

RISHI KUMAR TYAGI

Curriculum Vitae



PRESENT POSITION

Head & Principal Scientist (Economic Botany and Plant Genetic Resources), Division of Germplasm Conservation, Indian Council of Agricultural Research-National Bureau of Plant Genetic Resources (ICAR-NBPGR), New Delhi, India and **Lead Centre Platform Coordinator**, Consortium Research Platform on Agrobiodiversity.

CONTACT DETAILS

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PERSONAL PARTICULARS

Born July 10, 1959; Indian; male; married; one son (married, working in USA).

EDUCATION

- **Ph.D. (Botany)**, 1994, University of Delhi, Delhi, India; Thesis entitled '*In Vitro* and *In Vivo* Studies on Salt Tolerance in 11 Cultivars of Oilseed Brassicas'
- **M.Sc. (Botany)** 1980, Meerut University, Meerut, India; dissertation entitled 'Studies on Some Aspects of Industrial Wastes'
- **PG Diploma in Intellectual Property Rights (IPRs) Law**, 2005, Indian Law Institute (Deemed University), Delhi, India
- **Management Programme on Leadership Development**, 2012, National Academy of Agricultural Research and Management, Hyderabad, India

EMPLOYMENT (TOTAL RESEARCH EXPERIENCE: 36 YEARS)

- 2009 to Present (**7 years 10 months**): **Head, Division of Germplasm Conservation (National Genebank)**, ICAR-NBPGR, New Delhi, India, a premier institute under the Indian Council of Agricultural Research (ICAR), Department of Research and Education, Ministry of Agriculture, Government of India.
- 1986-2009 : **Scientist /Senior Scientist/Principal Scientist** at NBPGR, New Delhi and ICAR-NBPGR Regional Station, Shimla (1986-89), Himachal Pradesh

- 1997 to Present : **Faculty Member/Research Guide**, Post-Graduate School, Indian Agricultural Research Institute (IARI), New Delhi.
- 2002 : **Post-doctoral Research Associate** at University of Illinois, USA.
- 1981-1986 : **Senior Research Fellow**, IARI, New Delhi.

SUMMARY OF ACHIEVEMENTS

- Since 1986, I have undertaken several activities in the area of **plant genetic resources (PGR) management** including germplasm collecting, conservation, characterization, evaluation, diversity assessment and PGR informatics.
- Since 1993 working as Programme Leader/Principal Investigator for conservation of seed (at -20°C and vegetatively propagated crop germplasm (using *in vitro* and cryopreservation techniques). For the last **7 years 10 months**, I am working as Head, managing the **National Genebank Bank (NGB)** of ICAR-NBPGR, **the second largest genebank in the world** (after USA). NGB conserves 0.43 million accessions belonging to 1778 species including 58,212 of millets [(sorghum (25,737), pearl millet (8,098), minor millets (24377)], 106,548 of rice, 65,227 legumes [(including chickpea (14,635) and pigeonpea (11,337)], 57,973 oilseeds [(including groundnut (13,813)], 25,578 vegetables, 6,435 forages, and 2019 accessions of vegetatively propagated crops (fruits, yams, taro, garlic, medicinal plants) in the form of tissue cultures.
- **Lead Centre Platform Coordinator** of Consortium Research Platform on Agrobiodiversity on germplasm characterization, regeneration and evaluation of various agri-horticultural crops conserved in NGB for identifying core sets and trait-specific germplasm for utilization in breeding, involving about 86 centres in various institutes and State Agricultural Universities.
- I was involved in the development of a customized PGR Portal for NGB at ICAR-NBPGR ([http://www.nbpgr.ernet.in:8080/PGRPortal/\(S\(bz5xd5umoi4s155bxncfzuc\)\)/default.aspx](http://www.nbpgr.ernet.in:8080/PGRPortal/(S(bz5xd5umoi4s155bxncfzuc))/default.aspx)).
- Based on my experience, I was identified as a key **Genebank expert from India** to provide inputs to review the **Genebank Standards** at a meeting held in Rome in Sept. 2010 by experts from FAO, Bioversity International, Global Crop Diversity Trust (GCDT) and the secretariats of International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and Commission on Genetic Resources for Food and Agriculture (CGRFA). The revised Genebank Standards were published by FAO in 2013.
- I represented India in the CGIAR **Genebank Managers' Meeting**, held at CIMMYT, Mexico (2011). Participants comprised genebank managers, breeders, information specialists to develop GENESYS (second phase) information management system.
- I have been **liaisoning** with the Defence Research and Development Organization (DRDO) for development of a **National Permafrost Facility** at Leh-Ladakh, for safety duplication of unique plant germplasm.
- Significant studies on genetic diversity assessment of germplasm collections using phenotypic and molecular markers have been undertaken. Development of core sets using morphologic and molecular markers. Development of protocols/methodologies on seed dormancy breaking, enhancement of seed germination, markers for seed deterioration, low-cost multiplication and conservation of various vegetatively propagated crops using *in vitro* and cryopreservation techniques and investigations for genetic stability assessment of conserved gemplasm using molecular and morphological markers.
- The National Advisory Board on Management of Genetic Resources (NABMGR) identified an **Expert Committee for Development of Guidelines for Genetic Resources Management in India**. As the **Member Secretary** of the **Expert Committee**, coordinated the experts' consultaion and provided

technical input for the publication of Guidelines for Management of Plant, Animal, Fish, Microbes and Insect Genetic Resources.

- Consultancy provided for **designing and specifications of medium-term storage (MTS)** facility to Directorate of Sorghum Research, Hyderabad and Indira Gandhi Krishi Vishwavidalaya (IGKV), Raipur, for efficient energy consumption.
- Development and execution of a **Consortium Research Platform on Agrobiodiversity (CRP-AB)** (as Lead Centre Project Coordinator), for characterization, regeneration and evaluation of PGR conserved in the NGB, involving 89 collaborators in National Agricultural Research System. It includes, plant, animal, fish and agriculturally important insects & microbes.
- Organization of several international, Regional and national seminars, symposia and trainings on agrobiodiversity management, conservation of germplasm, diversity analyses, assessment of genetic stability using biotechnological methods, and biosafety issues.
- My work is published as research papers in **peer-reviewed international and national journals** (e.g. Acta Physiologia Plantarum, Biologia Plantarum, BMC Genetics, Cereal Research Communication, Crop Science, Cryoletters, Current Science, Euphytica, Genetic Resources and Crop Evolution, In Vitro Cellular and Developmental Biology, Plant Cell Tissue and Organ Culture, PLoS ONE, Scientia Horticulturae, Theoretical and Applied Genetics etc.).

RELEVANT EXPERIENCE FOR THE POST APPLIED

1. Management of PGR for Crop Improvement

- (a) **Management, coordination and monitoring** of activities of **National Genebank (NGB)** of ICAR-NBPGR, comprising **Seed Genebank** with a capacity of 1 million accessions [12 long-term storage (LTS, -18°C) modules, 11 medium term storage modules (MTS, 8°C); **>0.43 million accessions** of agri-horticultural crops of **1,778 species** in the form of seeds [including accessions of millets (sorghum, pearl millet, minor millets), chickpea, pigeonpea, groundnut]; **In Vitro Genebank** (6 culture rooms and 5 cryotanks) with **1,987** accessions of **132 species**.
 - (b) Augmentation of germplasm in genebank on the basis of gap analysis (region-wise; crop-wise).
 - (c) **Germplasm characterization, regeneration, evaluation and distribution** of agri-horticultural crops germplasm conserved in NGB for identifying core sets and trait-specific germplasm for utilization in breeding. Development of core sets of chickpea, wheat (morphological markers) and North-eastern rice germplasm (molecular markers; SNPs) for enhanced utilization of germplasm in crop improvement programs.
 - (d) **Genetic diversity assessment** of collections including wheat, chickpea, French bean, rice, proso millet etc. using phenotypic and molecular markers.
 - (e) Models for **in situ on-farm conservation** of PGR in Western Himalayas.
 - (f) Establishment of **containment facility** for **management of transgenic plant material** and related biosafety issues.
 - (g) Development of vision document and project pre-proposal for **National Permafrost Facility for Conservation** (in collaboration with Defence Research and Development Organization).
 - (h) **Lead Centre Platform Coordinator** - Development and execution of the **Consortium Research Project (CRP) on Agrobiodiversity** for characterization, regeneration and evaluation of agri-horticultural crop germplasm as (2012-17), with 89 partners.
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2. Products and Concepts

- (a) Genetic stocks of **leaf rust-resistant** germplasm of **wild wheat (*Aegilops* spp.)** with D genome and **race-specific multiple rust resistant** (stem, leaf, stripe rusts, spot blotch) accessions of **bread wheat** identified from a collection of ~22,000 accessions.
- (b) Genetic stock of **chickpea** with **upright peduncle and pod**, potentially useful in breeding varieties amenable to mechanical harvesting.
- (c) **Soybean rust resistant** fertile hybrid plants by development of inter-subgeneric hybrids of *Glycine max* and *G. tomentella* through embryo culture.
- (d) **Salinity tolerant somaclones** (22) of *Brassica juncea* up to 22ds/m.
- (e) Two **stable genotypes** (EC 57080 and EC 108101) of French bean for green pod yield.
- (f) **Rapid screening system** for oilseed brassica germplasm for **salt tolerance** using male gametophyte.
- (g) Induction of **storage organs** in root and tuber crops for ***in vitro* conservation** and **disease free planting material**.

3. Development of Protocols/Methodologies for Upstream Research

- (a) **Seed dormancy breaking, enhancement of seed germination** in wild species and identification of **biochemical markers** for early deterioration in seeds.
- (b) Low-cost multiplication and conservation of various vegetatively propagated crops (fruits, tubers, spices, medicinal crops) using ***in vitro*** and **cryopreservation techniques**.
- (c) **Genetic stability assessment** of conserved germplasm using molecular markers.

4. Research Projects and Human Resource Management

- (a) Managed the technical, financial and administrative matters for **31 institutional** and **16 externally funded** projects; **6 multi-disciplinary/inter-institutional/international projects** involving more than 150 partners. These related to research for:
 - Conservation of PGR of seed crops using conventional approaches and vegetatively propagated crops using *in vitro* and cryopreservation techniques
 - Germplasm collecting, evaluation, conservation and utilization of crops from North-West Himalayas and arid zone.

Projects funded by various national and international agencies such as World Bank, Global Crop Diversity Trust (GCDDT), Bioversity International, University of Illinois, Urbana, USA, Department of Biotechnology (DBT), Department of Science and Technology (DST), Council of Scientific and Industrial Research, besides ICAR.
- (b) Supervision and monitoring the progress of scientists (22), technical personnel (16), supporting and auxiliary staff (47) of the Division of Germplasm Conservation, NBPGR Regional Stations, Bhowali and Jodhpur (total 85 staff).

- (c) Organized international (15) including **1st International Agrobiodiversity Congress 2016** and national (22) training and symposia/workshops, including 6 international training courses on "In Vitro Conservation and Cryopreservation" held in 2000, 2006-09, linkages established with >50 trainees/participants from 18 countries like the Bhutan, Colombia, Czech Republic, Egypt, Fiji Islands, Indonesia, Malaysia, Papua New Guinea, Philippines, Saudi Arabia, South Africa, Sri Lanka, Taiwan, Thailand, Vietnam, Nepal, Nigeria, Mauritius etc.

5. Management of Knowledge and Intellectual Property Rights (IPR)

- (a) Standardization of **Guidelines for PGR Management in India** and coordinating in development of guidelines for genetic resources of fish, animals, agriculturally important microbes and insects.
- (b) Development of **PGR Databases** and **Web Portal of NBPGR** (Genebank Information System).
- (c) Facilitated in plant germplasm registration of 587 unique trait-specific germplasm accessions and development of online system for **Inventory of Registered Crop Germplasm**, published **Guidelines for Registration of PGR (Revised 2014)**.
- (d) Development of **Uniformity Guidelines of ICAR Websites, ICAR Web Portal** including **online modules** of 'Admissions System of PG School (IARI)', 'IPR management application of ICAR', submission of 'ICAR Awards' and 'Tender document application of ICAR'.
- (e) Facilitation for notification and release of **varieties by Central Variety Release Committee** and their conservation under LTS and varieties registered under the **Protection of Plant Varieties and Farmers' Right Act**, under MTS for the entire registration period.
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6. Symposia/Seminars/Trainings Organized

S. No.	Name of the Symposia/seminar/training	Duration (Year)	Sponsoring agency
1.	1 st International Agrobiodiversity Congress	4 days (2016)	ISPGR, Bioversity, ICRISAT, CIMMYT, ICARDA, GCDT, JIRCAS, ICAR, NAAS, TAAS...and more
2.	International Conference on Low Temperature Science and Biotechnological Advances	4 days (2015)	ICAR, ICAR-NBPGR, NAAS, India; Society for Low Temperature Biology, Royal Botanic Gardens (RBG), UK
3.	National Symposium on Crop Improvement for Inclusive Sustainable Development	3 days (2014)	Indian Society of Genetics & Plant Breeding, ISPGR, Crop Improvement Society of India, Maize Technologist Association of India, Punjab Agricultural University and ICAR
4.	National Training on Conservation of orthodox seeds in genebank	2 days (2014)	Protection of Plant Varieties and Farmer's Rights Authority (PPV&FRA)

5.	National Training on Management of Plant Genetic Resources	8 days (2013)	ICAR and PPVFRA
6.	International Training on <i>In Vitro</i> and Cryopreservation for Conservation of Plant Genetic Resources: Currents Methods and Techniques	8 days (2014)	ICAR, NBPGR and RBG Kew
7.	National Training on Conservation of Plant Germplasm including Registered Varieties in Genebank	4 days (2013)	PPV&FRA
8.	International Training on Plant Conservation Biology: Science and Practice	March 1-14, 2013	RBG, ICAR
9.	Training on Conservation of Plant Genetic Resources including Registered Plant Varieties	3 days (2012)	NBPGR/ICAR and PPV&FRA
10.	All India Plant Breeders' Meeting	2 days (2012)	ICAR
11.	NBPGR- NAGS Partnership Workshop for Efficient Management and Use of Plant Genetic Resources	2 days (2011)	NBPGR
12.	Training Course on Plant Germplasm Conservation for ICFRE scientific staff	5 days (2009)	NBPGR/ICAR
13.	International training course on in vitro and cryopreservation techniques for conservation of plant genetic resources	15 days (2008)	Bioversity International/ ICAR
14.	International training course on in vitro and cryopreservation techniques for conservation of plant genetic resources	15 days (2007)	Bioversity International/ ICAR
15.	International training course on in vitro and cryopreservation techniques for conservation of plant genetic resources	15 days (2006)	Bioversity International/ ICAR
16.	International symposium on plant introduction: achievements and opportunities in South Asia	3 days (2005)	ICAR/ ISPGR
17.	National conference on transgenics in Indian agriculture	2 days (2004)	ICAR/ ISPGR
18.	Regional training course on in vitro conservation and cryopreservation of plant germplasm	17 days (2002)	FAO/IPGRI
19.	Symposium on plant genetic resource management : advances and challenges	4 days (2001)	ISPGR/ICAR
20.	Biosafety considerations for evaluation of transgenics	7 days (2001)	ICAR/DBT
21.	Orientation course on biosafety considerations for evaluation of transgenic crops	10 days (2000)	ICAR/DBT

22.	National dialogue : issues in management of PGR	2 days (1998)	ISPGR/ICAR
23.	Technical training on World Information and Early Warning System (WIEWS) on plant genetic resources	3 days (1997)	FAO/ICAR
24.	<i>Ex situ</i> conservation of plant genetic resources	19 days (1994)	Indo-US PGR Project

7. Editorial Experience

- Editor-in-Chief, **Indian Journal of Plant Genetic Resources** (IJPGR), Indian Society of Plant Genetic Resources (ISPGR), New Delhi, 2010-2016; 2001-2002 (8 years)
- Editor, **Indian Horticulture**, ICAR, New Delhi, 2009 till date.
- Editor, *Journal of Biofuels*, 2012 till date.
- Member, Editorial Board, **IJPGR**, 1997-1998.
- Reviewer for research journals
 - **Acta Physiologiae Plantarum**; Springer Publishers, since 2007.
 - **African Journal of Biotechnology**; Academic Journals, since 2009.
 - **African Journal of Agricultural Science** (ISAAB, Academic Journals)
 - **Biologia Plantarum** ; Springer Publishers, since 2008.
 - **Indian Journal of Genetics and Plant Breeding**; Indian Society of Genetics and Plant Breeding, New Delhi, since 2004.
 - **Indian Journal of Natural Products and Resources Repository**, CSIR, New Delhi, since 2010.
 - **Indian Journal of Plant Genetic Resources**; Indian Society of Plant Genetic Resources, New Delhi, since 2000.
 - **Journal of Plant Biochemistry and Biotechnology**; Indian Society of Biochemistry and Biotechnology, New Delhi, India, since 2005.
 - **Journal of Plant Breeding and Crop Science** (Academic Journals), since 2012.
 - **Plant Cell, Tissue and Organ Culture** ; Springer Publishers, since 2007.
 - **Scientia Horticulturae**; Springer Publishers, since 2010.
- Co-editor of books
 - Guidelines for Management of Plant Genetic Resources in India, 2016.
 - Plant Genetic Resources: Foodgrain Crops, 2006.
 - Plant Genetic Resources: Horticultural Crops, 2005.
 - Plant Genetic Resources: Oilseed and Cash Crops, 2004.
 - Plant Genetic Resources Management, 2004.
 - Transgenic Crops and Biosafety Concerns, 2001.
 - *Ex-Situ* Conservation of Plant Genetic Resources, 1994.
- Editor/Co-editor of proceedings/reports/monographs/manuals/bulletins
 - *Proceedings of National Symposium on Crop Improvement and for Inclusive Sustainable Development*. ISGPB, ISPGR, MTAI, CSI, PAU, ICAR, November 7-9, 2014, 1007 p.
 - *Training Manual for Conservation of Orthodox Seeds in Genebank*. ICAR-NBPGR, New Delhi, p141.

- *Genetic Resources of Pigeonpea [Cajanus cajan (L.) Millspaugh] – Conservation and Use*. ICAR-NBPGR, New Delhi, p. 57.
- *Conservation of Trait-Specific Germplasm of Brassicas in National Genebank*. ICAR-NBPGR, New Delhi, p. 114.
- *National Symposium on Recent Global Developments in the Management of Plant Genetic Resources - Proceedings and Recommendations*. Indian Society of Plant Genetic Resources, New Delhi, 41 p.
- *Inventory of Registered Crop Germplasm (2009-2010)*. National Bureau of Plant Genetic Resources, Pusa Campus, Indian Council of Agricultural Research (ICAR), New Delhi, 75 p.
- *National Symposium on Recent Global Developments in the Management of Plant Genetic Resources, 17-18 December 2009. Souvenir and Abstracts*. Indian Society of Plant Genetic Resources, New Delhi, 368 p.
- *ISPR Year Book*. Indian Society of Plant Genetic Resources, New Delhi, 112 p.
- *Proceedings of the Research Advisory Committee Meeting*, 2010. NBPGR, New Delhi.
- *Proceedings of the Research Advisory Committee Meeting*, 2011. NBPGR, New Delhi.
- *Project Completion Report of Development of cryopreservation protocols in banana and ginger* (July 2004 - March 2008). DST, New Delhi.
- *Proceedings of the Research Advisory Committee Meeting*, July 30-31, NBPGR, New Delhi.
- *Report on AGROWEB – Digital Dissemination System For Indian Agricultural Research (ADDSIAR)*. NBPGR, New Delhi.
- Report on *In Vitro Conservation of Plant Biodiversity*. NATP funded sub-project on 'Sustainable Management of Plant Biodiversity' [Sub-project III (C)]. Final report (1999-2004). National Agriculture Technology Project, New Delhi, 10 p.
- *Project Completion Report of National Facility for Plant Tissue Culture Repository Project. (1997-2002)*. Department of Biotechnology, New Delhi, 26 p.
- *Report of the Technical Meeting on the Methodology of the World Information and Early Warning System on Plant Genetic Resources*. Food and Agriculture Organization of the United Nations, Rome and NBPGR, New Delhi, 157 p.

ONGOING RESEARCH PROJECTS

Project	Funding Agency (Duration), Funds (USD)
1. <i>Ex situ</i> conservation of plant genetic resources of agricultural and horticultural crops using conventional methods (Head of Division & Programme Leader)	ICAR (2009 onwards)
2. <i>Ex situ</i> conservation of genetic resources of vegetatively propagated crops using <i>in vitro</i> and cryopreservation techniques (Programme Leader)	ICAR (2000 onwards)
3. Consortium Research Project on Agrobiodiversity (Lead Centre Project Coordinator)	ICAR (2012-2017); USD 24.3 million
4. Establishment of National Rice Resource Database (Co-Principal Investigator)	Department of Biotechnology, Government of India; USD 10.8 million
5. Acquisition, evaluation and identification of climate resilient wheat and rice genetic resources for tolerance to heat, drought and salt stresses (Co-Principal Investigator)	National Initiative on Climate Resilient Agriculture of the ICAR (2011-2016), USD 329,558
6. Rationalization of rice collections originating from major areas of diversity and allele mining in selected unique set	ICAR; USD 243,333

of accessions for biotic, abiotic and quality traits using molecular markers

COMPLETED RESEARCH PROJECTS

Project	Funding Agency (Duration)	Location
1. Harmonizing biodiversity conservation and agricultural intensification through integration of plant, animal and fish genetic resources for livelihood security in fragile ecosystems (CCPI)	National Agricultural Innovation Project (NAIP), World Bank (2010- 2014)	NBPGR, New Delhi
2. AGROWEB - Digital Dissemination System for Indian Agricultural Research (ADDSIAR) (Principal Investigator)	NAIP, World Bank (July 2008- March 2014), USD 826,660	NBPGR, New Delhi
3. Conserving banana diversity for use in perpetuity (Co-Principal Investigator)	Global Crop Diversity Trust (GCDT) through the Bioversity International, Montpellier, France (March 2009- Dec 2011), USD 60,400	Tissue Culture and Cryopreservation Unit (TCCU), NBPGR, New Delhi
4. ICAR network project on transgenic crops – Rice (Co-PI)	ICAR (March 2009 -2014), USD 233,327	NBPGR, New Delhi
5. Field level conservation of germplasm with community participation and establishing nurseries on shared basis with community to improve rural income: a project for Jharkhand (Co-Principal Investigator)	Department of Science and Technology (DST), GOI (2011-2014), USD 24,827	NBPGR, New Delhi
6. Development of cryopreservation protocols in banana and ginger (Co-Principal Investigator)	DST, GOI (2004-08)	TCCU, NBPGR, New Delhi
7. Conservation of Plant Biodiversity – <i>In Vitro</i> Conservation (Co-Principal Investigator)	World Bank funded National Agriculture Technology Project (NATP) (1997-2003), USD 63,068	TCCU, NBPGR, New Delhi
8. HRD under Team of Excellence Mode (Co-Principal Investigator)	World Bank funded NATP (1997-2003)	NBPGR, New Delhi
9. Conservation of genomic DNA (Principal Investigator)	ICAR (1998-2001)	TCCU, NBPGR, New Delhi
10. Development of soybean rust resistant fertile lines and hybrids (<i>Glycine max</i> x <i>G. tomentella</i>) through embryo rescue techniques (Co-Principal Investigator)	University of Illinois, USA, (2002)	Department of Crop Sciences, University of Illinois, Urbana, IL, USA
11. National containment/quarantine facility for transgenic planting material (Co-Principal Investigator)	DBT, GOI (1999-2001), USD 405,790	NRC on DNA Fingerprinting, NBPGR, New Delhi

12	National Facility for Plant Tissue Culture Repository (NFPTCR) (Principal Investigator/Co-Principal Investigator)	DBT, GOI [PI (1999-2001); Co-PI (1996-1999)] USD 383,741	TCCU, NBPGR, New Delhi
13	Processing of germplasm collections for variability and moisture content for long-term storage (Co-Principal Investigator)	ICAR (1993-96)	Division of Germplasm Conservation, NBPGR, New Delhi
14	Monitoring the viability of seed accessions in genebank (Co-Principal Investigator)	ICAR (1993-96)	Division of Germplasm Conservation, NBPGR, New Delhi
15	Critical evaluation of seed viability and vigour in important agri-horticultural crops under different storage regimes (Co-Principal Investigator)	ICAR (1993-96)	Division of Germplasm Conservation, NBPGR, New Delhi
16	Selection of salt-tolerant somaclonal variants in oilseed brassicas (Senior Research Fellow)	Council of Scientific and Industrial Research, Government of India (1990-93)	Department of Botany, University of Delhi, Delhi
17	Collection, conservation, evaluation, documentation and distribution of genetic resources of French bean (Co-PI)	ICAR (1986-89)	NBPGR, Regional Station, Shimla, Himachal Pradesh
18	Conservation, documentation, and distribution of genetic resources of fodder legumes, grasses and other miscellaneous crops (Co-PI)	ICAR (1986-89)	NBPGR, Regional Station, Shimla, Himachal Pradesh
19	Biological nitrogen fixation by <i>Azotobacter</i> and <i>Azospirillum</i> ; development of low-cost carrier material for biofertilizers (Technical Assistant)	ICAR (1982-86)	Division of Microbiology, IARI, New Delhi
20	Survey and surveillance of wheat and rice diseases in India (Senior Research Fellow)	ICAR (1981-82)	Division of Mycology and Plant Pathology IARI, New Delhi

MAJOR RESEARCH ACHIVEMENTS

1. *Ex situ* conservation of plant genetic resources

- (a) *National Genebank Management* : Facilitated in the rationalization of about 0.43 million accessions of agriculturally important species (~1778 spp.) conserved in the Indian National Genebank through physical verification, database updation and supply of seeds for correct identification/multiplication. Initiated a programme for pest-free conservation of seeds. A dynamic customized on-line PGR Portal has been developed for germplasm conserved in the genebank.
- (b) *Orthodox seed germplasm* : *Ex situ* conservation of germplasm of cereals (rice, barley, maize, oat, wheat), pseudo-cereals (amaranth, buckwheat), vegetables (solanaceous, cucurbitaceous, French bean, cole crops, onion, garlic), oilseeds (*Brassica* complex) and legumes (French bean, chickpea,

pigeonpea, lentil, soybean) in National Seed Genebank (at -20°C and 4°C); identified the biochemical markers for early and progressive deterioration in seeds of mustard, soybean, lentil and amaranth; simulation of natural ageing with artificial ageing as indicator of seed deterioration; applied embryo culture methods to test the viability of dormant seeds of wild species of crop germplasm.

- (c) *Vegetatively propagated crop germplasm* : *In vitro* conservation of germplasm of root and tuber crops (including sweet potato, taro, yams), fruits (including banana and plantains, strawberry) in the *In vitro* Genebank; developed micropropagation and *in vitro* conservation protocols for wild and cultivated species of root and tuber crops ; somatic embryogenesis in wild *Piper* species; cost-efficient conservation of turmeric using alternative carbon source and gelling agent in media; conservation through *in vitro* rhizome formation and corm formation in tuber and spices crops; cryopreservation of banana and ginger; documentation of *in vitro*-conserved germplasm.
- (d) *Cryopreservation of pollen* : Cryopreserved pollen of soybean (*Glycine max*) and its wild species (*G. tomentella* and *G. canescence*) in liquid nitrogen (-196 °C); cryopreserved pollen successfully used for hybridization in *G. max* and *G. tomentella*.
- (e) *Genetic stability of conserved germplasm* : Identified the biochemical markers and molecular markers in wild and cultivated germplasm of banana, ginger, turmeric, taro, hops to assess the genetic stability of *in vitro*-conserved and cryopreserved germplasm.
- (f) *DNA banking* : Initiated the protocol development for conservation of genomic DNA of wild and endangered species of spices, medicinal and aromatic plants.

2. Collection, characterization, evaluation of plant germplasm

On the basis of gap analysis in the genebank, collected germplasm of cereals and legumes from North-western, and banana, ginger, turmeric, taro, yams North-eastern Himalayas for long-term conservation in National Genebank; field trials and evaluation of amaranth and French bean germplasm; identified the stable genotypes for green pod yield in French bean. Under CRP on Agrobiodiversity about 42,000 accessions of various field crops (cereals, legumes, millets, oilseeds, vegetables, spices) have been characterized for 22- 35 descriptors. Accessions of wheat (~20,000) evaluated for rusts (black, brown, yellow), ~ 5,000 for Karnal bunt, spot blotch diseases. Core sets developed in wheat, chickpea (using morphological markers), rice (using SNPs); genetic stability and diversity analyses of several agri-horticultural crop germplasm using morphological and molecular markers.

3. Soybean germplasm enhancement

Development of amphiploid hybrid (*Glycine max* x *G. tomentella*) through embryo rescue techniques; multiplication of hybrids using tissue culture techniques; testing hybridity using SSR markers; development of soybean rust resistant fertile lines derived from *G. tomentella*.

4. Salt tolerance in oilseed brassicas

Using *in vitro* techniques, development of salt-tolerant somaclones of oilseed brassicas, tested for salt tolerance up to F₂ in 12 dS/m soil salinity in field; demonstrated that pollen serve as reliable system for screening of large germplasm of oilseed brassicas for salt tolerance instead of whole plants.

5. Diseases in cereals and biological nitrogen fixation in legumes

Surveillance of wheat and rice diseases to forecast the disease occurrence in field; development of low-cost carrier material particularly agricultural wastes (paddy straw, baggasse) for *Azotobacter*- and *Azospirillum*-based biofertilizers.

RESEARCH MANAGEMENT EXPERIENCE (LEADERSHIP ATTRIBUTES)

(A) *Research Project/Programme Management, Co-ordination and Planning as Head, Division of Germplasm Conservation & Principal Scientist, NBPGR*

- Monitoring and evaluation of 10 research projects related to PGR conservation using conventional approaches (2009 to date).
- Monitoring and evaluation of 6 research projects related to germplasm collection, evaluation, conservation and utilization of mandated crops at NBPGR Regional Stations, Bhowali (N.W Himalayas) and Jodhpur (Arid zone) (2009 to date).
- Monitoring and evaluation of 7 research projects related to *ex situ* conservation of genetic resources of vegetatively propagated crops using *in vitro* and cryopreservation techniques (1997 to date).
- Coordination of two network projects for rationalization of rice germplasm for promotion of its effective conservation and use (2009 to date).
- Coordination of activities for PGR database management (2009 to date).
- Operational management of National Genebank (17 modules at -20°C) and Medium-Term Modules (MTM) (11 modules at +4°C) at Regional Stations of NBPGR and National Active Germplasm Sites (NAGS); Operational management of *In Vitro* Genebank (6 culture rooms and 5 cryotanks) and 10 laboratories.
- As Secretary, Institute Research Council (IRC), NBPGR, New Delhi, coordinated 6 IRC meetings and other related works, maintained 101 Research Project Files (RPFs I, II, III) of 108 scientists working on various aspects of PGR management (HQ and 10 regional stations) (2004-2007).
- Co-ordinated the visits of eminent scientists/policy makers and foreign visitors (from developed and developing countries) to *ex situ* conservation facilities at NBPGR, and participated in the academic and policy-related discussion with them.
- Involved in preparation of Perspective Plan of research at NBPGR, Vision 2020 and 2025.
- Planning the experiments; purchase of equipments, consumables, works and other stores for EFC of IX, X and XII Plan for *ex situ* conservation of germplasm.

(B) *Administrative and Financial Management*

- Supervision and monitoring the progress of scientists (22), technical personnel (16), supporting and auxiliary staff (47) of the Division of Germplasm Conservation, NBPGR Regional Stations, Bhowali and Jodhpur (total 85 staff).
- Financial management of 16 research projects (currently)
- As **Store and Purchase Officer** (1997-2004), for NBPGR, New Delhi and its 10 Regional Stations plan (contingency) and non-plan budget of ICAR, NATP (World Bank), DBT, DST, MoEF was utilized to effect the purchase of equipments, consumables, works and other stores.
- **Member-Secretary** (1998-2002), Purchase Advisory and Monitoring Committee, NBPGR, New Delhi.
- **Liaison Officer** for recruitment/ promotion of SCs/STs/OBCs, Nominated by Director General, ICAR New Delhi, 2007-to date.

(C) Infrastructure Development

- **Medium-term storage module** for installation at NBPGR Regional Station, Hyderabad for use by Directorate of Sorghum Research, Hyderabad, to conserve one set of all the sorghum germplasm.
- **Transit-storage facility** in the Division of Germplasm Conservation, NBPGR, New Delhi, for storage of germplasm meant for storing the seeds at 15°C and 35% RH during processing period for long-term conservation.
- **Molecular biology laboratory** in the Division of Germplasm Conservation, to study the molecular aspects of seed deterioration under storage.
- **Modernization of class room** and **computer room** for PGR students of PG School, IARI, New Delhi.
- Establishment and expansion of ***In Vitro* Genebank**, other laboratories, and greenhouse in the Tissue Culture and Cryopreservation Unit, NBPGR, New Delhi.
- **Laboratory** to study the **genetic stability** of *in vitro*-conserved germplasm using biochemical and molecular methods, in the Tissue Culture and Cryopreservation Unit, NBPGR, New Delhi.
- **CL4 containment facility** for transgenic crops at NBPGR, New Delhi.

(D) Linkages Established

- Under the project on 'Establishment of National Plant Variety Repository for Implementation of PPVFRA legislation', linkages established with Protection of Plant Varieties and Farmer's Rights Authority, New Delhi.
- Under a project on banana cryopreservation, funded by the Global Crop Diversity Trust, collaboration with Bioversity International, Montpellier, France & New Delhi, Katholieke Universiteit Leuven, Belgium and NRC on Banana, Tiruchirapalli. (2009 to date).
- As Programme Leader and resource person in 7 international training courses on "In Vitro Conservation and Cryopreservation" held at NBPGR in 2000, 2006-10, linkages established with >50 trainees/participants from 18 countries like the Bhutan, Colombia, Czech Republic, Egypt, Fiji Islands, Indonesia, Malaysia, Papua New Guinea, Philippines, Saudi Arabia, South Africa, Sri Lanka, Taiwan, Thailand, Vietnam, Nepal, Nigeria, Mauritius, besides participants from India.
- Under the Agroweb project, partnership in consortium mode with Central Institute of Brackishwater Aquaculture (CIBA), Chennai; Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad; Indian Agricultural Research Institute (IARI), New Delhi; Indian Council of Agricultural Research (ICAR), New Delhi; Indian Institute of Horticultural Research (IIHR), Bangalore; National Academy of Agricultural Research Management (NAARM), Hyderabad; National Centre for Integrated Pest Management (NCIPM), New Delhi and National Dairy Research Institute (NDRI), Karnal (2009-11).
- Under the ICAR Network Project On Transgenic Crops – Rice, networking with NRC on Plant Biotechnology (2009-to date).
- Under the project Establishment of Rice Resource Database, linkages with 7 national institutes.
- In the NATP subproject on 'Conservation of Plant Biodiversity – *In Vitro* Conservation', collaborations developed with NRC on Banana, Trichy, Indian Institute of Spices Research Calicut, Dr YS Parmar University of Horticulture and Forestry, Solan, Central Tuber Crop Research Institute, Trivandrum and HPKV Palampur.

AWARDS AND RECOGNITION

Award of Associateship/Fellowship

- **Distinguished Scientist Award 2011** for recognition in the field of Management of Plant Genetic Resources by Society for Recent Development in Agriculture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, India, October 9, 2011.
- **Research Associateship**, Crop Science, University of Illinois, Urbana, IL, USA, 2002.
- **Senior Research Fellowship**, Council of Scientific and Industrial Research, New Delhi, India, 1991-93.
- **Senior Research Fellowship**, Indian Council of Agricultural Research, New Delhi, India 1981-83.

Professional Societies

- **Fellow General Secretary**, Confederation of Horticulture Associations of India, New Delhi, 2015.
- **Fellow**, Indian Society of Plant Genetic Resources (ISPGR), New Delhi, India, 2008.
- **Fellow**, Indian Society of Seed Science and Technology, New Delhi, India, 2007.
- **Vice President**, ISPGR, New Delhi, India, 2010-2015.
- **Editor-in-Chief**, IJPGR, ISPGR, New Delhi, India, 2010-2015; 2001-02.
- **Member, Editorial Board**, Indian Horticulture, ICAR, New Delhi, India, 2009 to date.
- **General Secretary**, ISPGR, New Delhi, India, 2015-till date; 2007-2009; 2006-2007.
- **Member, Editorial Board**; IJPGR, ISPGR, New Delhi, India, 1997-1998.
- **Member of Executive Council** as Councilor (North Zone), ISPGR, New Delhi, India, 1994-1996.
- **Joint Secretary**, Agricultural Research Service Scientists' (ARSS) Forum (Central Unit), India, 2000-2004.
- **Secretary**, ARSS Forum (NBPGR Unit), New Delhi, 2004-till date.
- **Member**, International Society for the Advancement of Breeding Researchers in Asia and Oceania (SABRAO).
- **Life Member**, Indian Society of Genetics and Plant Breeding, IARI, New Delhi, India.
- **Life Member**, Indian Society of Biochemistry and Biotechnology, IARI, New Delhi, India.
- **Life Member**, Association for Improvement in Production and Utilization of Banana, Tiruchirapalli, India.

Member-Secretary/Member of Important Committees/Policy Making Bodies

- Represented India in the '**Global Consultation on Use and Management of Agrobiodiversity for Sustainable Food Security**', 12-14 February, 2013, at New Delhi. The meeting was organized by Bioversity International, Rome in collaboration with NBPGR/ICAR and support from ITPGRFA, Rome, FAO, Rome, APAARI, New Delhi, ICRISAT, Hyderabad and ICARDA, Syria. Some 55 international and 60 national participants comprising Heads of National Genebanks as well as users of PGR from developing countries attended.
- Represented India and participated in **Genebank Managers' Consultation Meeting on GENESYS** held at CIMMYT, Mexico, December 6-9, 2011.
- Identified as a key **Genebank Expert** from India by FAO and Bioversity International, Rome, to update the 'Genebank Standards' published by FAO in 1994. Invited for a meeting held in Rome in Sept. 2010 by experts from FAO, Bioversity International, Global Crop Diversity Trust and the secretariats of International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and Commission on Genetic Resources for Food and Agriculture (CGRFA) to review the first draft prepared for further discussions with a larger group of genebank experts.
- **Member, Research Advisory Committee (RAC)** of NRC on Banana, Tiruchirapalli, August 2012-15.

- **Member, Institute Management Committee (IMC)** of National Bureau of Fish Genetic Resources (NBFGR), Lucknow , January 2013 - 2016.
- **Member (Advisor)**, Screening and Selection Committee for promotion of Senior Scientists to Principal Scientists (Genetics and Cytogenetics), ASRB, New Delhi, December 10, 2013.
- **Member**, DPC Committee, Indian Institute of Maize Research, New Delhi.
- **Member-Secretary, Plant Germplasm Registration Committee** of ICAR, New Delhi, 2009 to date.
- **Member-Secretary, Research Advisory Committee**, NBPGR, New Delhi, 2008-2011.
- **Member, Institute Technology Management Committee**, NBPGR, New Delhi, 2007 to date.
- **Member, Germplasm Handling Unit**, National Genebank, NBPGR, New Delhi, 1999-2009.
- Nominated **Member, Technical Advisory Committee** of Centre for Plant Biotechnology, Centre for Plant Biotechnology, Hisar, Haryana, 2005-2008.
- **Member-Secretary, Institute Research Council**, NBPGR, New Delhi, 2004-2007.
- **Member**, Committee to examine the matters/anomalies concerning the 5th Pay Commission in respect of Scientific and Technical Staff of ICAR, Nominated by DG, ICAR, New Delhi, 1995.

TEACHING AND TRAINING EXPERIENCE

- **Faculty member (PGR)** of PG School, IARI (1997 to date) : Course Leader, *Economic Botany and Plant Genetic Resources*; Course Associate, *Advanced Economic Botany*; Chaiman, Co-chairman, Member, Advisory Committee of PGR and Biotechnology students, IARI, New Delhi.
- **Chairman/External supervisor** of six M.Sc. (PGR and Biotechnology) students and four Ph.D. student; external examiner of universities for PGR and biotechnology.
- **HRD programmes undertaken ; Resource Person/organizing committee member** : 11 trainings on *ex situ* conservation of PGR, biosafety and IPRs and 6 international and national conferences/symposia.

TRAININGS RECEIVED

S. No.	Title	Institution	Year (duration)
1.	Management Development Programme on Leadership Development	National Academy of Agricultural Research and Management (NAARM), Hyderabad, India	2012 (12 days)
2.	Technological and management aspects of banana cryobanking	Katholieke Universiteit Leuven, Leuven, Belgium	2009 (15 days)
3.	Advances in designing and analysis of agricultural experiments	Indian Agricultural Statistics Research Institute, New Delhi, India	2005 (21 days)
4.	Data management and documentation for genetic resources	NBPGR, New Delhi and International Rice Research Institute (IRRI), Manila, Philippines	1998 (18 days)
5.	Recent techniques on plant molecular biology and biotechnology	National Research Centre on Plant Biotechnology, New Delhi, India	1998 (19 days)
6.	Plant raising techniques in controlled environment	Indo-American Hybrid Seeds, Bangalore, Karnataka, India	1996 (11 days)
7.	Greenhouse systems, designs, operation and maintenance	Winrock International and Sharp Distribution Inc. under Indo-USAID	1996 (4 days)

		PGR Project at NBPGR, New Delhi, India	
8.	Conservation of plant genetic resources	NBPGR, New Delhi, India	1993 (16 days)
9.	Agricultural research project management	NAARM, Hyderabad, India	1988 (6 months)

List of Publications of Rishi Kumar Tyagi

Research Papers (Refereed Journals)	:	78
Books/Practical Manuals/Monographs	:	22
Book Chapters / Policy Papers	:	40
Popular Articles/ Bulletins/ Short Communications	:	14
Journals Edited (No. of Issues)	:	32
Papers/Abstracts in Proceedings	:	73
Reports, thesis, E publications	:	13
Invited Lectures in International training/ symposium	:	31
Invited lectures in National symposium/ training	:	31
TOTAL	:	334

Research Papers (78)

1. Sundeep Kumar, Sunil Archak, **RK Tyagi**, Jagdish Kumar, Vikas VK, Sherry R Jacob, Kalyani Srinivasan, J Radhamani, R Parimalan, M Sivaswamy, Sandhya Tyagi, Mamata Yadav, Jyotisna Kumari, Deepali, Sandeep Sharma, Indoo Bhagat, Madhu Meeta, NS Bains, AK Chowdhury, BC Saha, PM Bhattacharya, Jyoti Kumari, MC Singh, OP Gangwar, P Prasad, SC Bharadwaj, Robin Gogoi, JB Sharma, Sandeep Kumar GM, MS Saharan, Manas Bag, Anirban Roy, TV Prasad, RK Sharma, M Dutta, Indu Sharma and KC Bansal 2016. Evaluation of 19,460 Wheat Accessions Conserved in the Indian National Genebank to Identify New Sources of Resistance to Rust and Spot Blotch Diseases. *PLoS One* 11(12), e0167702.
2. Singh N., Choudhury D.R., Tiwari G., Singh, A.K., Kumar S., Srinivasan K., **Tyagi R.K.**, Sharma A.D., Singh N.K. and Singh R., 2016. Genetic diversity trend in Indian rice varieties: an analysis using SSR markers. *BMC Genetics* 17(1):127.
3. Archak S., **R.K. Tyagi**, P.N. Harer, L.B. Mahase, N Singh, O.P. Dahiya, M.A. Nizar, M. Singh, V.Tilekar, V. Kumar and M. Dutta 2016. Characterization of chickpea germplasm conserved in the Indian National Genebank and development of a core set using qualitative and quantitative trait data. *The Crop Journal* 4(5), pp.417-424.
4. Kumari J., Singh T.P., Kumar S., Bansal, R., Kumar S., Singh, S.K., Jha G.K., Kumar S., Kaur V., Jacob S.R. and **Tyagi R.K.** 2016. Morpho-Physiological Attributes of Cultivated Wheat Germplasm for high yield potential under Rain fed condition. *Biotech Today: An International Journal of Biological Sciences* 6(1):13-17.

5. Trivedi A.K., S.K. Verma and **R.K. Tyagi**. 2016. Variability in morpho-physiological traits and antioxidant potential of *Rubus* species in Central Himalayan Region. *Industrial Crops and Products* 82, pp.1-8.doi:10.1016/j.indcrop.2015.12.022.
6. **Tyagi R.K.** 2016.Conservation of PGR for effective utilisation : New initiatives at NBPGR. *Indian Journal of Plant Genetic Resources* 29(3): 272-277.
7. Jacob S.R., V. Tyagi, A. Agrawal, S.K. Chakrabarty and **R.K. Tyagi**. 2015. Indian plant germplasm on the global platter: An analysis. *PLoS ONE* DOI:10.1371/journal.pone.0126634, 1-15.
8. Rana J.C., T.R. Sharma, **R.K. Tyagi**, R.K. Chahota, N.K. Gautam, M. Singh, P.N. Sharma and S.N. Ojha. 2015. Characterisation of 4,274 accessions of common bean (*Phaseolus vulgaris* L.) germplasm conserved in the Indian Gene Bank for phenological, morphological and agricultural traits. *Euphytica* DOI 10.1007/s10681-015-1406-3
9. Trivedi A.K., L. Arya, M. Verma, S.K. Verma, **R.K. Tyagi** and A. Hemantaranjan. 2015. Genetic variability in proso millet [*Panicum miliaceum*] germplasm of Central Himalayan Region based on morpho-physiological traits and molecular markers. *Acta Physiologia Plantarum* 37(2): DOI 10.1007/s11738-014-1770-y.
10. Trivedi A.K., S.K. Verma, R.R. Arya and **R.K. Tyagi**. 2015. Genetic diversity in antioxidant potential and stomatal behaviour of peach in Central Himalayan region. *Journal of Environmental Biology* 36: e669-e675.
11. Trivedi A.K., S.K. Verma, R.R. Arya and **R.K. Tyagi**. 2015. Variability in morpho-physiological traits and antioxidant potential of kiwifruit (*Actinidia chinensis* Planch) in Central Himalayan Region. *Journal of Environmental Biology* 36: 1051-1056.
12. Sharma A.D., S.V.S. Rathore, K. Srinivasan and **R.K. Tyagi** . 2015. Cultivar-specific seed priming improves the field performance in three cultivars of okra *Abelmoschus esculentus* (L.) Moench). *Indian Journal of Agricultural Science* (accepted).
13. **Tyagi R.K.** and A. Agrawal. 2015. Revised genebank standards for management of plant genetic resources. *Indian Journal of Agricultural Sciences* 85: 157–165.
14. Radhamani J., Z. Khan, S. Sahai and **R.K. Tyagi**. 2015. Nutritional quality analyses of traditional varieties of rice (*Oryza sativa*) collected from tribal areas in eastern India. *Indian Journal of Agricultural Sciences* 85: 266–269.
15. Kak A. and **R.K. Tyagi**. 2015. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 28 (3): 356-370
16. Choudhury D.R. , N. Singh, A.K. Singh, S. Kumar, K. Srinivasan, **R.K. Tyagi**, A. Ahmad, N.K. Singh and R. Singh. 2014. Analysis of genetic diversity and population structure of rice germplasm from North-eastern region of India and development of a core germplasm set. *PLoS ONE* 9 (11): e113094, 1-12.
17. Vikas V.K., M. Sivasamy, J. Kumar, P. Jayaprakash, S. Kumar, R. Parimalan, A. Kumar, K. Srinivasan, J. Radhamani , S.R. Jacob, M. Yadav, J. Rani, I.S. Bisht, D.C. Bhandari, S. Archak, M. Dutta, **R.K. Tyagi** , K.C. Bansal. 2014. Stem and leaf rust resistance in wild relatives of wheat with D genome (*Aegilops* spp.) *Genetic Resources and Crop Evolution* 61:861-874
18. Mehta P.S., S.N. Ojha, K.S. Negi, S.K. Verma, A. Rayal and **R.K. Tyagi**. 2014. On-farm status of rice (*Oryza sativa* L.) genetic resources in Garhwal Himalaya of Uttarakhand, India *Genetic Resources and Crop Evolution* DOI 10.1007/s10722-014-0110-9
19. Sharma A.D., S.V.S Rathore, K. Srinivasan and **R.K. Tyagi**. 2014. Comparison of various seed priming methods for seed germination, seedling vigour and fruit yield in okra (*Abelmoschus esculentus* L. Moench). *Scientia Horticulturae* 165: 75-81
20. Agrawal A., R. Sanayaima, R. Singh, R. Tandon, S. Verma and **R.K. Tyagi**. 2014. Phenotypic and molecular studies for genetic stability assessment of cryopreserved banana meristems derived

- from field and in vitro explant sources *In Vitro Cellular and Developmental Biology – Plant* 50:345–356
21. Sivasamy M., M. Aparna, J. Kumar, P. Jayaprakash, V.K. Vikas, P. John, R. Nisha, K. Srinivasan, J. Radhamani, S.R. Jacob, S. Kumar, Satyaprakash, K. Sivan, E. Punniakotti, **R.K. Tyagi** and K.C. Bansal. 2014. Phenotypic and molecular confirmation of durable adult plant leaf rust resistance (APR) Genes *Lr34+*, *Lr46+* and *Lr67+* linked to Leaf Tip Necrosis (LTN) in select registered Indian wheat (*T. aestivum*) genetic stocks. *Cereal Research Communications* 42(2) 262–273; erratum 42(4):721.
 22. Trivedi A.K., S.K. Verma, R.R. Arya, P.S. Mehta and **R.K. Tyagi**. 2014. Variability in vegetative characters and yield attributes of raspberry (*Rubus* spp.) in Uttarakhand Himalayas. *International Journal of Fruit Science* 14(1): 107-116
 23. Agrawal A. and **R.K. Tyagi**. 2014. *In vitro* conservation and cryopreservation of genetic resources of *Musa* spp. - A review of the recent developments with special reference to India. *International Journal of Innovative Horticulture* 3(2):115-133.
 24. Agrawal A., S. Verma, N. Sharma, P. Vijay, D.P.S. Meena and **R.K. Tyagi**. 2014. Cryoconservation of some wild species of *Musa* L. *Indian Journal of Genetics and Plant Breeding* 74(4): 665-669.
 25. Pandey S., **R.K. Tyagi**, C. Devi, N. Singh and S.K. Yadav. 2014. Conservation and exchange of genetic resources in major vegetable crops. *Indian Journal of Horticulture* 71(2): 281-283.
 26. Kumar J., K.C. Bansal, **R.K. Tyagi**, V.K. Vikas, S. Kumar, P. Jayaprakash, G. P. Singh, R. Yadav, M. Sivasamy. 2014. Adult plant resistance to leaf rust (*Puccinia triticina*) in some Indian bread wheat (*Triticum aestivum*) accessions bearing leaf tip necrosis. *Indian Journal of Agricultural Sciences* 84: 112-118.
 27. Kak A. and **R.K. Tyagi**. 2014. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 27 (3): 277-291.
 28. Kak A. and **R.K. Tyagi**. 2014. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 27 (2): 181-199.
 29. Kak A. and **R.K. Tyagi**. 2014. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 27 (1): 66-89.
 30. Singh N., D.R. Choudhury, A.K. Singh, S. Kumar, K. Srinivasan, **R.K. Tyagi**, N.K. Singh, R. Singh. 2013. Comparison of SSR and SNP markers in estimation of genetic diversity and population structure of Indian rice varieties. *PLoS ONE* 8(12) e84136: 1-14
 31. Singh M., O.P. Dahiya, N. Singh, M. Dutta, **R.K. Tyagi**, P.N. Harer, L.B. Mahase, N.P. Singh and K.C. Bansal. 2013. Identification of an upright peduncle and podding genotype in chickpea germplasm conserved in the National Genebank. *Indian Journal of Plant Genetic Resources* 26 (2): 88-90.
 32. **Tyagi R.K.** and A. Agrawal. 2013. *Genebank Standards - Revised Guidelines Adopted by FAO*. *Current Science* 104 (12): 1600-1601.
 33. Srinivasan, K., J. Radhamani, T. Kalkande, and **R.K. Tyagi** 2013. Removal of tenacious glumes enhances the seed germination and seedling vigour in eight *Aegilops* species for efficient conservation in genebank. *Indian Journal of Agricultural Sciences* 83(4):437-440.
 34. Kak A. and **R.K. Tyagi**. 2013. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 26 (3): 252-263.
 35. Singh T.P., P.S. Deshmukh, J. Kumar, **R.K. Tyagi** and M. Dutta. 2013. Morpho-physiological evaluation of chickpea (*Cicer arietinum* L.) cultivars under restricted soil moisture conditions. *Indian Journal of Plant Genetic Resources* 26 (2): 84-87.
 36. Trivedi A.K., H. Krishna, S.K. Verma, **R.K. Tyagi** and R.R. Arya. 2013. Genetic diversity in pear (*Pyrus* spp.) in Uttarakhand Himalayas. *Indian Journal of Plant Genetic Resources* 26 (1): 32-37.

37. Singh O., A.K. Singh and **R.K. Tyagi**. 2013. A note on crinkle leaf virus disease resistant accessions of mothbean (*Vigna aconitifolia* (Jacq.) Marechal). *Indian Journal of Plant Genetic Resources* 26: 249-251.
38. Kak A. and **R.K. Tyagi**. 2013. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 26 (2): 173-192.
39. Kak A. and **R.K. Tyagi**. 2013. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 26 (1): 86-101.
40. Agrawal R.C., S. Archak and **R.K. Tyagi**. 2012. An overview of biodiversity informatics with special reference to plant genetic resources. *Computers and Electronics in Agriculture* 84:92-99.
41. **Tyagi R.K.** and Kak A. 2012. Registration of plant genetic resources in India – A review. *Indian Journal of Agricultural Science* 82:651-659
42. Kak A. and **R.K. Tyagi**. 2012. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 25(3): 311-326.
43. Sharma N., R. Satsangi, R. Pandey, R. Singh, N. Kaushik and **R.K. Tyagi**. 2012. *In vitro* conservation of *Bacopa monnieri* (L.) using mineral oil. *Plant Cell Tissue and Organ Culture* 11:291-301
44. Sharma A.K., M.S. Saharan, I. Sharma. M. Singh, S. Kundu, B.S. Phogat, M. Meena, D. Shikha, K. Srivastava, S.P. Singh, S.S. Vaish, P.C. Mishra, B.K. Honrao, I.K. Kalappanavar, V.A. Solanki, K. Srinivasan, S.R. Jacob and **R.K. Tyagi**. 2012. Identification of diverse germplasm of multiple disease resistance in wheat. *Indian Journal of Plant Genetic Resources* 25(2): 238-245.
45. Kak A. and **R.K. Tyagi**. 2012. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 25(2): 197-221.
46. Agrawal A, **R.K. Tyagi**, R. Goswami, S. Uma, M.S. Saraswathi and P. Durai. 2011. Cryobanking of banana (*Musa* sp.) germplasm in India: Evaluation of agronomic and molecular traits of cryopreserved plants. *Acta Horticulturae* 908: 129-138.
47. Kak A. and **R.K. Tyagi**. 2011. Plant germplasm registration notice. *Indian Journal of Plant Genetic Resources* 24(1): 97-120
48. Bonham C.A., E. Dulloo, P. Mathur, P. Brahmi, V. Tyagi, **R.K. Tyagi** and H.D. Upadhyay 2010. Plant genetic resources and germplasm use in India. *Asian Biotechnology and Development Review* 12: 17-34.
49. Agrawal A., R. Sanayaima, R. Tandon and **R.K. Tyagi** 2010. Cost-effective *in vitro* conservation of banana using alternatives of gelling agent (isabgol) and carbon source (market sugar). *Acta Physiologia Plantarum* 32 : 703-711.
50. Sundararaj S.G., A. Agrawal and **R.K. Tyagi** 2010. Encapsulation for *in vitro* short-term storage and exchange of ginger (*Zingiber officinale* Rosc.) germplasm. *Scientia Horticulturae* 125 : 761-766.
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53. Hussain Z., **R.K. Tyagi**, R. Sharma and A. Agrawal 2008. Genetic diversity in *in vitro*-conserved germplasm of *Curcuma* L. as revealed by RAPD markers. *Biologia Plantarum* 52:627-633.
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55. Agrawal A., **R.K. Tyagi** and R. Goswami 2008. Cryopreservation of subgroup Monthan (ABB) of Indian cooking bananas (*Musa* spp.) *Current Science* 94:1125-1128.

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58. Patzoldt M.E., **R.K. Tyagi**, T. Hymowitz, M.R. Miles, G.L. Hartman and R.D. Frederick 2007. Soybean rust resistance derived from *Glycine tomentella* in amphiploid hybrid lines. *Crop Science* 47:158-161.
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60. **Tyagi R.K.**, A. Agrawal and A. Yusuf. 2006. Conservation of *Zingiber* germplasm through *in vitro* rhizome formation. *Scientia Horticulturae* 108 : 210-219.
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169. **Tyagi R.K.** 2015. Low temperature conservation of plant genetic resources at ICAR-NBPGR. Invited oral lecture, *International Conference on 'Low Temperature Science and Biotechnological Advances'*, April 27-20, 2015, NASC, New Delhi.
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172. **Tyagi R.K.** and A. Agrawal. 2014. New paradigms in conservation and use of plant genetic resource. Lead lecture, *National Symposium on 'Crop Improvement for Inclusive Sustainable Development'*, Technical session on 'Conservation and utilization of plant genetic resources', PAU, Ludhiana, Nov. 7-10, 2014.
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