**

The highest gross yield (406.75 q/ha) and marketable yield (353.17 q/ha) were recorded in Early Grano and it was at par with Arka Lalima, NHRDF-Red-2 and NHRDF-Red-4 in respect of marketable yield. Highest TSS (14.33%) in both Pusa Ridhi and Arka Kirtiman and these were at par with Pusa White Flat, Pusa White Round, Arka Lalima and NHRDF-Red-2 at Nashik. At Karnal, the highest gross yield (189.35 q/ha) and marketable yield (169.12 q/ha) in Onion Hybrid-1 and it was at par with Early Grano. The TSS showed non-significant differences.

- **Evaluation of multiplier onion**

The study revealed the highest gross yield (174.33 q/ha) and marketable yield (105.89 q/ha) in WM-514 and line-1534, respectively and these were at par with line-1534 in respect of gross yield. Highest TSS (15.70%) was recorded in CO-ON-5 and it was at par with lines-1521, 1534, 1535, 1544, 1546, 1549, DOGR-CO-4-1 and WM-514.

## B. Crop Production System Management

### Kharif 2015

- **Efficacy of NPK fertilizers on growth, yield and quality of onion grown from bulbets**

The three years pooled data analysis at Nashik on onion variety Agrifound Drak Red, revealed that soil application of NPK (120:50:50), 50% N as basal, 25% at 20 DAP & 25% at 30 DAP gave the highest yield (106.94 q/ha) with TSS 11.80% at Nashik. It gave 184.53 q/ha yield with 11.40% TSS at Karnal.

- **Effect of different dates of planting and integrated nutrient management on growth, yield and quality through sets**

The pooled data of three consecutive years revealed that the most suitable time of bulblet planting of *khariif* onion variety Agrifound Dark Red was mid August with soil application of half the recommended dose of NPK *i.e.* 75: 25: 25 + 20 t FYM + Azotobacter 10 kg + PSB 10 kg per ha + S @ 45 kg by gypsum + water soluble K (available in market) @ 2% at 15, 30 & 45 days after planting which gave better growth, yield (141.69 q/ha) and highest net return (1.31) at Karnal, Haryana.

- **Weed management**

The results revealed that combined application of oxyflurofen @ 1.0 ml + quizalofop ethyl @ 2.0 ml/l of water at planting and then repeating at 30 DAT efficiently controlled both mono and dicot weed population with better yield (169.50 q/ha) in onion variety Agrifound Dark Red at Nashik.

- **Demonstration of drip irrigation in onion**

Higher 'A' grade (28.97%), and 'B' grade (36.28%) and lower 'C' grade bulb (34.76%) were recorded in drip irrigation system over surface irrigation. The highest gross yield (233.01 q/ha), marketable yield (200.31 q/ha), number of doubles and bolters were recorded in drip irrigation system as compared with flood irrigation with increased yield by 14.27 and 18.30%, respectively.

- **Effect of micronutrients application on onion production**

The study conducted on onion variety Agrifound Dark Red at Nashik revealed that foliar application of micronutrient mixture @ 0.5% at 30 and 45 DAT (composition: Fe-2.5%, B-0.50%, Zn-3.0%, Cu-1.0%, Mn-1.0%) gave higher yield (248.91 q/ha), whereas foliar application of boron @ 0.25% @ 30 & 45 DAT recorded highest Cost: Benefit Ratio (1.00 : 3.24).

- **Studies on morpho-physiological attributes in onion**

The study revealed that maximum dry matter accumulation at 80 DAT occurred due to maximum leaf area and leaf area index. Maximum absolute growth rate occurred at 60 DAT and maximum

relative growth rate and net assimilation rate took place at 20 DAT. The 15th August transplanting gave maximum marketable yield (184.10 q/ha) under Nashik conditions.

### **Rabi 2015-16**

- ***Efficacy of micronutrients on yield and quality of onion seed production***

The study showed that use of 'IIHR vegetable special micronutrient mixture' @ 5 g/l at 30, 60 & 90 DAP performed better in terms of highest leaf area, number of umbels, seed germination, seed test weight and seed yield (44.0% increased over control) at Nashik. At Karnal also, the same micronutrient treatment gave the highest seed yield (12.83% increased over control).

- ***Standardization of transplanting schedule for rabi onion for Zone-V***

The highest bulb yield (296.64 q/ha) was obtained with transplanting done on 1st December with 70% recommended dose of NPK (70:35:35) on onion variety NHRDF-Red-2 at Nashik.

- ***Efficacy of reduced nitrogen, increased potassium and chemical sprays on shelf life***

Three years' pooled data revealed that for better growth and yield of onion variety NHRDF-Red-2, soil application of NPKS @ 80:50:65:30 kg/ha along with foliar spray of humic acid @ 7.5 l/ha at 45 & 55 DAT was superior, as it gave high yield of 287.16 q/ha at Nashik and 294.18 q/ha at Karnal.

## **C. Plant Health Management**

### **Kharif 2015**

- ***Survey and monitoring of major diseases***

The higher intensity of stemphylium blight (9.40%), purple blotch (0.8%) and higher incidence of twister disease (7%) were recorded in onion during October, 2015. Maximum incidence of black mold (24%), and bacterial soft rot (42%) in September, 2015 and bacterial brown rot (8%) in May 2015 was recorded in stored onion bulbs at Nashik. At Karnal, higher intensity of stemphylium blight (28.27%) was recorded in onion crop during December, 2015 whereas maximum incidence of black mold

in onion bulbs (25%) and garlic bulbs (12%) were recorded in storage in October, 2015.

- ***Evaluation of germplasm for disease resistance (IET)***

Different germplasm of onion were evaluated against foliar disease viz. - stemphylium blight, colletotrichum blight, and purple blotch. At Nashik, none of the lines including Agrifound Dark Red was free from stemphylium blight and purple blotch diseases. However, intensity of stemphylium blight ranged from 0.20 to 6.80% and purple blotch intensity varied from 0.20 to 2.80% during the cropping period at Nashik. At Karnal also, none of the lines including Agrifound Dark Red was free from stemphylium blight disease. However, intensity of stemphylium blight ranged from 7.33 to 10.93% during the cropping period.

- ***Evaluation of germplasm for disease resistance (AVT-I)***

The study, revealed that none of the lines including Agrifound Dark Red was free from stemphylium blight and purple blotch diseases. The intensity of stemphylium blight ranged from 0.40 to 8.60% while purple blotch intensity varied from 0.20 to 3.0 during the cropping period at Nashik. At Karnal, intensity of stemphylium blight ranged from 6.90 to 10.13%.

- ***Evaluation of germplasm for disease resistance (AVT-II)***

None of the lines including Agrifound Dark Red was free from stemphylium blight and purple blotch diseases at both places. However, intensity of stemphylium blight ranged from 0.40 to 7.60% and purple blotch from 0.20 to 3.20% during the cropping period at Nashik, while at Karnal, intensity of stemphylium blight ranged from 6.65 to 11.40%.

- ***Evaluation of hybrid lines for disease resistance (AVT-II)***

None of the lines including Agrifound Dark Red was free from stemphylium blight and purple blotch diseases. However, intensity of stemphylium blight ranged from 0.40 to 7.60% and purple blotch from 2.0 to 3.20% during the cropping period at Nashik. At Karnal, intensity of stemphylium blight ranged from 8.30 to 10.83%.

- **Screening of germplasm for thrips resistance (IET)**

The study showed that none of the onion lines including check Agrifound Dark Red were found free from thrips at Nashik, while thrips did not appear at Karnal during cropping period.

- **Screening of germplasm for thrips resistance (AVT-I)**

None of the onion lines including check Agrifound Dark Red was found free from thrips at Nashik while thrips did not appear at Karnal during the observation period.

- **Screening of germplasm for thrips resistance (AVT-II)**

None of the onion lines including check Agrifound Dark Red was found free from thrips at Nashik while thrips did not appear at Karnal during the cropping period.

- **Screening of hybrid lines for thrips resistance (AVT-II)**

The study showed that none of the onion hybrid lines including check Agrifound Dark Red was found free from thrips at Nashik, while at Karnal, thrips did not appear during the cropping period.

- **Collection and identification of insects of onion, garlic and other vegetable crops**

The insects were identified in different crops *i.e.* white fly (*Bemisia tabaci*), Fruit borer (*Helicoverpa armigera*) in tomato, thrips (*Thrips tabaci*), okra jassids (*Amrasca biguttula biguttula*), cowpea pod borer (*Maruca testulalis*) and tobacco caterpillar (*Spodoptera litura*) in onion at Nashik, while at Karnal the insects were identified in different crops *i.e.* chilli mite (*Polyphagotarsonemus sp.*), okra fruit borer (*Earias sp.*), White fly (*Bemisia tabaci*), cowpea pod borer (*Maruca testulalis*), tobacco caterpillar (*Spodoptera litura*), fruit borer (*Helicoverpa armigera*) in onion, tomato Leaf miner (*Liriomyza sp.*), and jassids (*Amrasca biguttula biguttula*) in okra.

- **Effect of climate change on occurrence of foliar diseases and thrips of onion**

The study conducted on onion variety Agrifound Dark Red revealed that stemphylium blight disease

appeared during 38<sup>th</sup> standard week with an intensity of 0.50% in untreated control. The temperature varied from 19.10 to 29.4°C and relative humidity from 66-98%, coupled with 152.30 mm rainfall during the period. Sprays of mancozeb @ 0.25% in combination with fipronil @ 0.1% at 15 days intervals performed superior with lowest intensity of stemphylium blight (3.0%) and purple blotch (0.80%) at Nashik. The thrips appeared on 6<sup>th</sup> September with intensity ranging from 16.05 to 17.55 nymph/plant and 100% incidence was recorded during 36<sup>th</sup> standard week (30.08.2015 to 05.09.2015). The temperature ranged from 17.20 to 29.5°C and relative humidity from 46 to 84% during the period. The lowest thrips population was recorded in the plot where spray of Mancozeb @ 0.25% + Fipronil @ 0.1% was given at 15 days intervals at Nashik.

At Karnal, the study was conducted on onion variety Agrifound Dark Red wherein the stemphylium blight disease was first noticed on 15<sup>th</sup> October 2015, during 42<sup>nd</sup> standard week, with highest disease intensity of 1.63% and incidence 20% in untreated control. The temperature varied from 16.60 to 34°C with relative humidity of 44-81% during the period of 42<sup>nd</sup> standard week (11.10.2015 to 17.10.2015). Sprays of mancozeb @ 0.25% in combination with fipronil @ 0.1% at 15 days intervals performed significantly superior with lowest intensity of stemphylium blight (9.45%). Thrips did not appear during the entire cropping season.

- **Evaluation of fungicides and bio-pesticides for the management of foliar diseases**

The pooled data of three years trial conducted at Karnal on onion variety Agrifound Dark Red revealed that sprays of combined fungicide namely Cymoxanil + Mancozeb @ 0.25% at the time of appearance of disease and subsequently at 15 days intervals proved better for management of stemphylium blight with lowest intensity (7.03%) and increasing the yield as compared to intensity (17.15%) of onion in untreated control. However, the higher cost benefit ratio (1:21.04) was recorded with spray of mancozeb @ 0.25% because of its lower cost.

- **Evaluation of new molecules of mixed fungicides on foliar diseases**

The pooled data of three year trial conducted at Nashik on onion variety Agrifound Dark Red



revealed that significantly lowest intensity (4.0%) of stemphylium blight was recorded with spray of Propineb @ 0.25% as standard check which was found at par with spray of combined fungicide namely Zineb + Hexaconazole @ 0.25%, however, spray of combined fungicide namely Pyraclostrobin + Metiram @ 0.25% and Zineb + Hexaconazole @ 0.25% performed better for management of purple blotch. Significantly highest gross and marketable yield were recorded with spray of Mancozeb @ 0.25% and at par with Propineb @ 0.25%. The higher cost benefit ratio (1:24.64) was recorded with spray of mancozeb @ 0.25% because of its lower cost.

At Karnal, the pooled data of three year trial revealed that significantly lowest intensity (6.30%) of stemphylium blight was recorded in Mancozeb @ 0.25% as well as highest gross and marketable yield and at par with spray of Propineb @ 0.25% at 40 DAT and subsequently at 10 days interval as standard check. The higher cost benefit ratio (1:67.83) was recorded with spray of mancozeb @ 0.25% because of its lower cost.

### **Rabi 2015-16**

- ***Survey and monitoring of major diseases of onion***

The occurrences of major diseases of onion were recorded on the research farm at Chitegaon, Nashik. The data revealed that among the foliar diseases, stemphylium blight (*Stemphyllium vesicarium*) incidence ranged from 22.0 to 43% and the intensity from 2.20 to 12.80% in onion bulbs as well as in seed crop during the cropping period. The higher incidence of stemphylium blight (43.0%) and intensity (4.40%) was recorded in onion bulb crops while the highest incidence (66.0%) and intensity (12.80%) was recorded in the seed crop during March, 2016. The bacterial rotting at bolter initiation stage in onion seed production field was recorded with 4.80% incidence during February, 2016. The Iris Yellow spot virus was recorded with 90% incidence and 48.80% intensity in onion seed crop (cv.-NHRDF Red 2) during March, 2016.

At Karnal, major diseases of onion were recorded at Salaru farm. The study revealed that stemphylium blight disease intensity ranged from 1.28 to 23.75% in onion bulb crop during the cropping period. The

higher incidence of stemphylium blight (100.0%) and intensity (23.75%) was recorded in May, 2016 on the bulb crop.

- ***Evaluation of different onion lines for disease resistance (IET)***

There were fourteen onion lines alongwith check NHRDF Red-2 evaluated at Nashik. The ON15-01 and ON15-20 performed significantly superior with lower intensity (3.40%) of stemphylium blight and it was found at par with ON15-42, while the intensity of stemphylium blight was 6.20% in NHRDF Red-2. At Karnal, the line ON-15-11 performed superior with lower intensity of stemphylium blight (6.20%) and was at par with ON15-01, ON15-04, ON15-16, ON15-18, ON15-20, ON15-27, ON15-37 and ON15-48 and NHRDF Red (7.13%).

- ***Evaluation of onion advance lines for disease resistance (AVT-I)***

Nine onion lines alongwith check NHRDF Red-2 were evaluated wherein ON14-15 performed significantly superior with lower intensity (4.20%) of stemphylium blight and it was found at par with ON14-06, ON14-17 and ON14-27. The intensity of stemphylium blight in NHRDF Red-2 was 6.40% at Nashik while at Karnal, ON14-09 performed superior with lower intensity of stemphylium blight (5.40%) and it was at par with ON14-01, ON14-15 and ON14-25. The stemphylium blight intensity of 6.87% was recorded in NHRDF Red.

- ***Evaluation of onion advance lines for disease resistance (AVT-II)***

Eleven onion lines alongwith check NHRDF Red-2 were evaluated and it was revealed that OSR-1349 performed significantly superior with lower intensity (5.60%) of stemphylium blight and it was par with OSR-1359, 1362 and 1364. The intensity of stemphylium blight recorded in Red-2 was 7.80% while at Nashik. At Karnal OSR-1357 performed superior with lower intensity of stemphylium blight (6.07%) and it was at par with all the lines including NHRDF Red (6.30%) except OSR-1344 and OSR-1364.

- ***Evaluation of different onion hybrid lines for disease resistance (AVT-II)***

Seven onion hybrid lines alongwith check NHRDF Red-2 were evaluated wherein the intensity of

stemphylium blight ranged from 7.40 to 9.20% at Nashik. At Karnal, the study revealed that OSR-1377 performed significantly superior with lower intensity (5.53%) of stemphylium blight and it was at par with OSR-1367, OSR-1370 and OSR-1379 with check variety (7.37%).

- **Screening of different onion lines for thrips resistance**

At Nashik, fourteen onion lines along with the check NHRDF Red-2 were screened and the data revealed thrips foliage damage ranging from 47.20% to 87.0%. The lowest thrips foliage damage (47.20%) was recorded in ON15-13 and the highest (87.0%) in ON15-45 at 75 DAT. At Karnal, thrips foliage damage ranged from 20.0 to 25.6%. The lowest damage (20.0%) was recorded in ON15-48 at 75 DAT and the highest (25.6%) in ON15-06.

- **Screening of different onion lines for thrips resistance (AVT-I)**

Nine onion lines along with the check NHRDF Red-2 were screened. The thrips foliage damage ranged from 31.40 to 79.50%. The lowest damage (31.40%) was recorded in ON14-15 which was at par with ON14-06, and ON14-25. The highest thrips foliage damage (79.50%) was recorded in ON14-01 at Nashik, while at Karnal the damage ranged from 23.20 to 31.47% with the lowest damage being in ON14-11 and ON14-15, and the highest in ON14-06.

- **Screening of different onion lines for thrips resistance (AVT-II)**

Eleven onion lines along with check NHRDF Red-2 were screened at Nashik where the lowest thrips foliage damage (30.40%) was recorded in OSR-1357 which was at par with OSR-1359 (38.20%), and the highest damage (78.60%) was recorded in OSR-1364. At Karnal, the thrips foliage damage ranged from 22.13 to 33.60%, the lowest damage (22.13%) being in OSR-1323 that was at par with OSR-1347 (22.67%), OSR-1349 (22.93%) OSR-1344 (23.20%) and OSR-1357 (26.67%). The highest damage (33.60%) was recorded in OSR-1354.

- **Screening of different onion lines for thrips resistance (AVT-II)**

Seven onion hybrid lines along with the check NHRDF Red-2 were evaluated at Nashik. The results

showed the lowest thrips foliage damage (33.0%) in OSR-1372 which was at par with the NHRDF 2 (36.40%). The highest thrips foliage damage (80.0%) was recorded in OSR-1370. At Karnal revealed that thrips foliage damage ranged from 21.77 to 29.07%, with lowest damage (21.77%) recorded in OSR-1379 and the highest in OSR-1367.

- **Studies on reducing thrips population by optimizing nitrogen and potash levels**

The overall mean values showed the lowest thrips population in zero-nitrogen application. The highest gross yield (389.68 q/ha) and marketable yield (356.64 q/ha) were recorded in 50% of the recommended N through urea and potash through sulphate of potash both as basal application, which was found at par with 75% of the recommended N dose through urea and potash through sulphate of potash both applied as basal.

- **Evaluation of new generation insecticides for management of onion thrips**

Spraying of Spinosad @ 0.3 ml/l significantly reduced thrips population and increases gross yield in onion at Nashik and Karnal.

- **Evaluation of different insecticides against onion thrips in onion seed production**

Based on three years pooled data at Nashik basal application of Chlorantraniliprole 0.4% @10.0 kg/ha followed by spray of Fipronil @ 0.1%, Carbosulfan @ 0.2%, Profenofos @ 0.1% and Spinosad @ 0.03% at 10 days interval starting from appearance of thrips significantly reduced thrips population.

- **Efficacy of pesticides on foliar diseases and incidence of Erwinia rot in onion bulb production and storage**

The sequential sprays of Propineb @ 0.20% at 40 DAT + Chlorothalonil @ 0.25% at 60 DAT + Copper oxychloride @ 0.3% at 80 DAT + Carbendazim @ 0.10% at 100 DAT performed better for management of foliar disease in onion with the lowest intensity (7.80%) of stemphylium blight in comparison to untreated control (11.20%) at Nashik. Similarly at Karnal, sequential sprays of Propineb @ 0.20% at 40 DAT + Chlorothalonil @ 0.25% at 60 DAT + Copper oxychloride @ 0.3% at 80 DAT + Bromopal @ 0.05% at 100 DAT performed

better for management of foliar disease in onion with the lowest intensity (8.45%) of stemphylium blight in comparison to untreated control (19.33%). However, the intensity of Stemphylium blight was at par with all the treatments.

## D. Post Harvest Management

### Plant Genetic Resources and Crop Improvement

#### Rabi 2014-15

- *Storage performance of onion germplasm*

The well cured and representative bulbs of each collection kept for five months on 28/04/2015 at Nashik, the lowest total loss (26.20%) in collection-753 and it was at par with all the collections except collection-359, 407, 411, 628, 704, 772, 807, 812, 819, 823, 824, 828, 834, 837, 846, 849 and 851. Among the checks, Agrifound Light Red and NHRDF-Red-2 recorded the lowest losses (28.67%) after five months of storage.

- *Varietal Trial (IET)*

The well cured and representative bulbs were kept in storage at Nashik on 24/04/2015, and at Karnal on 03/06/2015 for 5 months. At Nashik the check variety NHRDF-Red-2 recorded the lowest total loss (29.38%) and was at par with ON-14-06, ON-14-17, ON-14-25, Agrifound Light Red and NHRDF Red-2, whereas at Karnal the lowest total loss (16.72%) was recorded in ON-14-17 and it was at par with ON-14-06, ON-14-25 and check Agrifound Light Red.

- *Varietal Trial (AVT-I)*

The well cured and representative bulbs were kept in storage at Nashik on 24/04/2015, and at Karnal on 03/06/2015. After 5 months of storage, the lowest total loss (28.10%) was recorded in NHRDF Red-2 at Nashik and it was at par with OSR-1344, OSR-1359, OSR-1362, OSR-1364 and Agrifound Light Red. At Karnal, the lowest total loss (18.46%) was recorded in OSR-1362 and it was at par with OSK-1323, OSR-1359 and OSR-1364.

- *Varietal Trial (AVT-II)*

The well cured and representative bulbs were kept in storage at Nashik on 25/04/2015, and at Karnal on 03/06/2015 for 5 months. At Nashik, the lowest

total loss (26.30%) was noted in ASRO-1207 and it was at par with ASRO-1275 and Agrifound Light Red, while at Karnal, the lowest total loss (19.27%) was recorded in ASRO-1207 and it was at par with ASRO-1201, ASRO-1203, ASRO-1229 and ASRO-1275.

- *Varietal trial hybrid (AVT-I)*

The well cured and representative bulbs were kept in storage for 5 months at Nashik on 25/04/2015, and at Karnal on 06/06/2015. At Nashik, the lowest total loss (28.81%) was recorded in NHRDF Red-2 and it was at par with OSR-1367, OSR-1374, OSR-1377 and Agrifound Light Red, whereas at Karnal, the lowest total loss (19.49%) was recorded in Agrifound Light Red and it was at par with OSR-1372 and OSR-1377.

- *Storage performance of hybrid onion lines (AVT-II)*

The well cured and representative bulbs were kept in storage for 5 months at Nashik on 27/04/2015, and at Karnal on 05/06/2015. The results at Nashik showed the lowest total loss (28.17%) in check Agrifound Light Red and it was at par with ASRO-1217, ASRO-1220, ASRO-1230, ASRO-1289 and ASRO-1291. At Karnal, the lowest total loss (19.14%) was recorded in ASRO-1289.

- *Storage performance of red onion collections for late kharif*

The well cured representative bulbs of 22 collections were kept in storage for three months on 20/02/2015. Among the collections, total lowest loss (15.26%) was recorded in collection-744 and it was at par with all collections except 382, 776, 821 and 819. Among the checks, Agrifound Light Red recorded the lowest total loss (15.56%) and it was at par with Agrifound White, Agrifound Dark Red and NHRDF Red-2.

- *Performance of red advance lines*

The well cured representative bulbs were kept in storage at Nashik on 27/04/2015, and at Karnal on 02/06/2015 each for five months. At Nashik minimum total loss (25.67%) in line-840 and it was at par with 702 and 744, while at Karnal, the minimum total loss (22.16%) was recorded in line-752 and it was at par with line-355 and Agrifound Light Red.

- **Performance of white onion advance lines**

The well cured representative bulbs were kept for storage at Nashik on 28/04/2015 and at Karnal on 02/06/2015 each for five months. At Nashik, the lowest total loss (28.52%) was recorded in line-792. At Karnal, the lowest total loss (24.60%) was noted in check Agrifound White, which was at par with lines-627, 784, 798, 799 and 842.

- **Storage performance of exotic onion hybrids**

The well cured representative bulbs along with two checks Agrifound Light Red and NHRDF-Red were kept in storage for five months on 06/06/2014. The minimum total loss (16.80%) was recorded in Agrifound Light Red and it was at par with Arka Kirtiman at Karnal.

### **Khariif 2015**

- **Storage performance of onion varieties-IET**

The well cured and representative bulbs were kept in storage at Nashik on 05/12/2015 and at Karnal on 21/12/2015 for two months each. Line ON-15-13 exhibited, the lowest total loss (24.34%) and it was at par with ON-15-11 and ON-15-32 at Nashik. At Karnal, the line ON-15-18 exhibited the lowest total loss (55.03%).

- **Storage performance of onion lines-AVT-I**

The well cured and representative bulbs were kept in storage at Nashik on 05/12/2015 and at Karnal on 19/12/2015 for two months each. The line ON-14-04 showed the lowest total loss (24.80%) and it was at par with ON-14-11, ON-14-15, ON-14-23 and ON-14-27 at Nashik. At Karnal, line ON-14-09 showed the lowest total loss (69.40%).

- **Storage performance of onion lines-AVT-II**

The well cured and representative bulbs were kept in storage at Nashik on 06/12/2015 and at Karnal on 19/12/2015 for two months each. The line OSK-1320 recorded the lowest total loss (23.98%) and it was at par with ASKO-1213, OSK-1301 and OSK-1317 at Nashik. At Karnal the lowest total loss (49.60%) was recorded in OSK-1314.

- **Storage performance of onion hybrid lines-AVT-II**

The cured representative bulbs were kept in storage

for two months at Nashik on 06/12/2015 and at Karnal on 18/12/2015. The line OSK-1332 showed the lowest total loss (23.57%) and it was at par with OSK-1325, OSK-1329, and Arka Kirtiman at Nashik. At Karnal, line OSK-1327 showed the lowest total loss (61.20%) and it was at par with OSK-1332, OSK-1337 and OSK-1339.

## **Crop Production System Management**

### **Rabi 2014-15**

- **Effect of micronutrients on storage quality**

The storage trial was conducted to assess the impact of micronutrients application on storage performance of onion variety Agrifound Light Red. The produce was kept for a period of 5 months on 29.04.2015. The pooled data revealed that micronutrient treatments influenced the storage performance of onion. Soil application of boron @ 10 kg/ha performed better as compared with all the other treatments in terms of lowest sprouting loss (8.56%), rotting loss (15.79%), PLW (24.62%) and total loss (48.97%) at Nashik, Maharashtra.

- **Efficacy of reduced nitrogen, increased potassium and foliar sprays on shelf life**

The impact of reduced nitrogen, enhanced potassium and foliar sprays of chemicals on storage performance on onion variety was studied at Nashik on NHRDF Red-2 and at Karnal on NHRDF-Red. The produce was kept for storage on 27.04.2015 at Nashik and on 28.05.2015 at Karnal for 5 months each. The lowest loss due to decay and total loss was recorded in soil application of NPKS @ 60:50:80:30 kg/ha along with foliar spray of calcium chloride @ 5000 ppm at 45 & 60 DAT at Nashik as well as Karnal. Minimum loss due to PLW was recorded in soil application of NPKS @ 80:50:65:30 kg/ha along with foliar spray of calcium chloride @ 5000 ppm at 45 & 60 DAT at Nashik, whereas at Karnal, the minimum PLW in soil application of NPKS @ 60:50:80:30 kg/ha along with foliar spray of calcium chloride @ 5000 ppm at 45 & 60 DAT. However the results for the two stages were at par. Soil application of NPKS @ 80:50:65:30 kg/ha along with foliar spray of calcium chloride @ 5000 ppm at 45 & 60 DAT.



- **Standardization of transplanting schedule for rabi onion under Zone-V**

The onion variety NHRDF Red-2 was kept for storage on 29.04.2015 for a period of 5 months. The study revealed that crop transplanted in December 15<sup>th</sup>, 2014 recorded lowest decay loss (10.83%) and total loss (37.07%) after 5<sup>th</sup> month of storage. However, fertigation level and interaction effects were not significant.

## II. Garlic

### A. Plant Genetic Resources and Crop Improvement

#### Kharif 2015

- **Varietal Trial (IET)**

The field trial conducted at RRS, Nashik and Karnal, revealed that at both places the bulb development and clove separation did not take place in any line.

- **Varietal Trial (AVT-I)**

The field trial was conducted at Nashik and Karnal. At Nashik, the highest gross yield (26.48 q/ha) was recorded in GN-14-01. The clove separation did not take place in entries viz. GN-14-05, GN-14-07, GN-14-09, GN-14-13, GN-14-25, GN-14-27 and Yamuna Safed-3. At Karnal also bulb development and clove separation did not take place in any of the lines.

- **Evaluation of garlic lines-AVT-II**

The field trial was conducted both at Nashik and Karnal. The highest gross yield (39.98 q/ha) and marketable yield (18.61 q/ha) at Nashik were recorded in GKS-1301, While Karnal no bulb development and clove separation took place in any line.

#### Rabi 2015-16

- **Collection, evaluation and utilization**

The trial conducted at RRS Karnal, showed highest gross yield (227.08 q/ha) and marketable yield (227.08 q/ha) in G-392 followed by G-404 (201.39 & 201.39 q/ha), G-397 (180.28 & 180.28 q/ha), G-363 (174.17 & 174.17 q/ha), G-347 (171.04 & 171.04 q/ha), G-176 (150.56 & 150.56 q/ha) and G-14 (149.58 & 149.58 q/ha). The highest TSS (40.00%) was

recorded in G-383, G-331, G-368, G-420, G-415, G-213, G-376, G-241, G-324, G-411, G-25, G-397, G-273, G-343, G-265, G-264, G-425 and G-304 followed by Yamuna Safed-3 (G-282) (39.80%) and G-383, G-405, G-258, G-433, G-401, G-176, G-404, G-394, G-299 and G-73 (39.75%).

- **Varietal Trial (AVT-I)**

At Nashik, the highest gross yield (67.11 q/ha) and marketable yield (54.00 q/ha) were recorded in GN-14-25. The highest total soluble solids (41.80%) and dry matter content (43.07%) were recorded in GN-14-01 and these were at par with GN-14-15, GN-14-27 and Yamuna Safed-3 in respect of total soluble solids, and with GN-14-15 and GN-14-27 w.r.t. dry matter content. At Karnal, the highest gross yield (145.00 q/ha) and marketable yield (145.00 q/ha) were recorded in Yamuna Safed-8. The total soluble solids exhibited non-significant differences.

- **Varital trail (AVT-II)**

At Nashik the highest gross yield (64.50 q/ha) and marketable yield (51.25 q/ha) were obtained in GRS-1328 which was at par with GRS-1345 in respect of marketable yield. The highest total soluble solids (42.10%) and dry matter content (43.48%) were recorded in GRS-1330 and it was at par with Yamuna Safed-3. At Karnal, the highest gross yield (151.16 q/ha) and marketable yield (150.79 q/ha) were recorded in Yamuna Safed-8. The highest total soluble solids (39.67%) was recorded in both the entries i.e. GRS-1328 and GRS-1332 and these were at par with Yamuna Safed-9.

- **Performance of advance lines**

The study conducted at Karnal revealed the highest gross yield (165.83 q/ha) and marketable yield (165.70 q/ha) in G-404 and it was at par with G-304. Total soluble solids showed non-significant differences.

### B. Crop Production System Management

#### Rabi 2015-16

- **Effect of sulphur on yield and quality**

The study was conducted at Nashik on garlic variety Yamuna Safed-3 (G-282). The results revealed that soil application of sulphur @ 45 kg/ha performed



superior in terms of bulb yield, where 140.06% and 193.64% increase in total yield and marketable yield, respectively were recorded over control. However, the highest TSS and dry matter was recorded with soil application of sulphur @ 75 kg/ha.

- ***Effect of micronutrients application on quality yield in garlic seed crop***

The field experiment was conducted at Nashik (Zone V) and RRS, Karnal (Zone II) on garlic variety Yamuna Safed-3. The foliar application of zinc sulphate @ 3 g/l performed superior in terms of phenological attributes and yield (104.23 q/ha) at Nashik. At Karnal, the treatment IIHR vegetable special (micronutrient mixture) @ 5 g/l at 30, 60 and 90 DAP performed better in terms of marketable yield (143.90 q/ha).

- ***Studies on morpho-physiological attributes in garlic***

The experiment was conducted to assess the growth of garlic and their development in different environments and relationship between assimilatory apparatus and dry matter production at Nashik. The results revealed that maximum leaf area index and absolute growth rate took place at 100 DAT, therefore dry matter accumulation was maximum at 100 DAP in all the dates. The maximum relative growth rate occurred at 40 DAP and net assimilation rate at 20 DAP.

## C. Plant Health Management

### *Kharif 2015*

- ***Survey and monitoring of major disease***

The higher incidence of stemphylium blight (48.0%) and purple blotch incidence (30%) in garlic were recorded in October during *kharif* season at Nashik.

- ***Evaluation of germplasm for disease resistance (IET)***

The study conducted at Nashik and Karnal, revealed that none of the lines was free from stemphylium blight and purple blotch diseases. However, intensity of stemphylium blight ranged from 0.20 to 3.0% and purple blotch from 0.20 to 1.0% at Nashik. At Karnal, the intensity of stemphylium blight ranged from 5.20 to 9.20%. The bulb formation was not recorded in any line of garlic including Yamuna safed-3 at both the places.

- ***Evaluation of germplasm for disease resistance (AVT-I)***

None of the lines including Yamuna safed-3 was free from stemphylium blight and purple blotch diseases at both the places. However, intensity of stemphylium blight ranged from 0.20 to 2.60% and purple blotch intensity from 0.60 to 1.40% at Nashik. At Karnal intensity of stemphylium blight ranged

from 4.60 to 10.60%. The bulb formation did not take place in any line of garlic including Yamuna safed-3 at both the places.

- **Evaluation of different lines of garlic for disease resistance (AVT-II)**

None of the lines including check Yamuna safed-3 was free from stemphylium blight and purple blotch disease at Nashik and Karnal. The intensity of stemphylium blight ranged from 0.40 to 2.0% and purple blotch from 0.20 to 1.0% at Nashik. Similarly at Karnal, the intensity of stemphylium blight ranged from 5.90 to 8.70% during the cropping period.

- **Screening of germplasm for thrips resistance (IET)**

The trial was conducted at Nashik and Karnal showed none of the entries free from thrips at Nashik while thrips did not appear at Karnal. The bulb formation was not recorded in any line of garlic including Yamuna Safed-3.

- **Screening of germplasm for thrips resistance (AVT-I)**

The trial showed none of the lines free from thrips at Nashik, while thrips did not appear at Karnal during the cropping period. The bulb formation was not recorded in any line of garlic including Yamuna Safed-3.

- **Screening of different garlic lines for thrips resistance (AVT-II)**

The trial was conducted at Nashik and Karnal which showed none of the lines free from thrips. The bulb formation was not recorded in any line of garlic including Yamuna Safed-2.

### Rabi 2015-16

- **Survey and monitoring of major diseases of garlic**

The occurrence of major diseases of garlic was recorded on the research farm at Chitegaon, Nashik. Stemphylium blight was observed with highest incidence (53.0%) and intensity (4.80%) during March, 2016. At Karnal, 100% incidence of stemphylium blight was recorded in February–March, 2016 and highest intensity (24.86%) during the month of March, 2016.

- **Evaluation of garlic advance lines for disease resistance (AVT-I)**

Eleven garlic lines along with the check Yamuna Safed-3 were evaluated at Nashik, out of which GN14-05 and GN14-26 performed superior with the lowest intensity (0.60%) of stemphylium blight (*Stemphylium vesicarium*) and it was at par with GN14-13, GN14-15 and GN14-27, whereas the intensity of stemphylium blight was 1.80% in Yamuna safed-3. At Karnal, line GN14-09 performed superior with the lowest intensity (1.63%) of stemphylium blight and it was at par with GN14-05. However, the intensity did not differ significantly while in Yamuna safed-3 recorded (2.63%).

- **Evaluation of different garlic lines for disease resistance (AVT-II)**

At Nashik, seven garlic lines alongwith check Yamuna Safed-3 were evaluated and line GRS-1345 performed superior with lowest intensity (1.40%) of stemphylium blight as compared to that (3.40%) in check variety. At Karnal, GRS-1330 performed significantly superior with lowest intensity (1.80%) of stemphylium blight as compared to the intensity (2.0%) in Yamuna safed-3.

- **Screening of different garlic lines for thrips resistance (AVT-I)**

Eleven garlic lines along with check Yamuna Safed-3 were screened. The thrips foliage damage ranged from 67.80 to 75.60%. The lowest thrips foliage damage (67.80%) was recorded in GN14-07 at 75 DAP and the highest (75.60%) in check. At Karnal, the thrips foliage damage ranged from 20.0 to 21.07% for all lines including the check Yamuna Safed-3 at 75 DAP.

- **Screening of different garlic lines for thrips resistance (AVT-II)**

Seven garlic lines along with the check Yamuna Safed-3 were screened, wherein the lowest thrips foliage damage (67.80%) was recorded in GRS-1328, and the highest (89.34%) in Yamuna Safed-3 at Nashik. At Karnal, the lowest thrips foliage damage (20.0%) was recorded in GRS-1332 and Yamuna Safed-3 at 75 DAP while the highest (20.80%) in GRS-1340 and GRS-1345.



- **Population dynamics of insect vectors on garlic in different parts of India**

The trial was conducted at Nashik and the regime-2 (Insecticide + Fungicide spray) proved better in controlling the thrips population and gave highest gross yield. The highest thrips population (29.37 nymph/plant) was recorded during 5<sup>th</sup> standard week and the lowest (8.30 nymph/plant) during 12<sup>th</sup> standard week. At Karnal, the highest thrips population (23.25 nymph/plant) was recorded during 16<sup>th</sup> standard week and the lowest (2.93 nymph/plant) during 9<sup>th</sup> standard week.

- **Evaluation of fungicides for the management of foliar diseases in garlic**

At Karnal standard check *i.e.* Mancozeb @ 0.25% spray at the disease appearance and subsequently at fortnightly intervals performs superior with lowest stemphylium blight (9.83%) and purple blotch (11.77%) as compared to in control. However, the intensity of stemphylium blight was at par with Fenamidone + Mancozeb @ 0.20%, Cymoxanil + Mancozeb @ 0.20% and Metiram @ 0.30%.

- **Integrated management of foliar diseases of garlic**

The pooled data of three years trial conducted at Nashik on garlic variety Yamuna Safed-4 (G-323) revealed that, soil application of *Pseudomonas fluorescens* @ 5 kg/ha and spray of combined fungicide Pyraclostrobin 5% + Metiram 55% @ 0.25% at 30, 60 and 90 days after planting and sprays of Mancozeb @ 0.25% at 30, 60 and 90 DAP standard check performed overall better for management at stemphylium blight. However, the highest cost benefit ratio (1:10.01) was recorded with spray at mancozeb @ as standard check because of low cost of this fungicide.

## D. Post Harvest Management

### Plant Genetic Resources and Crop Improvement

#### Rabi 2014-15

- **Collection, evaluation and utilization of garlic germplasm**

The bulbs were kept in storage on 02/05/2015 for

four months. The lowest PLW and total loss (3.60%) was recorded in G-402, followed by G-407 (3.80%), G-11, G-73, G-273, G-329 & G-427 (4.00%), G-71, G-305 (5.20%) & G-418 (4.40%), G-420 (4.60%), G27R, G-200, G-343, G-365, G-425 & G-192 (4.80%), G-7, G-39, G-264 (5.00%) and G-32 & G-310 (5.20%). The check varieties Yamuna Safed, Agrifound White, Yamuna Safed-2, Yamuna Safed-5, Yamuna Safed-3, Yamuna Safed-4 and Yamuna Safed-8 (G-384) recorded total loss of 8.00, 8.50, 6.20, 5.60, 6.40, 6.00 and 6.00%, respectively.

- **Varietal trial (IET)**

The well cured representative bulbs were kept for 5 months storage at Nashik on 08/04/2015 and at Karnal on 05/05/2015. At Nashik, the lowest total loss (9.29%) was recorded in GN-14-27 and it was at par with GN-14-01, GN-14-05, GN-14-15, GN-14-25 and Yamuna Safed-3. At Karnal, line GN-14-15 recorded, the lowest total loss (11.07%), which was at par with GN-14-07, Yamuna Safed-3, Yamuna Safed-5 and Yamuna Safed-8.

- **Varietal trial (AVT-II)**

The well cured representative bulbs were kept for 5 months storage at RRS, Nashik on 08/04/2015 and at Karnal on 06/05/2015. At Nashik, the lowest total loss (8.79%) was recorded in GRS-1330 and it was at par with GRS-1328, GRS-1345 and Yamuna Safed-3. At Karnal, line GRS-1330 recorded the lowest total loss (11.80%) and it was at par with GRS-1328, GRS-1332, GRS-1345, Yamuna Safed-5, Yamuna Safed-3 and Yamuna Safed-8.

- **Performance of garlic advance lines**

The well cured representative bulbs of 20 advance lines along with checks were kept in storage on 21/05/2015 for five months. The data lowest total loss (5.07%) in G-357 and it was at par with G-305, G-364, G-366 and G-368.

### Crop Production System Management

- **Effect of sulphur on yield and quality of garlic**

To assess the effect of soil application of sulphur on storage performance of garlic, a field study was conducted at Nashik on garlic variety

Yamuna Safed-3. The produce was kept for a period of 4 months on 10.04.2015. At the end of storage, the minimum total loss (4.87%) and PLW (4.60%) was recorded in soil application of 30 kg sulphur to the /ha as compared to the other treatments.

### III. Frenchbean

#### Plant Genetic Resources and Crop Improvement

##### *Kharif 2015*

- *Evaluation of pole type Frenchbean lines (IET)*

The trial conducted at Nashik revealed that among all entries the highest yield (50.55 q/ha) was recorded in 2015FBBVAR-1.

### IV. Cowpea

#### Plant Production System Management

- *Integrated nutrient management in cowpea*

The study was conducted on cowpea variety Kashi Kanchan (CP-4) at Karnal. The analysis of pooled data revealed that poultry manure @ 2.5 t/ha + half of the NPK through fertilizers performed superior in terms of growth, yield (175.35 q/ha) and highest C: B ratio (1:2) followed by the treatment of neem cake @ 2.5 q/ha + half of the NPK through fertilizers.

- *Weed control in cowpea*

The pooled data of three consecutive years on cowpea variety Kashi Kanchan (CP-4) showed that hand weeding performed better as compare to all the other treatments, and mulching with black polythene showed results at par with weed-free check. However, the highest C:B ratio (1.00: 2.07) was recorded in application of oxyphorophil (oxygoal) @ 150 g a.i./ha + one hand weeding and pendimethaline (stomp) @ 1 kg a.i./ha + one hand weeding.

- *Effect of integrated weed management on quality and seed yield of vegetable crops (cowpea)*

The study was conducted at Karnal on cowpea variety Kashi Kanchan. The two years pooled data revealed that weed-free check performed superior in terms of plant height (62.86 cm), number of branches (5.94/plant), length of green pods (29.85 cm), green pod girth (0.64 cm), and green pod yield (14.47 q/ha) and was found at par with mulching with black polythene.

### V. Chilli

#### Plant Health Management

- *Effect of different sowing dates on insect pest population of chillies*

The trial conducted at Karnal showed the highest population of white fly (2.60 nymphs/3 leaves/plant), mite (4.53 nymphs/3 leaves/plant) and fruit borer infestation (4.65%), while the highest population of aphids (0.80 nymphs/3 leaves/plant) was recorded during 45<sup>th</sup>, 46<sup>th</sup>, 40<sup>th</sup> and 45<sup>th</sup> standard week, respectively.

### VI. Okra

- *Seasonal incidence of major insect pests of okra and tomato*

The trial conducted at Nashik revealed the highest population of jassid (14.90 nymphs/ 3 leaves/plant), white fly (33.33 nymphs/ 3 leaves/plant) and fruit borer infestation (49.0%) during 35<sup>th</sup>, 37<sup>th</sup> and 41<sup>th</sup> standard week respectively in okra. In tomato, the highest population of white fly (11.40 nymphs/ 3 leaves/plant) was recorded during 38<sup>th</sup> standard week. At Karnal, the highest population of jassids (35.83 nymph/ 3 leaves/plant), shoot borer (25.66%) and fruit borer infestation (85.57%) were recorded during 37<sup>th</sup>, 35<sup>th</sup> and 37<sup>th</sup> standard at 15 DAT. The highest population of white fly (11.40 nymphs/ 3 leaves/plant) was recorded during 3<sup>rd</sup> week of September (38<sup>th</sup> standard week). During this period the temperature varied from 20.10 to 29.4°C and relative humidity varied from 66 to 71%.

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# 8. Laboratory Studies/Services

## i. Bio-control Laboratory

### Nashik

#### *Trichoderma viride* (TRICHO-VIR)

##### a. Talcum base

Mass production of Tricho - Vir was carried out in Bio-control Laboratory, Chitegaon, Nashik. A total of 19.7 q. of Tricho - Vir was prepared, packed and distributed to the farmers under Mission for Integrated Development of Horticulture (MIDH) for the management of soil borne fungal diseases in different vegetables.



##### b. Liquid base

Mass production of liquid based Tricho - Vir was also carried out in Bio-control Laboratory, Chitegaon, Nashik. A total of 1162 liters of liquid base formulation was prepared, packed and distributed to the farmers under plant protection services for the management of fungal diseases viz., wilt, white rot, basal rot, root rot and collar rot in different vegetables as well as horticultural crops, especially in grape and pomegranate.



#### SNPV (S-Guard)

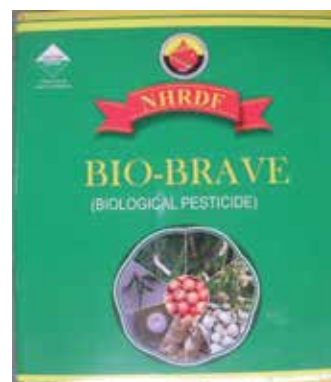
Mass production of the *Spodoptera* Nuclear Polyhedrosis Virus (SNPV) was carried out in Bio-control Laboratory, RRS, Chitegaon, Nashik. A total of 132800 LE prepared and distributed to the farmer under Mission for Integrated Development of Horticulture in vegetable seed production (VSP) programme.



### Karnal

#### *Beauveria bassiana* (BIO-BRAVE)

Mass production of BIO-BRAVE was carried out in laboratory at Karnal. A total of 53 q. of Bio Brave in talc base formulation was prepared and distributed to the farmers under the Mission for Integrated Development of Horticulture.



## ii. Entomology Laboratory

### Karnal

#### Honey production

A total of 927 kgs of honey was produced from the honey bee unit at RRS, Karnal and the entire quantity was distributed on cost basis.



### iii. Geo-Informatics Laboratory

#### Nashik

#### Standardization of the Technology for Assessment of Onion Area Using Remote Sensing and Field Survey Techniques

National Horticultural Research and Development Foundation, Nashik has carried out onion acreage estimation for the year 2015-16 using Remote Sensing Data with technical support from MNCFC, New Delhi & Space Application Centre (ISRO) on "Standardization of the technology for assessment of onion area using Remote Sensing and Field Survey Techniques". The study was carried out under the CHAMAN project implemented by MNCFC, New Delhi.

Resourcesat-2 LISS III and LISS IV multi date data were used for ground truth, crop signature and separability, classification technique for onion, chilli and tomato crop discrimination and acreage estimation.

#### Results of Onion Study Carried Out during 2015-16

The major onion growing regions in the five states covered under the study were Maharashtra (Nasik, Pune, Satara, Ahmadnagar and Dhule), Madhya Pradesh (Indore, Dewas, Ujjain, Shahajapur, Khandwa, Ratlam and Dhar), Gujarat (Bhavnagar, Rajkot, Junagarh and Amreli), Karnataka (Dharwad, Gadag, Bijapur and Chitradurg) and Bihar (Patna, Nalanda, Sheikhpura and Lakhisarai). The results obtained are as follows:

#### Maharashtra

For all the 5 districts of Maharashtra taken together, the total area during *rabi* 2015-16 was estimated to be 113780 ha, showing an increase of 3.06% over the previous years's area of 110400 ha. Similarly, late *kharif* and *rabi* onion area was found to be 227250 ha during the year 2015-16, is 23.54% higher than the previous year's area of 183950 ha. The total area covered under late *kharif* & *rabi* onion in Maharashtra state during 2015-16 based

#### District-wise area of onion in different states

Table 1. Maharashtra

Area in '000 ha.

District	Late <i>kharif</i> onion		<i>Rabi</i> onion		Total onion		% Inc/ Dec
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	
Nasik	27.36	37.10	43.48	41.87	70.84	78.97	11.48
Ahmadnagar	19.60	36.19	26.48	28.96	46.08	65.14	41.37
Pune	17.85	27.31	24.88	22.19	42.73	49.49	15.83
Satara	4.55	6.05	6.93	4.83	11.48	10.88	-5.19
Dhule	4.19	6.82	8.63	15.94	12.82	22.76	77.52
<b>Total</b>	<b>73.55</b>	<b>113.47</b>	<b>110.40</b>	<b>113.78</b>	<b>183.95</b>	<b>227.25</b>	<b>23.54</b>

on 3 years' trend analysis was 296120 ha. District-wise estimated area is given in Table 1.

### Madhya Pradesh

For all the 7 district of Madhya Pradesh during the year 2015-16 total *rabi* onion area estimated 5,22,700 ha which is 89.02% more compared to previous years area of 27,600 ha. Total area covered under late *kharif* and *rabi* onion in Madhya Pradesh state during the year 2015-16 based on 5 years trend analysis is 16,08,900 ha. District-wise estimated area is given in Table 2.

### Gujarat

For all the 5 districts of Gujarat during the year 2015-16 total *rabi* onion area estimated 2,89,000 ha, which is 49.12% more compared to last year's

area of 1,93,800 ha. District-wise estimated area is given in Table 3.

### Karnataka

For 2 districts of Karnataka during the year 2015-16 total *rabi* onion area is 68,300 ha, which is 27.18% less compared to last year's area of 93,800 ha. District-wise estimated area is given at Table 4.

### Bihar

For all the 4 districts of Bihar i.e. Patna, Nalanda, Shiekhapura & Lakhisarai during the year 2015-16 total *rabi* onion area estimated 28.21 thousand ha, which is 22.22% less compared to last year's area of 36.27 thousand ha. District-wise estimated area is given in Table 5.

**Table 2. Madhya Pradesh**

Area in '000 ha.

District	Late <i>kharif</i> onion		<i>Rabi</i> onion		Total		% Inc/ Dec	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16		
Indore	NE	0.93	3.10	8.27	3.10	9.20	-	
Ujjain	NE	4.65	3.10	7.95	3.10	12.60	-	
Dewas	NE	3.94	4.84	8.48	4.84	12.42	-	
Khandwa		3.75	6.46	4.37	5.23	8.12	43.97	
Shajapur	NE	7.16	4.31	9.32	4.31	16.48	-	
Ratlam	NE	0.73	1.64	6.86	1.64	7.59	-	
Dhar	NE	0.26	6.24	6.06	6.24	6.32	-	
<b>Total</b>		<b>3.75</b>	<b>24.13</b>	<b>27.60</b>	<b>52.17</b>	<b>31.35</b>	<b>76.30</b>	<b>143.38</b>

NE - Area not estimate due to cloud

**Table 3. Gujarat**

Area in '000 ha.

District	Late <i>kharif</i> onion		<i>Rabi</i> onion		Total		% Inc/ Dec
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	
Bhavnagar	24.48	24.27	5.49	7.32	29.97	31.59	5.41
Rajkot	13.24	13.37	5.29	5.29	18.53	18.66	0.70
Junagadh	8.03	5.80	4.75	8.81	12.78	14.61	14.31
Amreli	19.87	2.03	3.85	6.93	23.72	8.96	-62.21
Jamnagar	NA	3.39	NA	0.54	NA	3.93	-
<b>Total</b>	<b>65.62</b>	<b>48.86</b>	<b>19.38</b>	<b>28.90</b>	<b>85.00</b>	<b>77.75</b>	<b>-8.52</b>

NA - Study not included in particular season



**Table 4. Karnataka**

Area in '000 ha.

District	Late <i>kharif</i> onion		<i>Rabi</i> onion		Total		% Inc/ Dec
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	
Gadag	2.39	1.05	NE		2.40	1.05	-56.25
Dharwad	6.79	4.54	NE		6.79	4.54	-33.14
Bijapur	NE		6.86	5.91	6.86	5.91	-13.85
Chitradurg	NE		2.52	0.92	2.52	0.92	-63.49
<b>Total</b>	<b>9.18</b>	<b>5.59</b>	<b>9.38</b>	<b>6.83</b>	<b>18.57</b>	<b>12.42</b>	<b>-33.11</b>

NA - Study not included in particular season

**Table 5. Bihar**

Area in '000 ha.

District	<i>Rabi</i> onion		% Inc/ Dec
	2014-15	2015-16	
Patna	11.67	14.85	27.22
Nalanda	16.50	6.62	-59.88
Shiekhapura	6.00	1.81	-69.83
Lakhisarai	2.10	4.93	134.76
<b>Total</b>	<b>36.27</b>	<b>28.21</b>	<b>-22.23</b>

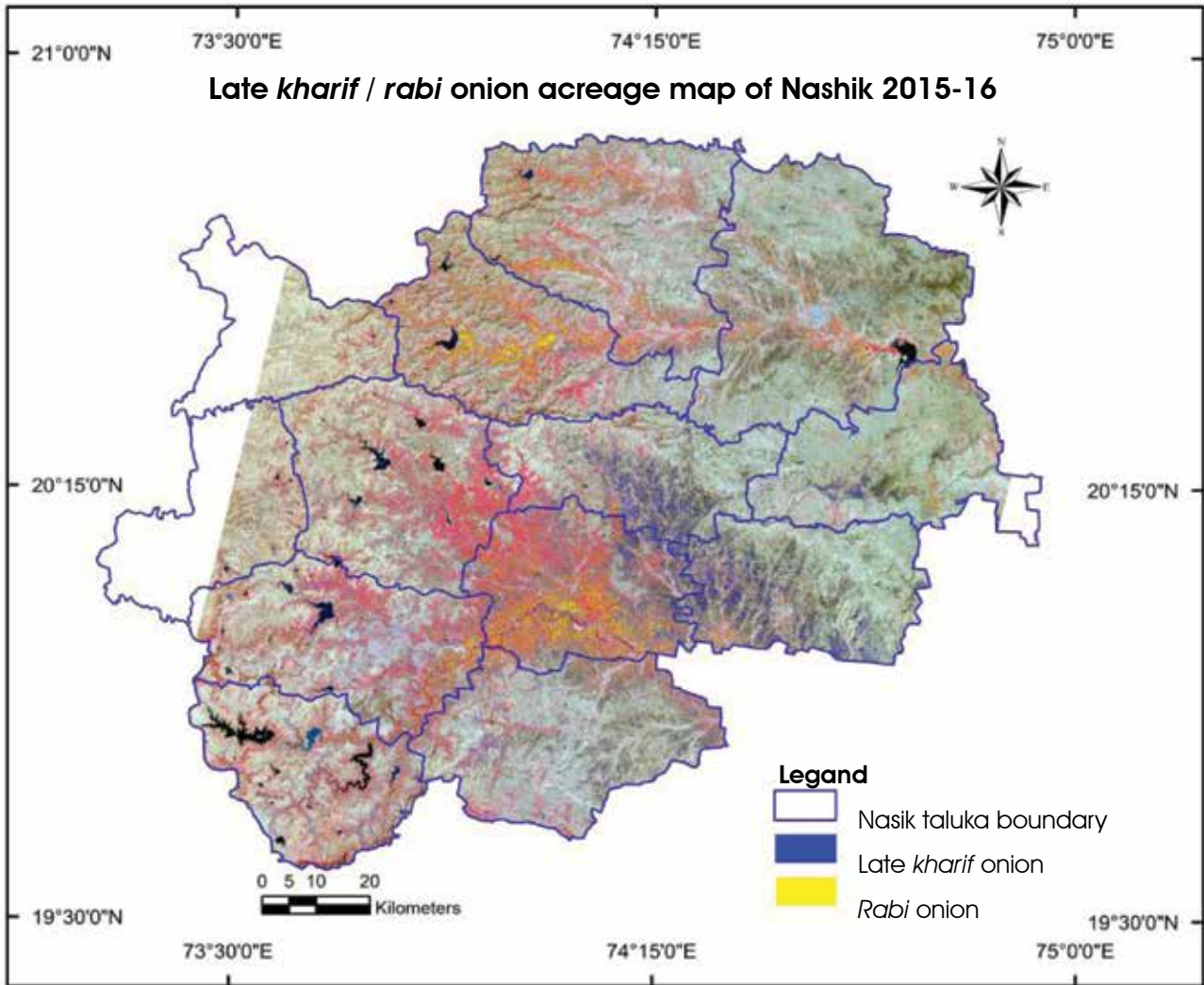
Table 6. Estimated onion area during 2015-16 in Comparison to previous year (2014-15)

Area in '000 ha.

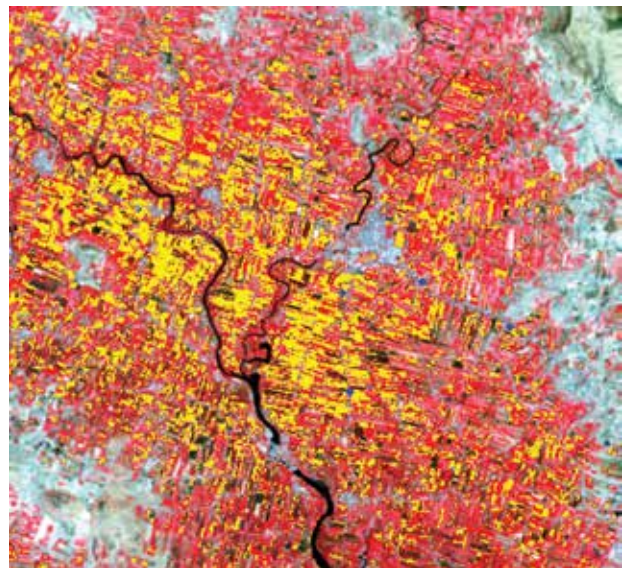
State (Districts)	Late kharif onion			Rabi onion			Total onion		
	2014-15	2015-16	% Inc/ Dec	2014-15	2015-16	% Inc/ Dec	2014-15	2015-16	% Inc/ Dec
<b>Maharashtra</b> Nashik, Ahmadnagar, Pune, Satara, Dhule	73.55	113.47	54.28	110.40	113.78	3.06	183.95	227.25	23.54
<b>Gujarat</b> Bhavnagar, Rajkot, Junagadh, Amreli & Jamnagar	65.62	48.86	-25.54	19.38	28.90	49.12	85.00	77.75	-8.53
<b>Madhya Pradesh</b> Indore, Dewas, Ujjain, Shajapur, Khandwa, Ratlam & Dhar (Khandwa Only)	3.75	24.13	-	27.60	52.17	89.02	31.35	76.30	-
<b>Karnataka</b> Dharwad, Gadag, Bijapur & Chitradurg	9.18	5.59	-39.11	9.38	6.83	-27.19	18.57	12.42	-33.11
<b>Bihar</b> Patna, Nalanda, Sheikhpura & Lakhisarai	-	-	-	36.27	28.21	-22.22	36.27	28.21	-22.22

Extrapolating area in Madhya Pradesh state in 16,08,900 ha. based on 5 year trend of state Govt. data

Extrapolating area Late Kharif + Rabi in Maharashtra state in 29,61,200 ha. based on 3 year trend of state Govt. data



*Junnar (Pune) 10 March 2016*



*Satana (Nashik) 10 March 2016*

*Rabi onion*

## iv. Mushroom Spawn Production Laboratory

### New Delhi

The good quality spawn of different edible species of mushroom namely button mushroom (*Agaricus bisporus*), pleurotus mushroom (*Pleurotus florida*, *P. sajor caju*, *P. eous*) and milky mushroom (*Calocybe indica*) were produced in the laboratory. A total of 16789 kg spawn of different species of mushroom were produced and 12054 kg spawn distributed to the mushroom growers in Delhi, Uttar Pradesh, Haryana, Punjab and Uttarakhand. The good quality 19,045 kg pasteurized compost was also produced and distributed to the mushroom growers.



Button mushroom (*A. bisporus*)



Oyster mushroom (*P. florida*)



Milky mushroom (*C. indica*)

## v. Pesticide Residue Analysis Laboratory

### Nashik

A total of 833 samples of different commodities viz. grapes; chemicals, wine, pomegranate, onion and other vegetables were analyzed for agrochemicals residue as well as chemicals for quality standards in Pesticide Residue Analysis Laboratory. The details of samples are summarized below:

#### Method validation

The laboratory has also validated the methods for various agrochemicals to cover the NABL scope in fruits, vegetables, wine and peanut as per DG-SANCO guidelines.

#### Participation in proficiency test

The laboratory has participated in national level Proficiency Test (PT) for okra, groundnut and grape which was conducted by NRL, NRC Grapes, Pune and it has got satisfactory 'Z' score results.

#### NABL accreditation and APEDA renewal:

Re-assessment of Pesticides Residue Analysis Laboratory was done by NABL and APEDA and renewed the



accreditation up to January 2018 and February 2020, respectively.

## vi. Plant Pathology Laboratory

### Nashik

#### Identification of diseases and plant pathogens

Different types of samples were received from the farmers, research and extension centres for identification of pathogens causing diseases in different crops, cocopit and soil sample for estimation of pathogens as well as and bioproducts for microbial count. A total of 401 samples (Soil-75, Grape plants-17, Onion bulbs-269, Tomato-2, Capsicum-3, Pomegranate-1, Rose-1, Brinjal-1, Garlic-2, cocopit-2 and Bioproducts-28) were tested in the laboratory. Onion bulb samples were tested and the test reports issued. The soil samples as well as cocopit were analyzed for nematode population, fungal count, and identified the diseases of vegetable, flower, fruits and appropriate management practices made accordingly.

### Laboratory Experiments

#### *In vitro* experiments on quality test of talcum and liquid formulation of *Tricho-vir*

*In vitro* experiments were conducted for quality test of talcum base *T. viride* produced in Bio-control Laboratory at Nashik. The colony count of *T. viride* was recorded in the talcum base formulation followed by the serial dilution method using potato dextrose agar (PDA) medium. The colony count after mixing of *T. viride* culture, talcum powder and carboxy methyl cellulose ranged from  $2.33 \times 10^6$  to  $3.0 \times 10^6$  per gram in the talcum base and from  $2.66 \times 10^6$  to  $4.0 \times 10^6$ /ml in the liquid formulation.

#### Fruit bud differentiation in grape

A total of 68 samples of grape canes received from the farmers in Nashik area of Maharashtra were observed under stereoscopic binocular microscope for fruit bud differentiation.

## vii. Plant Physiology Laboratory

### Nashik

A total of 2394 samples of onion and garlic received from different field trials were analyzed for total soluble solids, dry matter, moisture, leaf area, leaf dry matter, carotenoid, leaf injury as well as chlorophyll a, chlorophyll b, and total chlorophyll content in garlic leaves.

### Karnal

A total of 597 samples of onion and garlic received from different field trials were analyzed for total soluble solids, dry matter and pyruvic acid content.

## viii. Seed Testing Laboratory

### Nashik

A total of 1431 seed samples of various e.g. crops (Onion, Coriander, Palak, Bhindi, Ridgegourd, *Methi*, Wheat, Cauliflower, Maize, Tomato, Jawar, Pea, Clusterbean, Chilli, Brinjal, Soybean, Marigold, Lentil, Cumin, Radish, Babycorn, Bottleguard, Drumstick, Cabbage, Muskmelon, Lucern, Cowpea, Bitterguard, Paddy, Dolichus, *Frenchbean* & Groundnut were tested for germination, moisture and physical purity.

## ix. Soil Testing and Biochemistry Laboratory

### Nashik

A total of 9936 samples of soil, irrigation water, plant petiole, grape wine, table grapes, organic manure, FYM, vermicompost were tested. The 7,929 soil samples were analysed under RKVY project for national soil health card mission recently launched by Hon'ble Prime Minister of India.

### Soil Health Card Mission

A total of 7929 soil samples received from different taluka in RKVY project under Maharashtra



Government for soil health card mission were tested in the laboratory. and 28,983 Soil Health Cards were generated and submitted to taluka Agriculture Officer for further distribution to the concerned farmers.

### ICAR Micronutrient Project

A total of 253 soil samples were received from different onion and garlic seed production fields at Rajasthan & Haryana for micronutrient status under Network Project of ICAR-IIHR, Bengaluru.

Particulars	No. of samples	Parameters analyzed	Remarks
Soil (Farmers, IINRG, Ranchi,	752	Macro and Micro nutrients	pH level in most of soils ranged from 7.0-8.0, low organic carbon, high Mg & K was found and micronutrients in most of soils were above critical level in Maharashtra. For other than Maharashtra, P was low to medium, K medium to high and organic carbon medium to high.
Soil RKV Project under Maharashtra Govt.)	7929 (28983 SHC)	pH, EC, OC, N, P, K, S, Fe, Zn, Cu, b, & Mn	
Soil Micronutrient Project-ICAR-IIHR	253	Micronutrients	
Irrigation water	232	pH, EC, Ca, Mg, Na, CO <sub>3</sub> , HCO <sub>3</sub> , SO <sub>4</sub> , RSC, SAR, SSP and Mg/Ca ratio	pH level in most of waters was below 8.0 and found suitable for irrigation purpose in respect of SAR, RSC, SSP & TDS and Mg/Ca ratio.
Grape wine	86	pH, Brix, Alcohol, Volatile acidity, Tritable acidity, Reducing sugar, Total sugar and free SO <sub>2</sub>	Alcohol ranging from 10.0-14.0%.
Table grapes	326	Lead, Cadmium	Heavy metal was below MRL
Plant petiole (Grapes)	272	Macro and Micro nutrients	Most of the plants were deficient in N, P, Mg, Fe, S and sufficient in K and other nutrients.
Organic manure/ FYM /vermicompost	86	Macronutrients	Most of the manures were normal in nutrients status.
<b>Total</b>	<b>9936</b>		

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# 9. Agricultural Economics

## i. Cost of Production

The NHRDF made all necessary arrangements to survey the cost of production of onion bulb and seed crops in major onion-growing pockets of the country.

The cost of production of common *kharif* onion varied from Rs. 405 to Rs. 762/q depending upon the labour wages, cost of seed / planting material, other inputs and yield of onion (Annexure I; Table 1).

- The cost of production of *kharif* onion produced by locally grown sets (bulblets) in Kota district at Rajasthan was Rs. 1010/q, while it was Rs. 677/q for crop raised by transplanting seedlings (Annexure I; Table 1).
- The cost of production of common *rabi* onion varied from Rs. 409/q to Rs. 802/q depending upon the labour wages, cost of seed other input and yield of onion (Annexure I; Table 2).
- The cost of production of common onion seed varied from Rs. 309 to Rs. 537/kg depending upon the inputs, labour and seed yield. Rs. 239/kg and Coo-On5 is Rs. 659/kg (Annexure I; Table 3).
- The cost of production of garlic ranged from Rs. 1051 to Rs. 2664/q depending upon the varieties, labour wages, input cost, and yield at different places. The details of cost of production of garlic are given in (Annexure I; Table 4).

## ii. Area and Production of Onion, Garlic and Potato

The production of onion and garlic crop is higher by about 10.70 and 13.46% respectively, however, potato production was lower by around 9.56% compared to 2014-15. The state-wise area,

production and productivity of onion, garlic and potato during 2015-16 are given in Annexure II.

## iii. Export of Onion, Garlic and Potato

During 2015-16 the export has been made free and no NOC is required for export. However, MEP is to be followed during onion export. Garlic and potato were exported to different countries under open general license (OGL). The perusal of data obtained from NAFED, New Delhi, and DGCI&S, Kolkata, indicates that export of onion during 2015-16 was 11.15 lakh metric tonnes, which was about 2% more than the previous year (2014-15). Onion was exported mainly to Malaysia, Singapore, Bangladesh, Nepal, Sri Lanka, Mauritius and Gulf countries as given in Annexure III (Table 1).

The information obtained from DGCI&S, Kolkata, revealed that this year export of garlic was 15440.59 metric tonnes, which is 23.03% more than previous year's export. Garlic was exported mainly to Pakistan, Bangladesh, Nepal, Netherland, Mauritius, UK, Germany and UAE (Annexure III; Table 2).

Potato was exported mainly to Nepal, Sri Lanka, Bangladesh, Mauritius, Maldives and Malaysia. The export of potato in this year was 180757.49 metric tonnes, which is about 40.85 metric tonnes less than the previous year's. The month-wise export of onion, garlic and potato is given in Annexure III (Table 3).

# 10. Projects Implemented

The NHRDF continued to implement various projects related to research & development of vegetable and their seed production under different Central Sector Schemes of Government of India and State Government. The projects implemented are given as under:

## **i. Ministry of Agriculture & Farmers Welfare, Government of India**

- Mission for Integrated Development of Horticulture (MIDH)
- Central Sector Scheme for Mushroom Development

## **ii. Indian Council of Agricultural Research**

- All India Network Research Project on Onion and Garlic (AINRPOG)
- All India Coordinated Research Project on Vegetable Crops (AICRP-VC)
- Krishi Vgyan Kendra
- Effect of micronutrients on yield and quality of horticultural crops especially on onion and garlic

## **iii. CHAMAN (Coordinated Programme on Horticulture Assessment and Management using Geoinformatics)**

- Standardization of the technology for assessment of onion, chilli and tomato area using remote sensing and field survey technique.

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# 11. Transfer of Technology

## i. Extension

The NHRDF is involved in extension education of farmers and trainers since its inception. The object behind this is to quicken the process of transfer of technology so that farmers are able to adopt the same and thereby improve the yield and quality of their crops at a faster rate. The farmers were guided on improved package of practices for growing onion, garlic and other exportable vegetable crops under this programme. The NHRDF implemented extension education programmes through demonstrations, trainings, meetings, providing literature and arranging exhibition, seminars and group visits through different centres located almost all over the country for onion, garlic and other vegetables. The extension centres implemented the transfer of technology programmes which are given below:

States covered	NHRDF Centres
Andhra Pradesh & Telangana	Kurnool
Bihar & Jharkhand, West Bengal & NE states	Patna
Delhi and Uttarakhand	Janakpuri (New Delhi)
Gujarat	Rajkot & Mahua
Haryana, J&K and Himachal Pradesh	Karnal
Karnataka	Hubli
Maharashtra	Chitegaon, Lasalgaon and Sinnar
Madhya Pradesh & Chhattisgarh	Indore
Punjab	Bathinda
Rajasthan	Kota
Tamil Nadu & Kerala	Coimbatore & Kombai
Uttar Pradesh	Kanpur & Deoria
Odisha	Boudh

## ii. Visits

A total of 809 farmers and 247 students visited NHRDF, Chitegaon Phata, Nashik, Maharashtra from different states of the country to know the research and developmental activities on horticultural crops especially on onion and garlic. The details are given below:

### Karnataka

Date of visit	No. of farmers/students*	Place
21 July 2015	6*	K.R.C. Collage of Horticulture, Arabhavi
2 February 2016	12	Bellary

## Telangana

Date of visit	No. of farmers/students*	Place
21 September 2015	22	Hyderabad

## West Bengal

Date of visit	No. of farmers/students*	Place
18.12.2015	31	Kolkata

## Odisha

Date of visit	No. of farmers	Place
17 December 2015	32	Nayagarh
17 December 2015	24	Kalahandi
8 January 2016	37	Sambhalpur
18 January 2016	11	Deogarh

## Madhya Pradesh

Date of visit	No. of farmers	Place
10 September 2015	27	Sahjanpur
16 September 2015	120	Damoh
16 September 2015	11	Angar Nalkheda
29 September 2015	30	Sahjanpur
04 November 2015	36	Tikamgarh
05 December 2015	120	Ratlam
16 December 2015	14	Ratlam
5 December 2015	60	Ashoknagar
21 December 2015	120	Sihore
01 January 2016	12	Sahjanpur
20 January 2016	8	Damoh
10 February 2016	10	Bhopal
24 February 2016	28	Indore
26 February 2016	31	Bhopal
27 February 2016	9	Shajapur



## Maharashtra

Date of visit	No. of farmers/students*	Place
21 August 2015	30*	K.K. Wagh College of Agriculture, Nashik
27 August 2015	22*	K.K. Wagh College of Agriculture, Nashik
03 September 2015	40*	K.D.S.P. College of Agriculture, Nashik
21 September 2015	60*	K.K. Wagh College of Agriculture, Nashik
1 October 2015	29*	K.K. Wagh College of Agriculture, Nashik
7 November 2015	60*	K.K. Wagh College of Agriculture & Biotech., Nashik

## Rajasthan

Date of visit	No. of farmers	Place
15 February 2016	31	Sawai Madhopur

## Uttar Pradesh

Date of visit	No. of farmers	Place
28 July 2015	12	Sidharthnagar
27 November 2015	21	Lucknow
27 February 2016	20	Fatehpur

## Gujarat

Date of visit	No. of farmers/students	Place
29 February 2016	40	Amreli

## iii. Trainings

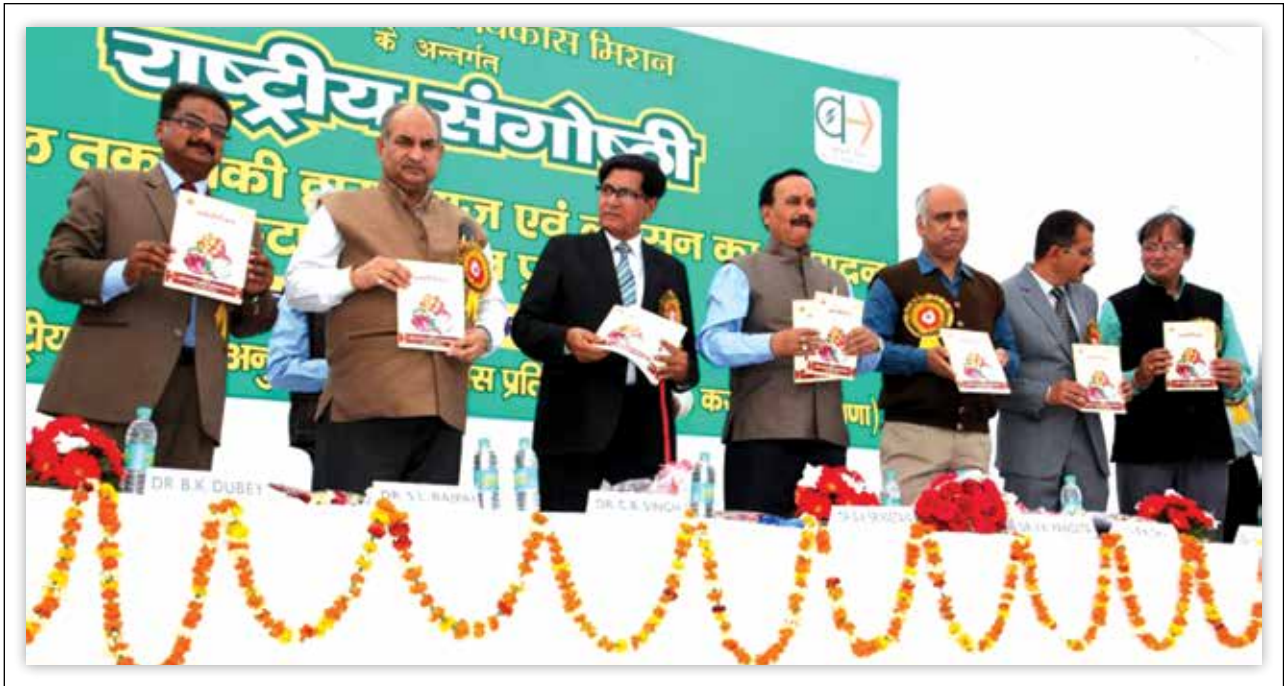
Training imparted by NHRDF, RRS, Chitegaon, Nashik to Agricultural/Horticultural Officers/Farmers of national and international participants during 2015-16.

Date	Duration (days)	No. of farmers/officers**	District & state/country	Topic	Sponsored by
19-26 July, 2015	8	10	Nepal	Use of improved technology for production of onion & garlic and post-harvest management	ICIMOD, Kathmandu, Nepal
5-16 October 2015	12	10**	Bhutan	Onion cultivation and post-harvest management practices	Govt. of Bhutan
26-28 October 2015	3	20	Rajkot, Gujarat	Use of improved technology for production & post-harvest management of onion and garlic	M/s. Pidilite Industry Pvt. Ltd., Gujarat

Date	Duration (days)	No. of farmers/officers**	District & state/country	Topic	Sponsored by
16-21 November 2015	6	6**	Sri Lanka	Seed production technology of big onion	Govt. of Sri Lanka
24-28 November 2015	1	800 (4 batches)	Nashik, Maharashtra	Use of improved technology for production & post-harvest management of onion	ATMA, Nashik, Maharashtra
7-9 December 2015	3	20**	Different district of Telangana	Use of improved technology for production & post-harvest management of onion	State Horticulture Mission, Telangana
4-6 January 2016	3	100	Indore, M.P. Kota, Rajasthan	Use of improved technology for production of onion & garlic and post-harvest management	MIDH, DAC&FW, MOA&FW, Govt. of India
12-14 January 2016	3	50	Rajkot, Gujarat	Use of improved technology for production of onion & garlic and post-harvest management	-do-
18-20 January 2016	3	50	Kurnool, A.P. Hubli, Karnataka	Use of improved technology for production of onion, cowpea, okra & garlic and post-harvest management	-do-
21-23 January 2016	3	75	Kanpur & Deoria, U.P. Patna, Bihar	Use of improved technology for production of onion, cowpea, okra & garlic and post-harvest management	-do-
28-30 January 2016	3	100	Bhatinda, Punjab Karnal, Haryana	Use of improved technology for production of onion, potato & garlic and post-harvest management	-do-
16-17 February 2016	2	24	Boudh, Odisha	Use of improved technology for production of onion and post-harvest management	Govt. of Odisha
14-16 March 2016	3	24	Arendol, Jalgaon, Maharashtra	Use of improved technology for production of onion and post-harvest management	ATMA, Arendol, Jalgaon, Maharashtra
20-22 June 2016	3	5	Kolkata, West Bengal	Onion production in <i>kharif</i> seasons	Govt. of West Bengal

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## **Colour Plate No. 4 :** **National and State level Seminars**



*State level seminar organized by NHRDF, Karnal under MIDH*



*National level seminar organized by NHRDF Nashik*





*National level seminar organized by NHRDF, Rajkot*



*State level seminar organized by NHRDF, Deoria*



*National level seminar organized by NHRDF, Paljhar, Boudh*



## **Colour Plate No. 5 :** **Trainings imparted to Agriculture/ Horticulture officials and Farmers**



*Practical in hand training by NHRDF scientist at Nashik*



*Nashik*



*KVK, Ujwa, New Delhi*



*Nashik*



*Nashik*



*Deoria*



***Colour Plate No. 6 :***  
**NHRDF Centres participated in various Agricultures Horticultural Exhibition through its Stall and shown activities to Farming Community**



## ***Colour Plate No. 7 :*** **Higher officials visit to NHRDF, Nashik**



*Dr. Shakil P. Ahammed, IAS, Joint Secretary (MIDH),  
Ministry of Agriculture, Cooperation and Farmers  
Welfare, Government of India*



*Sh. Alok Kumar Mehta, Hon'ble Minister of  
Co-operative, Government of Bihar*



*Sh Sunil Porwal, IAS, Additional Chief Secretary, Maharashtra*





## 12. Production and Distribution of Seed and Planting Material

Seed is the key agri-input in agriculture production system. The expected results of most advanced technology will not be achieved without using quality seed/planting material. Timely availability of recommended varieties is of utmost importance in maximizing per unit returns and productivity. In past decade NHRDF has significantly contributed in multiplication and distribution of quality seed/planting material. The NHRDF is engaged in quality seed production and distribution of improved varieties of onion, garlic, potato and others exportable vegetables. Onion and garlic nucleus, breeder, foundation as well as truthful labeled seeds are regularly produced and distributed by NHRDF. During the period 2015-16 NHRDF produced and distributed 2093 kg nucleus/breeder seed, 8970 kg foundation, 5820 kg certified and 248238 kg truthful seeds of different onion varieties. In case of garlic, 8,800 kg of nucleus/breeder seed and 403407 kg of truthful labeled garlic seeds/cloves were also produced and distributed.

### Quantity of seed of different crops produced and distributed 2015-16

S. No.	Crop	Varieties	Seed Produced (kg)	Seed distributed (kg)
1	Onion	ADR, ALR, NHRDF Red, NHRDF Red-2 & NHRDF Red-3	265251.50	262583.00
2	Garlic	Yamuna Safed-2, 3, 4, 8, 9	403407.00	324168.00
3	Potato	Kufri Bahar, K. Pukhraj, K. Sinduri, K. Chipsona-1, 2, K. Lovkar, K. Sadabhahar	2212381.50	1767772.00
4	Okra	Arka Anamika, Pusa A-4	23783.00	13943.00
5	Chilli	K-1 and K-2	3.00	50.78
7	Bottle gourd	Pusa Naveen	0.00	93.45
8	Radish	Pusa Chetki	834.25	843.00
9	Coriander	CS-6	6975.00	6448.00
10	Cauliflower	Sabour Agrim	196.00	172.00
11	Drumstick	PKM-1	1279.00	1266.00
12	Cowpea	Kashi Kanchan	16227.00	4816.00
13	Cluster Bean	Pusa Navbahar	1503.00	1495.00
14	Cumin	Gujarat-4	2062.00	1850.00
15	Tomato	PKM-1, Arka Rakshak (F-1 hybrid)	2742.50	262.60
16	Pea	Azad Pea-3, Golden-10	33419.00	33298.50
17	Musk Melon	Pusa Madhurash	1133.50	642.00
18	Methi	Hissar Sondlika, Pusa Early Bunch	11797.00	11772.00
19	Paddy	Sarju-52, BPT-5204, MTU-7029, PB-1211, PB-1509	171114.00	183503.00
20	Soybean	JS-335	1200.00	30807.00
21	Wheat	HD-2967, HD-3086	100451.00	101175.00
22	Maize	Rajarshi (F-1 Hybrid)	10383.00	6352.00
	<b>Total</b>		<b>3262112.75</b>	<b>2753752.33</b>

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# 13. Administration and Accounts

## Managing Committee

The management of the NHRDF vests with the Managing Committee (Annexure VI).

## Staff Position

The total strength of staff in different categories in NHRDF (Annexure VIII).

## Finance and Accounts

To meet out various expenses under different heads, the fund were received by NHRDF from sources at distribution of seed planting material, farm produce, laboratory services and Income from investments.

The NHRDF received Rs 42,302,705.58 by interest from fixed deposits, Rs 1337651.00 from the distribution of planting material and farm produce, Rs 7287638.95 from the laboratory service charges, Rs. 152,630,163.50 from seed procurement proceeds and Rs 28600.00 as annual subscription. The total expenditure during 2014-15 was Rs 186563376.00 which was less by Rs.39066889.35 over the income during the year Annexures XI (Table-1), XI (Table-2) and XI (Table-3).

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# *Annexures*

## Cost of Production of Onion and Garlic in different States

Annexure I

**Table 1. Cost of production of common onion bulb during kharif 2015 (₹/ha)**

S. No.	Operation/Item	Punjab	Bihar	Gujarat	Maharashtra	Andhra Pradesh	Haryana	Karnataka	Madhya Pradesh		Rajasthan	
									Seedlings	Bulblets	Seedlings	Bulblets
1	Land rent for six months	30000	15000	20000	12000	18000	30000	15000	17000	22000	20000	20000
2	Seed cost	15000	15000	15000	12000	14000	14000	7500	12000	10000	62500	62500
3	Land preparation	4050	6600	10150	15820	12500	6250	9500	8000	8800	7300	7300
4	Nursery raising	1400	7500	3788	6723	6250	2500	800	4000	6000	0	0
5	Manures & fertilizers	8540	19840	23480	9154	10425	10783	13729	17450	15130	15080	15080
6	Transplanting	10000	12500	11100	19000	8750	13200	0	12750	13250	10000	10000
7	Weeding & hoeing	10000	6250	11830	14500	9000	9000	11250	6000	9000	7600	7600
8	Plant protection	4460	9750	6625	18995	9550	3200	9500	9462	7000	7000	7000
9	Irrigation	2500	2500	19500	9540	7500	2500	0	8000	3300	5000	5000
10	Harvesting, curing, sorting, grading & packing	10000	15000	14000	29500	20000	11250	6000	21750	17400	25950	25950
11	Transportation	4000	3000	15125	12000	6250	6000	5000	7000	9000	9000	9000
12	Overhead charges	1000	1000	2000	-	1500	2000	2000	2500	3300	3300	3300
13	Supervisory charges	6000	3000	2500	4000	7000	3000	2500	4500	3500	3500	3500
14	Total (₹)	106950	116940	155098	163231	130725	113683	82779	130412	127680	176230	176230
15	Bank interest	5348	4678	7755	8162	5229	5684	4139	6521	7661	10574	10574
16	Grand total cost (₹)	112298	121618	162853	171393	135954	119367	86918	136933	135341	186804	186804
17	Average yield (q)	230	300	250	225	220	200	150	225	200	185	185
18	Final cost per quintal (₹)	488	405	651	762	618	597	579	609	677	1010	1010

## Annexure I

Table 2. Cost of production of common onion bulb during rabi 2015-16 (₹/ha)

S. No.	Operation/Item	Punjab	Bihar	Gujarat	Maharashtra	Andhra Pradesh	Haryana	Karnataka	Madhya Pradesh	Uttar Pradesh	Rajasthan
1	Land Rent for six months	25000	15000	15000	12000	22000	40000	15000	18000	17000	20000
2	Seed Cost	23000	12000	9500	9600	12000	10000	9600	9600	13000	10000
3	Land preparation	4800	6600	10550	15820	12500	2500	9500	8000	3750	8550
4	Nursery raising	2620	12000	4538	6100	6250	2500	800	3500	0	7000
5	Manures & fertilizers	9990	19840	25730	30034	10425	12283	13729	17450	23141	12000
6	Transplanting	12000	15000	12425	19000	8000	11950	7500	13500	18750	13000
7	Weeding & hoeing	12000	15000	13080	11350	9000	9450	13500	7750	20820	9000
8	Plant protection	2820	9750	2275	14980	9550	2500	13800	6113	6020	7000
9	Irrigation	8800	15000	19500	14000	10000	3000	6000	10800	7200	8500
10	Harvesting, curing, sorting, grading & packing	15000	18750	16875	27000	22000	10000	9000	27000	19500	23200
11	Transportation	4000	3000	19500	27000	6250	6000	6000	7500	4500	9000
12	Overhead charges	1000	1500	2000	-	1500	2000	2000	3000	1250	3300
13	Supervisory charges	6000	3000	2500	4000	7000	3000	3000	4000	2500	3500
14	Total (₹)	127030	146440	153473	190884	136475	115183	109429	136213	137431	134050
15	Bank interest	6352	5858	7674	9544	8189	5759	5471	6811	4123	8043
16	Grand total cost (₹)	133382	152298	161146	200428	144664	120942	114901	143023	141553	142093
17	Average yield (q)	260	300	325	250	260	250	200	350	250	250
18	Final cost per quintal (₹)	513	508	496	802	556	484	575	409	566	568



Table 3. Cost of production of onion seed during rabi 2015-16 (₹/ha)

S. No.	Operation/Item	Gujarat		Karnataka		Madhya Pradesh			Andhra Pradesh		Maharashtra		
		ADR	ALR	NHRDF Red-2	ADR	ADR	ADR	L-652	L-28	A. Rose	CO-ON-5	ADR	ALR
1	Land rent for six months	15000	15000	15000	15000	18000	18000	18000	18000	15000	15000	12000	12000
2	Bulb cost	50000	125000	125000	37500	50000	115000	125000	125000	32000	52500	42500	100000
3	Land preparation	10550	10550	10550	9500	9000	10000	10000	10000	12250	12250	13640	13640
4	Manures & fertilizers	25839	25839	25839	13729	18500	19000	19000	19000	29425	29425	16943	16943
5	Planting/sowing	6663	6663	6663	3000	7500	7000	7000	7000	7000	7000	11000	11000
6	Weeding & hoeing	18705	18705	18705	11250	15000	15000	15000	15000	7000	7000	15000	15000
7	Plant protection	2665	2965	2965	5800	9000	10000	10000	10000	9550	9550	19087.5	19087.5
8	Irrigation	23400	23400	23400	0	15000	16500	16500	16500	7500	7500	8300	9000
9	Harvesting, curing, sorting, grading & packing	9800	9800	9800	3000	20500	22500	22550	22650	10600	10600	23800	24210
10	Transportation	1500	1500	1500	1000	4000	5000	5000	5000	2500	2500	1800	1800
11	Overhead charges	2000	2000	2000	2000	3500	3500	3500	3500	2000	2000	-	-
12	Supervisory charges	3600	3600	3600	2500	4000	4000	4000	4000	3000	3000	12500	15000
13	Total (₹)	169722	245022	245022	104279	174000	245500	255550	255650	137825	158325	176571	237681
14	Bank interest	8486	12251	12251	3128	8700	12275	12778	12783	5513	6333	8829	11884
15	Grand total cost (₹)	178208	257273	257273	107408	182700	257775	268328	268433	143338	164658	185399	249565
16	Average yield (q)	500	600	500	300	500	500	500	500	600	250	600	600
17	Final cost per quintal (₹)	356	429	515	358	365	516	537	537	239	659	309	416

ADR- Agrifound Dark Red, ALR- Agrifound Light Red, A. Rose- Agrifound Rose, L-28- NHRDF Red

## Annexure I

Table 4. Cost of production of garlic 2015-16 (₹/ha)

S. No.	Operation/Item	Punjab	Bihar	Gujarat	Haryana	Madhya Pradesh	Uttar Pradesh	Rajasthan
1	Land Rent for six months	25000	15000	15000	40000	18000	17000	25000
2	Seed Cost	50000	49500	60000	50000	60000	60000	30000
3	Land preparation	4800	6600	9350	5000	10000	2250	5200
4	Manures & fertilizers	9082	24304	24330	12296	20450	25741	18800
5	Planting	13500	29000	14500	13725	13500	12000	9000
6	Weeding & hoeing	12000	15000	11375	19450	13750	21120	14625
7	Plant protection	2820	9450	2050	6500	8750	6800	14300
8	Irrigation	8800	15000	21450	4050	10800	10800	24000
9	Harvesting, curing, sorting, grading & packing	21000	20000	13500	20750	24000	24800	18600
10	Transportation	4000	1800	8750	400	7000	1870	8400
11	Overhead charges	1000	1500	2000	2000	3000	1400	4500
12	Supervisory charges	3200	3000	3000	3000	4000	3500	3500
13	Total (₹)	155202	190154	185305.19	177170.6	193250	187280.5	175925
14	Bank interest	7760	7606	9265	8859	9663	6555	10556
15	Total Cost (₹)	162962	197760	194570	186029	202913	193835	186481
16	Average yield (q)	155	110	125	70	100	85	70
17	Final cost per quintal (₹)	1051	1798	1557	2658	2029	2280	2664

Table 1. State-wise area, production and productivity of onion during 2015-16

S. No.	State	Area		Production		Productivity (tonnes/ha)
		('000 ha)	Share (%)	('000 MT)	Share (%)	
1	Maharashtra	522.35	39.57	6529.34	31.19	12.50
2	Madhya Pradesh	118.20	8.95	2848.00	13.61	24.09
3	Karnataka	190.21	14.41	2695.99	12.88	14.17
4	Rajasthan	86.31	6.54	1435.11	6.86	16.63
5	Gujarat	53.20	4.03	1355.78	6.48	25.48
6	Bihar	54.03	4.09	1247.34	5.96	23.09
7	Andhra Pradesh	45.02	3.41	885.42	4.23	19.67
8	Haryana	30.65	2.32	705.80	3.37	23.03
9	West Bengal	33.98	2.57	544.55	2.60	16.03
10	Uttar Pradesh	24.96	1.89	422.75	2.02	16.94
11	Telangana	20.87	1.58	395.96	1.89	18.97
12	Tamil Nadu	36.73	2.78	380.95	1.82	10.37
13	Odisha	33.45	2.53	378.58	1.81	11.32
14	Chhattisgarh	23.49	1.78	375.99	1.80	16.01
15	Jharkhand	14.86	1.13	254.63	1.22	17.13
16	Punjab	8.50	0.64	193.71	0.93	22.79
17	Assam	8.47	0.64	80.31	0.38	9.49
18	Jammu & Kashmir	2.85	0.22	65.27	0.31	22.94
19	Himachal Pradesh	2.53	0.19	47.96	0.23	19.00
20	Uttarakhand	4.07	0.31	41.59	0.20	10.23
21	Others	5.34	0.40	46.21	0.22	8.65
	<b>Total</b>	<b>1320.04</b>	<b>100.00</b>	<b>20931.21</b>	<b>100.00</b>	<b>15.86</b>

Source: Horticulture Division, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi

**Annexure II****Table 2. State-wise area, production and productivity of garlic during 2015-16**

S. No.	State	Area		Production		Productivity (tonnes/ha)
		('000 ha)	Share (%)	('000 MT)	Share (%)	
1	Madhya Pradesh	81.17	28.89	424.50	26.25	5.23
2	Rajasthan	69.10	24.60	377.49	23.34	5.46
3	Gujarat	40.60	14.45	318.20	19.67	7.84
4	Uttar Pradesh	33.60	11.96	193.62	11.97	5.76
5	Assam	10.39	3.70	76.95	4.76	7.41
6	Punjab	6.46	2.30	73.74	4.56	11.41
7	West Bengal	3.73	1.33	36.07	2.23	9.67
8	Haryana	4.44	1.58	35.83	2.22	8.07
9	Odisha	10.90	3.88	35.50	2.19	3.26
10	Maharashtra	2.05	0.73	12.69	0.78	6.19
11	Himachal Pradesh	4.57	1.63	9.35	0.58	2.05
12	Karnataka	4.73	1.68	5.19	0.32	1.10
13	Bihar	4.25	1.51	4.00	0.25	0.94
14	Chhattisgarh	1.34	0.48	3.60	0.22	2.69
15	Nagaland	0.29	0.10	2.89	0.18	9.97
16	Tamil Nadu	0.48	0.17	2.72	0.17	5.67
17	Uttarakhand	1.29	0.46	1.93	0.12	1.50
18	Others	1.56	0.56	3.07	0.19	1.97
	<b>Total</b>	<b>280.95</b>	<b>100.00</b>	<b>1617.34</b>	<b>100.00</b>	<b>5.76</b>

Source: Horticulture Division, Ministry of Agriculture & Farmers Welfare Government of India, New Delhi

Table 3. State-wise area, production and productivity of potato during 2015-16

S. No.	State	Area		Production		Productivity (tonnes/ha)
		('000 ha)	Share (%)	('000 MT)	Share (%)	
1	Uttar Pradesh	607.32	28.69	13851.76	31.90	22.81
2	West Bengal	427.00	20.17	8427.00	19.41	19.74
3	Bihar	319.13	15.08	6345.52	14.62	19.88
4	Madhya Pradesh	141.05	6.66	3161.00	7.28	22.41
5	Gujarat	112.40	5.31	3549.38	8.18	31.58
6	Punjab	92.36	4.36	2385.26	5.49	25.83
7	Assam	104.83	4.95	1037.26	2.39	9.89
8	Jharkhand	44.93	2.12	627.01	1.44	13.95
9	Haryana	34.27	1.62	853.81	1.97	24.91
10	Karnataka	33.15	1.57	455.45	1.05	13.74
11	Chhattisgarh	41.95	1.98	644.83	1.49	15.37
12	Uttarakhand	25.89	1.22	358.24	0.83	13.84
13	Odisha	25.18	1.19	278.75	0.64	11.07
14	Himachal Pradesh	18.02	0.85	183.25	0.42	10.17
15	Meghalaya	18.56	0.88	183.82	0.42	9.90
16	Tripura	7.68	0.36	128.51	0.30	16.72
17	Rajasthan	14.32	0.68	229.83	0.53	16.05
18	Jammu & Kashmir	6.91	0.33	127.24	0.29	18.42
19	Telangana	4.29	0.20	71.63	0.16	16.69
20	Tamil Nadu	3.98	0.19	72.23	0.17	18.14
21	Maharashtra	12.50	0.59	251.46	0.58	20.12
22	Others	21.19	1.00	193.81	0.45	9.15
	<b>Total</b>	<b>2116.93</b>	<b>100.00</b>	<b>43417.05</b>	<b>100.00</b>	<b>17.29</b>

Source: Horticulture Division, Ministry of Agriculture & Farmers Welfare Government of India, New Delhi



## Annexure III

Table 1. Month-wise export of onion during 2015-16

Month	Quantity (MT)	Value (₹ lakh)	PUV (₹/(MT))
April	117377.22	22189.66	18904.50
May	118507.11	22280.43	18800.90
June	103518.22	21760.24	21020.60
July	77002.03	21281.17	27637.10
August	42693.41	14548.01	34075.50
September	26832.52	13006.69	48473.60
October	23353.65	10864.46	46521.40
November	65939.09	30349.01	46025.80
December	120008.07	39880.66	33231.60
January	133425.37	20010.03	14997.10
February	151909.55	20038.84	13191.20
March	133851.89	16660.29	12446.80
<b>Total</b>	<b>1114418.13</b>	<b>252869.49</b>	<b>22690.72</b>

Source: DGC&amp;S, Kolkata

Table 2. Month-wise export of garlic during 2015-16

Month	Quantity (MT)	Value (₹ lakh)	PUV (₹/(MT))
April	1831.71	459.48	25084.70
May	1414.19	377.65	26704.30
June	15.40	8.73	56688.30
July	151.40	66.51	43929.90
August	90.92	52.26	57479.10
September	613.65	320.61	52246.30
October	445.63	214.25	48078.00
November	188.58	105.54	55965.60
December	52.99	46.78	88280.80
January	321.77	224.89	69891.50
February	906.02	480.98	53087.10
March	9408.33	4927.32	52371.80
<b>Total</b>	<b>15440.59</b>	<b>7285.00</b>	<b>47180.84</b>

Source: DGCI&amp;S, Kolkata

**Table 3. Month-wise export of potato during 2015-16**

Month	Quantity (MT)	Value (₹ lakh)	PUV (₹/(MT))
April	11780.96	1749.15	14847.20
May	10652.28	1886.21	17707.10
June	14692.55	2070.75	14093.80
July	22613.55	3300.62	14595.70
August	23629.65	3121.03	13208.10
September	20481.55	1997.20	9751.20
October	12044.80	1334.34	11078.10
November	7765.25	1182.99	15234.40
December	12855.61	1828.61	14224.20
January	17284.82	1685.45	9751.00
February	8986.47	1193.44	13280.40
March	17970.00	2069.63	11517.10
<b>Total</b>	<b>180757.49</b>	<b>23419.42</b>	<b>12956.27</b>

Source: DGCI&S, Kolkata

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# NHRDF Publications

## i. Research Papers

- Singh, R.K., Dubey B.K. and Gupta, R.P. (2016). Genotype × environment interaction and stability analysis for yield and its attributes in garlic (*Allium sativum* L.) *International Journal of Spices and Aromatic Crops* **25(2)**: 175-181.
- Singh, R.K. and Gupta, R.P. (2016). Studies on stability parameters for yield and its components in onion (*Allium cepa* L) *Ind. J. Hort.* **73(3)**: 362-370.

## ii. Popular Articles/Abstract

- Singh, R.K. and D.K. Singh (2015). Pyaj Aur Lahsun me Akikrit Posak Tatva Prabandhan, *Phal Phool*, July-August 2015, pp. 13-16.
- Singh, R.K., Dubey, B.K., and Gupta, R.P. (2016) Agrifound Parvati: New Garlic for hills. *Indian Horticulture*, **61(2)**: 42-43 pp.
- Singh, R.K. and Gupta, R. P. (2016) Kharif onion production through bulblets is remunerative. *Indian Horticulture*, **61** (4) 10-11pp
- Bhasker, P., Gupta, P.K., and Gupta, R.P. (2016) Weed management studies in onion (*Allium cepa* L.) during *kharif* season. International Conference on Plant Research and Resources Management and 25<sup>th</sup> APSI Silver Jubilee Scientists Meet 2016: 50 p.
- Gupta, P.K. and Gupta, R.P. (2016). Challenges & Prospective of Onion Production and Export **In**: Global Conference on Perspective of Future Challenges and Options in Agriculture organized by ASM Foundation, New Delhi & Jain Irrigation System Ltd., Jalgaon, India

28-31 May, 2016, Jalgaon, Maharashtra: 104 pp.

- Gupta, P.K. and Gupta, R.P. (2016). Planting Material Production Technology in Garlic **In**: 'Global Conference on Perspective of Future Challenges and Options in Agriculture' organized by ASM Foundation, New Delhi & Jain Irrigation System Ltd., Jalgaon, India 28-31 May, 2016, Jalgaon, Maharashtra: 67 pp.

## iii. Books

1. Onion and Garlic Production Utilization
2. Planting Material of Horticulture Crops, Issues and Strategies
3. Approaches for Sustainable Development of Onion and Garlic

## iv. Technical Bulletins

### (a) English

1. Onion Production in India
2. Garlic Cultivation in India
3. Diseases of Onion and Garlic
4. Onion and Garlic Varieties
5. Post Harvest Management and storage of Onion and Garlic
6. Nutrient deficiency and their management in onion and garlic
7. Pest and disease management in onion and garlic
8. Onion seed production

## **(b) Hindi**

9. Subjoun Me Ekikrit Keet Avam Rog Prabandhan
10. Bharat mein Pyaj ki Kheti
11. Pyaj aur Lahsun Beejotpadan
12. Pyaj Phasal Calender
13. Kechua aur Kechua Khad

## **v. Regular Publications**

### **(a) English**

1. NHRDF Annual Report (every year)
2. Annual Progress Report of MIDH-NHM (every year)
3. NHRDF News Letter (Quarterly)
4. Vision-2050
5. NHRDF at a Glance
6. Training brochure of NHRDF
7. NHM-A success story
8. Impact analysis of technology development by NHRDF
9. Consumption pattern of onion, garlic and potato in India

### **(b) Hindi**

10. NHRDF, Beej

## **vi. DVDs**

### **(a) English**

1. NHRDF Kal Aaj Aur Kal/NHRDF forever
2. Improved Practices of Onion Cultivation
3. Improved Practices of Garlic Cultivation

### **(b) Hindi**

4. NHRDF Kal Aaj Aur Kal/NHRDF forever
5. Improved Practices of Onion Cultivation
6. Improved Practices of Garlic Cultivation

## **vii. Extention Leaflets**

### **(a) English**

1. Garlic Cultivation- English
2. Onion Cultivation
3. Onion Seed Cultivation
4. Pesticides Residue Analysis- Laboratory

### **(b) Hindi**

1. Baby corn
2. Bhindi Cultivation
3. Bitter gourd Cultivation
4. Bottle gourd Cultivation
5. Carrot
6. Chilli cultivation
7. Cumin
8. Coriander Cultivation
9. Drumstick Cultivation
10. French bean Cultivation
11. Garlic Cultivation
12. Kisano Ke Liye Pradatta Suvidhaye
13. Kharbuja
14. Lobiya ki Kheti
15. Makka Ki Kheti
16. Methi Cultivation
17. Mrida Aum seenchai ka Jal Parikshan
18. Mrida Swasthya Aum Kheti ke liye vermicompost labhdayak
19. Ek Parichay
20. Sankar Mirch (F1 Hybrid) CH-1
21. Sankar Mirch (F1 Hybrid) Arka Khayati
22. Sankar Tomato (F1 Hybrid) Arka Rakshak
23. Bio Brave
24. S-Guard (SNPV)



25. Onion and Garlic- Medicinal value
26. Onion Cultivation by Bulblets
27. Onion-Sulphur- Hindi/Marathi
28. Organic production of vegetable
29. Paddy Cultivation
30. Pea
31. Potato Cultivation
32. Pyaj me rog aum kit niyantran
33. Radish Cultivation
34. Soyabean ki Unnat Kheti
35. Tomato
36. Trichoderma

37. Trichoderma-Marathi
38. Wheat Cultivation
39. Gende ki kheti

### **(c) Marathi**

1. Bhindi Cultivation
2. Garlic Cultivation
3. Onion Cultivation
4. Onion Seed Cultivation
5. Onion-Insect and disease control
6. Onion-Yellow Hybrid Cultivation
7. Pesticides Residue Analysis- Laboratory

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# Members of Managing Committee

1. **Dr Bijender Singh**  
Hon'ble President, NHRDF  
Farm House, Telangpura Kotla, Delhi - 110 043
2. **Shri Harbhajan Singh**  
Hon'ble Vice President, NHRDF  
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Mandi, Azadpur, Delhi - 110 033
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1-Siddhartha Enclave, Ashram Chowk, Ring Road,  
New Delhi - 110 014
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NAFED  
1-Siddhartha Enclave, Ashram Chowk,  
Ring Road, New Delhi - 110 014
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Director, NAFED  
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New Delhi - 110 016
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M/s Grainotch Industries  
T-13-14, Suyojit Sankul, above Bafna Jewellers,  
Near Rajiv Gandhi Bhavan, Tilakwadi Cornder,  
Nashik - 244 005 (Maharashtra)
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16. **Dr. N.K. Krishna Kumar**  
Deputy Director General (Hort. Science),  
Indian Council of Agricultural Research  
Krishi Anusandhan Bhavan-II, Pusa, New Delhi -  
110 012
17. **Dr. Jai Gopal**  
Director,  
Directorate of Onion & Garlic Research,  
Rajguru Nagar, Distt.: Pune - 410 505  
(Maharashtra)
18. **Dr. Major Singh**  
Project Coordinator  
All India Vegetable Research Project (ICAR),  
Indian Institute of Vegetable Research  
Post Bag No. 01, P.O.- Jakhini, Shahanshahpur  
Varanasi - 221 305 (Uttar Pradesh)
19. **Dr. R.P Gupta**  
Director & Member Secretary,  
National Horticultural Research and  
Development Foundation, Baghwani Bhawan,  
47, Pankha Road, Institutional Area, Janakpuri,  
New Delhi - 110 058

# Members of Advisory Committee

1. **Dr N.K. Krishna Kumar**  
Deputy Director General (Hort.Sci.) & Chairman,  
NHRDF Scientific Advisory Committee, ICAR, Krishi  
Anusandhan Bhavan-II, Pusa,  
New Delhi - 110012
2. **Dr Kirti Singh**  
Ex- Vice Chancellor,  
C-9/9766, Vasant Kunj,  
New Delhi - 110 070
3. **Dr Major Singh**  
Project Coordinator,  
AICRP (Vegetable Crops), IIVR  
Post Bag No. 01, P.O.-Jakhini (Shahanshahpur)  
Varanasi - 221 305 (U.P.)
4. **Dr B.P. Singh**  
Ex-Head Plant Pathology-NBRI,  
4/300, Vivek Khand, Gomati Nagar  
Lucknow - 226 010 (U.P.)
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Member- NITI AYOOG  
Yojana Bhawan, Sansad Marg,  
New Delhi - 110 012
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Sr. Scientist (Vegetable Science),  
Division of Vegetable Crops, IIHR, Hessaraghatta  
Lake Post, Bengaluru - 560 089  
(Karnataka)
7. **Dr A.N. Ganeshamurthy**  
Principal Scientist & Head,  
Division of Soil Science & Agril. Chemistry, IIHR,  
Hessaraghatta Lake Post, Bengaluru – 560 089  
(Karnataka)
8. **Dr R. Venugopalan**  
Principal Scientist (Agril. Statistics),  
Section of Econ. and Stat., IIHR, Hessaraghatta  
Lake Post, Bengaluru – 560 089  
(Karnataka)
9. **Dr K.E. Lawande**  
Ex- Vice Chancellor  
Flat No.-7, Nisarg Phase II, Kaspate Vasti,  
Kalewadi Phata, Wakad, Pune - 411057  
(Maharashtra)
10. **Shri R.P. Gupta**  
Director & Member Secretary,  
National Horticultural Research and  
Development Foundation  
Chitegaon Phata, Post- Darna Sangvi, Taluka-  
Niphad, Nashik - 422 003 (Maharashtra)

.....

# Officers and Staff of NHRDF

## Head Office, Chitegaon (Maharashtra)

**Dr. R.P. Gupta**  
Director

### A. Research and Development

1. **Dr. P.K. Gupta**  
Joint Director
2. **Mr. Hari Prakash Sharma**  
Deputy Director (Statistics)
3. **Mr. M.K. Srivastava**  
Deputy Director(Maintenance)
4. **Mr. H.K. Sharma**  
Assistant Director (Horticulture)
5. **Dr. Rajesh Kumar Singh**  
Assistant Director (Horticulture)
6. **Dr. Ram Chandra Gupta**  
Assistant Director (Plant Pathology)
7. **Dr. Shio Prakash Yadav**  
Organic Chemist
8. **Mr. N.K. Pandey**  
Senior Technical Officer (Plant Pathology)
9. **Mr. Bala Rajashekar**  
Senior Technical Officer (Residue Analysis)
10. **Mr. Tushar Prakash Ambare**  
Senior Technical Officer (Horticulture)
11. **Mrs. T. Devi**  
Senior Technical Officer (Horticulture)
12. **Mr. R.P. Shukla**  
Technical Officer (Residue Analysis)
13. **Mr. Avinash Mishra**  
Technical Officer (Residual Analysis)
14. **Mr. Ashok Kumar Tailor**  
Technical Officer (Statistics)
15. **Mr. Deepak Singh**  
Technical Officer (Soil)
16. **Mr. Manoj Kumar Pathak**  
Technical Officer (Entomology)
17. **Dr. Rajendra Prasad Pandey**  
Technical Officer (Soil)
18. **Dr. P. Bhasker**  
Technical Officer (Plant Physiology)
19. **Mr. Manoj Kumar Pandey**  
Technical Officer (Plant Pathology)
20. **Mr. P.K. Bhagat**  
PS to Director
21. **Ms. U.D. Yardi**  
Steno Typist
22. **Mr. Hayat Singh**  
Projector Operator
23. **Mr. Sandeep Lawand**  
Technical Assistant
24. **Mr. Bishram Prajapati**  
Technical Assistant
25. **Mr. B.S. Negi**  
Technical Assistant
26. **Mr. Rameshwar P. Nikam**  
Typist-cum-Clerk

### Administration Section

1. **Mr. R.P. Gupta**  
Senior Administrative Assistant
2. **Mr. Awadh Bhushan**  
Administrative Assistant
3. **Mr. D.D. Dubey**  
Driver



4. **Mr. M.V. Kale**  
Driver
5. **Mr. A. Saravanan**  
Driver
6. **Mr. J.N. Yadav**  
Driver

### Personnel Section

1. **Sh. Ramesh Babu P.K.**  
Assistant Director (Personnel)
2. **Mr. Gyan Prakash Dwivedi**  
Section Officer (Personnel)
3. **Mr. Sureshram G.**  
General Clerk
4. **Mr. T. Prabhakar**  
Typist-cum-Clerk
5. **Mrs. Sangita Ghodekar**  
Typist-cum-Clerk

### Finance and Accounts Section

1. **Shri S.K. Sharma**  
Assistant Accounts Officer
2. **Mr. P.S. Verma**  
Senior Accounts Assistant
3. **Mr. A.C. Raval**  
Senior Accounts Assistant
4. **Mr. Subedar Pandey**  
Senior Accounts Assistant
5. **Mr. M.A. Joshi**  
Accounts Assistant
6. **Mrs. Mithilesh Singh**  
Accounts Assistant
7. **Mr. Sabha Pati Dubey**  
General Clerk

### Supporting Staff

1. **Mr. Nand Ram**  
Attendant
2. **Mr. Safi Mohammed**  
Attendant
3. **Mr. B.S. Shinde**  
Attendant

4. **Mr. D.K. Gadekar**  
Attendant
5. **Mr. Ajay Kumar Singh**  
Attendant
6. **Mr. K.B. Erande**  
Attendant
7. **Mr. V.B. Mali**  
Attendant
8. **Mr. Sopan S. Kshirsagar**  
Attendant
9. **Mr. Chandrakant D. Holkar**  
Attendant
10. **Mr. Krishna Nath Prajapati**  
Attendant

### Registered Office, Janakpuri (New Delhi)

1. **Shri R.K. Yadav**  
Joint Director
2. **Mr. S.N. Choudhary**  
Assistant Director (Plant Breeder)
3. **Mr. Sanjay Kumar Singh**  
Assistant Director (Horticulture)
4. **Mrs. Radha Joshi**  
Senior Administrative Assistant
5. **Mr. Subash Chandra Tiwari**  
Senior Technical Officer (Plant Pathology)
6. **Mr. Santosh Kumar**  
Technical Assistant
7. **Mr. A.K. Wadhwa**  
Senior Liaison Assistant
8. **Mr. Sudhir Kumar Singh**  
Senior Programmer
9. **Mr. Rajesh Kumar**  
Computer Assistant
10. **Mr. Jai Prakash Sharma**  
Administrative Assistant
11. **Miss. Pooja Phogat**  
Administrative Assistant
12. **Mr. Raj Singh**  
General Clerk
13. **Mr. Amit Kumar**  
Typist-cum-Clerk

14. **Mr. Brijesh Kumar**  
General Clerk
15. **Mr. Anil Kumar Sharma**  
Driver
16. **Mr. Manjeet Singh**  
Driver
17. **Mr. Chanda Prasad**  
Attendant
18. **Mr. Sri Kishan Yadav**  
Attendant
19. **Mr. Prahlad Singh**  
Attendant
20. **Mr. Ramesh Kumar Singh**  
Attendant
21. **Mr. Vikas Dangi**  
Attendant

## Research/Extension Centres

### Bathinda (Punjab)

1. **Mr. M.M. Dwivedi**  
Assistant Director (Horticulture)
2. **Mr. Deo Raj Ram**  
Technical Officer (Horticulture)
3. **Mr. Vinod Kumar Singh**  
Technical Officer (Horticulture)
4. **Mr. Sandeep Kumar Gupta**  
Technical Officer (Horticulture)
5. **Mr. Girdhari Lal**  
Typist-cum-Clerk
6. **Mr. Tarsem Lal**  
General Clerk
7. **Mr. Ram Charitra Yadav**  
Attendant

### Boudh (Odissa)

1. **Mr. Ajit Patra**  
Technical Officer (Horticulture)
2. **Mr. Astik Kumar Sahu**  
Attendant

### Coimbatore (Tamil Nadu)

1. **Dr. Suresh Dagade**  
Deputy Director (Horticulture)
2. **Mr. M. Saravanan**  
Technical Officer (Horticulture)
3. **Mrs. P. Rajeswari**  
Typist-cum-Clerk
4. **Mr. Nanubala Brahmaiah**  
Attendant

### Delhi (K.V.K.)

1. **Mr. R.K. Yadav** (On deputation to KVK)  
Programme Coordinator
2. **Mr. V.K. Dixit** (On deputation to KVK)  
Office Suptt. cum Accountant

### Deoria (Uttar Pradesh)

1. **Dr. Rajneesh Mishra**  
Deputy Director (Horticulture)
2. **Mr. Anil Kumar**  
Technical Officer (Horticulture)
3. **Mr. Abhay Singh**  
Technical Assistant
4. **Mr. Rama Nand Singh**  
General Clerk
5. **Mr. Shailesh Kumar**  
Attendant
6. **Mr. Ram Lochan Yadav**  
Attendant
7. **Mr. Shinde Sharad Eknath**  
Attendant

### Hubli (Karnataka)

1. **Dr. Alok Kumar Singh**  
Assistant Director (Horticulture)
2. **Mr. B.P. Rayate**  
Technical Assistant
3. **Mr. Dhananjay G. Desai**  
Technical Assistant
4. **Mr. B.C. Valli**  
Attendant

**Indore (Madhya Pradesh)**

1. **Dr. S.K. Singh**  
Deputy Director (Seed)
2. **Mr. Nahar Singh**  
Senior Technical Officer (Horticulture)
3. **Mr. Hind Mahasagar Singh**  
Senior Technical Officer (Horticulture)
4. **Mr. Akash Kumar Upadhyay**  
Technical Officer (Hort.)
5. **Mr. S.P.S. Bhandari**  
Accountant Assitant
6. **Mr. Ram Murti Verma**  
Typist-cum-Clerk
7. **Mr. Jagdev Yadav**  
Driver
8. **Mr. Fauzdar Prasad**  
Attendant
9. **Mr. Rakesh Singh Rawat**  
Attendant

**Kanpur (Uttar Pradesh)**

1. **Mr. S.P. Tripathi**  
Assistant Director (Horticulture)
2. **Mr. Vinay Kumar Gupta**  
Senior Technical Officer (Horticulture)
3. **Mr. Sunil Kr. Tiwari**  
Technical Officer (Horticulture)
4. **Mr. B.P. Shukla**  
Attendant

**Karnal (Haryana)**

1. **Mr. B.K. Dubey**  
Deputy Director (Plant Breederling)
2. **Dr. Sujay Pandey**  
Assistant Director (Entomology)
3. **Mr. H.N. Tiwari**  
Senior Technical Officer (Horticulture)
4. **Mr. A.N. Verma**  
Senior Technical Officer (Horticulture)
5. **Mr. S. Purushothaman**  
Senior Technical Officer (Plant Pathology)

6. **Mr. Desh Raj Yadav**  
Technical Officer (Horticulture)
7. **Mr. Shashi Kumar Doldar**  
Technical Officer (Horticulture)
8. **Mr. Dharminder Saini**  
Accounts Assistant
9. **Mr. Baljeet Singh**  
Administrative Assistant
10. **Mr. Suresh Babu**  
Technical Assistant
11. **Mr. Ashok Kumar Srivastava**  
Technical Assistant
12. **Mr. L.N. Sharma**  
General Clerk
13. **Mr. Pancham Ram**  
Driver
14. **Mr. Pankaj Kumar Shukla**  
Driver
15. **Mr. Pawan Kumar Srivastava**  
Attendant
16. **Mr. U.S. Negi**  
Attendant
17. **Mr. Madan Lal**  
Attendant
18. **Mr. Ratan Lal**  
Attendant
19. **Mr. Ran Singh Tomar**  
Attendant
20. **Mr. Sanjeev Kumar Srivastava**  
Attendant
21. **Mr. Mukesh Kumar**  
Attendant
22. **Mr. Vijay Shankar Mishra**  
Attendant
23. **Mr. Santosh Kumar Sharma**  
Attendant

**Kombai (Tamil Nadu)**

1. **Mr. K.V. Gnanasundaram**  
Technical Officer (Horticulture)
2. **Mr. G.C. Kondaiah**  
Attendant

### Kota (Rajasthan)

1. **Mr. Awadhesh Kumar Mishra**  
Senior Technical Officer (Horticulture)
2. **Mr. Vimlesh Kumar**  
Technical Officer (Horticulture)
3. **Mr. Deep Narayan**  
Technical Assistant
4. **Mrs. Meenakshi Jairath**  
General Clerk
5. **Mr. Sushil Kumar**  
Attendant

### Kurnool (Andhra Pradesh)

1. **Dr. Satyendra Singh**  
Deputy Director (Horticulture)
2. **Dr. Himanshu Singh**  
Senior Technical Officer (Horticulture)
3. **Mr. Venugodu Gopal**  
Technical Assistant
4. **Mr. K.V.B. Reddy**  
Senior Accounts Assistant
5. **Mr. G.C. Obanna**  
Attendant

### Lasalgaon (Maharashtra)

1. **Mr. R.B. Singh**  
Assistant Director (Horticulture)
2. **Mr. Akhilesh Kumar Singh**  
Senior Technical Officer (Horticulture)
3. **Mr. Sushil Kumar Pandey**  
Technical Officer (Horticulture)
4. **Mr. Sameer C. Patil**  
Technical Assistant
5. **Mr. G.N. Tiwari**  
Administrative Assistant
6. **Mr. Arun Pimple**  
Attendant
7. **Mr. D.G. Pawar**  
Attendant

### Mahuva (Gujarat)

1. **Mr. M.D. Mukhedkar**  
Technical Officer (Horticulture)

2. **Mr. Popat B. Pathan**  
Attendant

### Patna (Bihar)

1. **Mr. A.K. Pandey**  
Assistant Director (Horticulture)
2. **Mr. Prem Swarup**  
Senior Technical Officer (Horticulture)
3. **Mr. Tej Narayan Singh**  
Technical Assistant
4. **Mr. Gulab Ram**  
Accounts Assistant
5. **Mr. Lal Babu**  
Attendant

### Rajkot (Gujarat)

1. **Dr. Jitendra Kumar Tiwari**  
Assistant Director (Horticulture)
2. **Dr. Sharad Kumar Tiwari**  
Senior Technical Officer (Horticulture)
3. **Mr. Amar Bahadur Verma**  
Senior Technical Officer (Horticulture)
4. **Mr. Dinesh Kumar Tiwari**  
Technical Assistant
5. **Mr. N.B. Rupapara**  
Senior Administrative Assistant
6. **Mr. Aparbal Singh**  
Driver
7. **Mr. Rupapara Kamlesh Kumar**  
Attendant
8. **Mr. Ram Tirath Gupta**  
Attendant

### Sinnar (Maharashtra)

1. **Mr. Anup Kumar Singh**  
Technical Assistant
2. **Mr. Bhasker Londe**  
Attendant
3. **Mr. T.G. Mali**  
Attendant
4. **Mr. A.K. Yadav**  
Attendant
5. **Mr. R.R. Mali**  
Attendant

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# NHRDF Centres

S. No.	Place	Address	Phone No. & E-mail
1.	<b>Nashik</b> Head Office	<b>Sh. R.P. Gupta</b> Director Chitegaon Phata, Post – Darna Sangvi, Tq- Niphad, (via – Panchavati S.O.), Distt.: Nashik - 422 003 (Maharashtra)	Tel.: 02550-237816 Telefax: 02550-237947 E-mail: nasik@nhrdf.com nhrdf_nsk@sancharnet.in Website: www.nhrdf.com Mob: 09850880668
2.	<b>New Delhi</b> Registered office	<b>Sh. R.K. Yadav</b> Joint Director "Bagwani Bhawan", Plot No. 47, Institutional Area, Pankha Road, Janakpuri, New Delhi - 110058	Tel.: 011-28524150, 28522211 Telefax: 011-28525129 E-mail: delhi@nhrdf.com Mob: 09818087979
3.	<b>Karnal</b> (Regional Research Station)	<b>Sh. B.K. Dubey</b> Deputy Director (Breeder) Post Box No. 98, Village-Salaru, PO : Darar Distt.: Karnal - 132 001 (Haryana)	Telefax: 0184-2389040 Tel.: 0184-2006297 E-mail: karnal@nhrdf.com Mob: 09466575409
4.	<b>Sinnar</b> (Regional Research Station)	<b>Mr. Anup Kr. Singh</b> Technical Assistance Village : Kundewadi, PO : Musalgaon, Tq : Sinnar, Distt.: Nashik - 422103 (M.S.)	Tel.: 02551-202052 E-mail: sinnar@nhrdf.com; drpkgupta11@nhrdf.com Mob: 09405195874
5.	<b>Paljhar (Boudh)</b> (Regional Research Station)	<b>Sh. Ajit Patra</b> Tech. Officer (Hort.) Opposite Krishi Vigyan Kendra Paljhar, Post : Salunki Distt.: Boudh - 762 016 (Odisha)	E-mail: paljhar@nhrdf.com Mob: 08658552373
6.	<b>Kombai</b> (Regional Research Station)	<b>Sh. K.V. Gnansundaram</b> Tech. Officer (Hort.) C/o Shri. G.C. Kondaiah, Door No. 31/A, South Street Pannaipatty, PO : Kannaiwadi, via-Dindigul, Distt.: Dindigul - 624 705 (Tamil Nadu)	Mob: 09442881067 E-mail: kombai@nhrdf.com

S. No.	Place	Address	Phone No. & E-mail
7.	<b>Lasalgaon</b>	<b>Shri R.B. Singh</b> Assistant Director (Hort.) Post Harvest Research Complex, Gat No. 275, Kotamgaon Road, Lasalgaon, Tq: Niphad, Distt.: Nashik - 422 306 (Maharashtra)	Telefax: 02550-266074 E-mail: lasalgaon@nhrdf.com Mob: 09405888564
8.	<b>Bathinda</b>	<b>Shri M.M. Dwivedi</b> Assistant Director (Hort.) Near Shiv Wadi Mandir, Santpura Road, Thermal Canal, Bathinda City, Bathinda - 151 005 (Punjab)	Tel.: 0164-2168966, Telefax: 0164-2760820, 2240254 (PP) E-mail: bhatinda@nhrdf.com Mob: 09463470098
9.	<b>Kota</b>	<b>Sh. A.K. Mishra</b> Sr. Tech. Officer (Hort.) Plot No. 20, Vasundhara Vihar, In front of KVK Borkheda Baran Road, Kota - 324 001 (Rajasthan)	Tel.: 0744-2330830 E-mail: kota@nhrdf.com Mob: 08890896955
10.	<b>Kurnool</b>	<b>Dr. Satyendra Singh</b> Deputy Director (Hort.) Agricultural Market Committee Premise, Near Onion Market, Opp. New Bus Stand Kurnool - 518 003 (A.P.)	Telefax: 08518-257688 E-mail: kurnool@nhrdf.com Mob: 08978288308
11.	<b>Coimbatore</b>	<b>Dr. Suresh Dagade</b> Deputy Director (Hort.) 5/5 B-1B, Sakthi Vinayagar Nagar, Vellalore, Coimbatore - 641 111 (Tamil Nadu)	Telefax: 0422-2410370 E-mail: coimbatore@nhrdf.com Mob: 08124800814
12.	<b>Hubli</b>	<b>Dr. A.K. Singh</b> Assistant Director (Hort.) C/o APMC, Amargol Market Yard At & Post : Hubli, Distt.: Dharwad - 580 025 (Karnataka)	Tel.: 0836-2225813 Telefax: 0836-2224606 / 2224665 (PP) E-mail: hubli@nhrdf.com Mob: 09482961866
13.	<b>Rajkot</b>	<b>Dr. J.K. Tiwari</b> Assistant Director (Hort.) Plot No. 7, Behind Hotel Murlidhar, Village - Naranka, Post - Khandheri Taluka - Paddhari, Distt.: Rajkot - 360 110 (Gujarat)	Telefax: 02820-291505 E-mail: rajkot@nhrdf.com Mob: 09467950061
14.	<b>Indore</b>	<b>Dr. S.K. Singh</b> Deputy Director (Seed) Near Kashi Vishwanath Dham, Post : Soleshinde, Sanwer Road, Indore - 453 551 (M.P.)	Telefax: 07321-226600 E-mail: indore@nhrdf.com Mob: 08349487251

S. No.	Place	Address	Phone No. & E-mail
15.	<b>Kanpur</b>	<b>Shri S.P. Tripathi</b> Assistant Director (Hort.) House No. D-574, Near Kargil Petrol Pump, Barra-8, Kanpur - 208 027 (U.P.)	E-mail: kanpur@nhrdf.com Telefax: 0512-2680166 Mob: 09454923800
16.	<b>Deoria</b>	<b>Dr. Rajneesh Mishra</b> Deputy Director (Hort.) Plot No. E-23, Industrial Area, Post : Tiwai (Ushra Bazar), Tehsil : Rudrapur, Distt.: Deoria - 274 204 (U.P.)	Mob:09454801746 E-mail: deoria@nhrdf.com Mob: 09415575819
17.	<b>Patna</b>	<b>Dr. A.K. Pandey</b> Assistant Director (Hort.) Dass Market, Near Patliputra Rest House, Karbi Gahia Patna - 800 001 (Bihar)	Telefax: 0612-2340002 E-mail: patna@nhrdf.com Mob: 08987192019
18.	<b>Mahuva</b>	<b>Sh. M.D. Mukhedkar</b> Tech. Officer (Hort.) Below Farmers Training Center Near Bhutada dada Temple Marketing Yard, Mahuva, Tq – Mahuva Distt.: Bhavnagar - 364 290 (Gujarat)	Tel.: 02844-246127 E-mail: mahuva@nhrdf.com Mob: 09724068827
19.	<b>Ujwa, New Delhi</b> (Krishi Vigyan Kendra)	<b>Sh. R.K. Yadav</b> Programme Coordinator Post - Ujwa, via-Nazafgarh New Delhi - 110 073	Telefax: 011-28015272 E-mail: kvkujwa@yahoo.com, kvk@nhrdf.com Mob: 9818087979

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Table 1. Income & Expenditure Account (Research & Development) for the year ending on 31<sup>st</sup> March 2016

Previous Year 31.03.2015	Expenditure Particulars	Current Year 31.03. 2016	Previous Year 31.03.2015	Income Particulars	Current Year 31.03.2016
46,308.00	Audit fee	40,00.00	13,37,651.00	Farm Produce	25,75,779.50
63,080.00	Benevolent fund	59,050.00	4,43,02,705.58	Interest Received	4,52,65,419.15
4,25,652.00	Books and Periodicals	4,39,594.00	72,87,638.95	Laboratory Charges	1,27,69,886.00
3,75,248.00	Extension Services	16,69,204.00	28,600.00	Subscription Fees	21,700.00
28,09,782.00	Farm Expenses	48,65,865.00	0.00	Membership Fees	55,000.00
6,51,533.00	Insurance Charges	7,11,957.00	4,97,147.65	Closing Stock of NHRDF Publication	4,18,748.65
13,44,203.00	Lab Expenses	44,78,822.76	73,51,388.17	Deficit	67,76,103.61
1,85,219.00	Legal & Professional Fees	7,66,407.00			
4,85,970.00	Medical Expenses	3,97,836.00			
6,65,626.00	Meeting Expenses	9,06,106.00			
5,08,358.00	Municipal & Non-Agril. Taxes	1,92,805.00			
40,309.00	Service Tax	1,09,354.00			
4,08,83,736.50	Salary and Allowances	4,41,64,509.50			
45,138.00	Staff Recruitment	1,94,255.00			
1,89,751.00	Staff Welfare	1,94,300.00			
2,26,334.85	Telephone Expenses	2,38,438.00			
55,026.00	Training & Seminar	68,400.00			
4,23,561.00	Travelling and Conveyance	4,94,365.00			



Previous Year 31.03.2015	Expenditure Particulars	Current Year 31.03. 2016	Previous Year 31.03.2015	Income Particulars	Current Year 31.03.2016
17,39,525.00	Gratuity Expenses	6,02,147.00			
70,09,686.00	Depreciation	67,92,074.00			
6,31,085.00	Opening Stock of NHRDF Publication	4,97,147.65			
<b>5,88,05,131.35</b>	<b>Total Rs.</b>	<b>6,78,82,636.91</b>	<b>5,88,05,131.35</b>	<b>Total Rs.</b>	<b>6,78,82,636.91</b>

As per our report of even date

**For Kale & Associates**

Chartered Accountants (FRN : 114144W)

**(A.V. Kale)**  
Proprietor  
[M.No. 32039]  
5 Aug, 2016

**(P.S. Verma)**  
Senior Accounts Assistant

**(R.K. Yadav)**  
Acting Director

**Table 2. Income & Expenditure Account (Seed) for the year ending on 31<sup>st</sup> March 2016**

Previous Year 31.03.2015	Expenditure Particulars	Current Year 31.03.2016	Previous Year 31.03.2015	Income Particulars	Current Year 31.03.2016
43,406.00	Bank Charges	64,902.18	1,41,94,970.50	Closing Stock of seed	60,84,378.00
15,53,857.00	Medical Expenses	16,26,841.00	15,26,30,163.50	Seed & Bulb Distribution	22,68,40,958.00
21,39,407.00	Office Rent & Maintenance	24,49,294.00			
87,24,601.00	Opening Stock	1,41,94,970.50			
2,29,005.00	Postage and Telegram	3,00,334.50			
2,78,141.00	Printing and Stationery	3,75,495.88			
3,61,77,281.00	Salary and Allowances	4,15,04,829.00			
7,04,07,517.30	Seed and Bulb Procurement	12,68,78,577.00			
3,38,472.00	Staff Welfare	6,20,534.00			
18,95,574.00	Travelling and Conveyance	19,78,323.50			
13,13,920.40	Vehicle Maintenance	14,82,783.50			
8,50,912.00	Water & Electricity	19,52,701.00			
38,06,150.00	Gratuity Expenses	7,05,289.00			
3,90,66,889.35	Add Surplus	3,87,90,460.94			
<b>16,68,25,134.00</b>	<b>Total Rs.</b>	<b>23,29,25,336.00</b>	<b>16,68,25,134.00</b>	<b>Total Rs.</b>	<b>23,29,25,336.00</b>

As per our report of even date

**For Kale & Associates**

Chartered Accountants (FRN : 114144W)

**(A.V. Kale)**

Proprietor

[M.No. 32039]

5 Aug, 2016

**(P.S. Verma)**

Senior Accounts Assistant

**(R.K. Yadav)**

Acting Director

Table 3. Statement of Affairs for the year ending on 31<sup>st</sup> March, 2016

Previous Year 31.03.2015	Particulars	Schedule	Current Year 31.03.2016	Previous Year 31.03.2015	Particulars	Schedule	Current Year 31.03.2016
	<b>Corpus/Develop Fund</b>				<b>Fixed Assets</b>	F	8,66,67,962.15
23,46,98,260.75	Op. Balance		26,90,99,543.81		<b>Total (Rs.)</b>		<b>8,66,67,962.15</b>
26,85,781.88	Add During the period		0.00		<b>Investments</b>		
-73,51,388.17	Less deficit R&D		-67,76,103.61		Fixed Deposits	G	445,876,245.00
3,90,66,889.35	Add Surplus Seed Division		3,87,90,460.94	44,58,76,245.00			
	<b>Total (Rs.)</b>		<b>30,11,13,901.14</b>		<b>Total (Rs.)</b>		<b>56,22,84,043.00</b>
	<b>Reserves &amp; Surplus</b>						
14,91,18,694.19	Reserve (R&D)		16,36,75,169.69		<b>Current Assets</b>		
17,21,60,657.90	Revolving Fund (Seed)		29,18,86,128.90				
	<b>Total (Rs.)</b>		<b>45,56,61,298.59</b>				
	<b>Current Liabilities</b>						
4,66,399,.34	Sundry Creditors	B	11,86,706.34	97,409.00	Cash in Hand		1,79,574.00
	<b>Total (Rs.)</b>		<b>11,86,706.34</b>	4,52,84,498.24	Cash at Bank	H	7,32,62,774.45
	<b>Other Liabilities</b>			1,18,31,889.50	Sundry Debtors	I	3,99,64,774.45
3,93,157.50	Earnest Money	C	9,20,850.50	7,54,558.00	Imprest with Centres	J	10,95,836.00
13,32,518.00	Security Payable	D	13,07,018.00	1,34,20,500.05	Interest Receivable		1,47,28,110.00
	Premembership Fees		44,531.40	6,75,178.00	Development fund rec.	A	6,75,176.00
	LIC (Gp and Superannuation scheme)		0.00	1,41,94,970.50	Closing Stock of Seeds		60,84,378.00
				4,97,147.65	Closing Stock of NHRDF Publication		4,18,748.65

Previous Year 31.03.2015	Particulars	Schedule	Current Year 31.03.2016	Previous Year 31.03.2015	Particulars	Schedule	Current Year 31.03.2016
	<b>Total (Rs.)</b>		<b>22,72,399.90</b>		<b>Total (Rs.)</b>		<b>13,64,08,923.60</b>
	<b>Provisions</b>						
97,19,335.00	Project Expenses Payable		3,18,94,033.00				
3,72,170.75	Salary Payable		7,69,617.75				
5,21,842.00	Bonus		4,97,376.00	6,43,288.30	<b>Loans and Advances</b>		
45,600.00	Audit Fee		40,000.00	5,79,623.00	Security Deposits Receivable	K	6,48,838.30
1,90,64,844.50	Grant Project Account	E	-64,49,308.67	5,19,973.00	Staff Advance	L	6,511.00
1,200.00	Benevolent Fund Trust		50,400.00		TDS Receivable		10,20,146.00
	<b>Total (Rs.)</b>		<b>2,68,02,118.08</b>		<b>Total (Rs.)</b>		<b>16,75,495.30</b>
<b>62,43,40,494.39</b>	<b>Total (Rs.)</b>		<b>78,70,36,424.05</b>	<b>62,43,40,494.39</b>			<b>78,70,36,424.05</b>

As per our report of even date  
**For Kale & Associates**  
Chartered Accountants (FRN : 114144W)

**(A.V. Kale)**  
Proprietor  
[M.No. 32039]  
5 Aug, 2016

**(P.S. Verma)**  
Senior Accounts Assistant

**(R.K. Yadav)**  
Acting Director

# Meteorological Data

## RRS, Nashik

S. No.	Month	Temperature (°C)		RH (%)		Rainfall (mm)
		Max.w	Min.	Max.	Min.	
1.	July, 2015	28.64	20.37	81	65	63.0
2.	August, 2015	27.10	19.16	82	69	16.40
3.	September, 2015	28.02	18.49	79	58	183.10
4.	October, 2015	30.35	17.57	62	40	60
5.	November, 2015	27.32	14.46	57	38	15.4
6.	December, 2015	26.26	10.45	58	35	-
7.	January, 2016	24.38	8.17	62	43	-
8.	February, 2016	25.95	8.25	65	47	-
9.	March, 2016	31.00	13.45	46	28	-
10.	April, 2016	33.02	18.16	46	27	-
11.	May, 2016	34.17	21.03	59	32	10.6

## RRS, Karnal

S. No.	Month & year	Temperature (°C)		RH (%)		Rainfall (mm)
		Max.	Min.	Max.	Min.	
1.	July, 2015	33.83	26.48	79	69	72.70
2.	August, 2015	33.85	25.33	82	73	64.20
3.	September, 2015	33.33	22.95	78	64	28.10
4.	October, 2015	32.05	17.81	72	48	-
5.	November, 2015	28.04	12.54	74	43	6.8
6.	December, 2015	22.23	7.55	83	53	-
7.	January, 2016	18.94	6.85	88	69	-
8.	February, 2016	20.65	9.55	86	72	-
9.	March, 2016	28.91	13.16	72	49	-
10.	April, 2016	37.90	18.90	36	20	-
11.	May, 2016	40.50	21.54	58	40	-



# Acronyms

AICRP (VC)	:	All India Coordinated Research Project on Vegetable Crops
AINRPOG	:	All India Network Research Project on Onion and Garlic
AGMARK	:	Agriculture Marketing
APEDA	:	Agricultural and Processed Food Products Export Development Authority
CHAMAN	:	Coordinated Programme on Horticulture Assessment and Management using Geoinformatic
CIPC	:	Isopropyl N-3•chlorophenyl carbamate
CSS	:	Central Sector Scheme
DAT	:	Days after Transplanting
DAP	:	Days after Planting
DGCI&S	:	Directorate General of Commercial Intelligence and Statistics
DAS	:	Days after sowing
EC	:	Extension Centre
ECs	:	Extension Centres
FYM	:	Farm Yard Manure
ICAR	:	Indian Council of Agricultural Research
ISRO	:	Indian Space Research Organization
IVRS	:	Interactive Voice Response System
KVK	:	Krishi Vigyan Kendra
MEP	:	Minimum Export Price
MIDH	:	Mission of Integrated Horticulture
MRL	:	Maximum Residue Limit
MT	:	Metric tonnes
NABL	:	National Accreditation Board for Testing and Calibration of Laboratories
NAFED	:	National Agricultural Marketing Federation of India Ltd.
NHM	:	National Horticulture Mission
NRC	:	National Research Centre of Grape
NRL	:	National Reffaral Laboratory
NRCG	:	National Research Center for Grape
NHRDF	:	National Horticultural Research and Development Foundation
NVIUC	:	National Vegetable Initiative for urban cluster
NPKS	:	Nitrogen Phosphorus Potash Sulphur
OGL	:	Open General License
PHRC	:	Post-Harvest Research Complex
PLW	:	Physiological loss of weight
RKVY	:	Rashtriya Krishi Vikas Yojna
PRA	:	Pesticides Residue Analysis
R&D	:	Research and Development
RRS	:	Regional Research Station
SAUs	:	State Agricultural Universities



**Yamuna Safed**



**Yamuna Safed-2**



**Yamuna Safed-3**



**Yamuna Safed-4**



**Yamuna Safed-5**



**Yamuna Safed-6**



**Agrifound White**



**Agrifound Parvati**





**NHRDF Red (L-28)**



**NHRDF Red-2 (L-355)**



**NHRDF Red-3 (L-652)**



**NHRDF Red-4 (L-744)**



**Coll-883**



**Coll-863**



**National Horticultural Research and Development Foundation**

Bagwani Bhawan, 47, Pankha Road, Institutional Area

Janakpuri, New Delhi - 110 058, India

Tel. : (011) 28525129, 28522211; Fax : (011) 28525129

E-mail: delhi@nhrdf.com; Visit us at : [www.nhrdf.com](http://www.nhrdf.com)