

**SHRI MOHAN JAIN**

***WORK ADDRESS***

Department of Agricultural Sciences, PL 27, Latokartanonkaari 5, 00014 Helsinki University, Finland

Tel: +358 9 191 58428; Fax: +358 9 191 58582

Email: mohan.jain@helsinki.fi; shrimohanjain937@hotmail.com

***PERSONNEL DATA***

Date of Birth/Nationality: 05-12-1949/Finnish ***Marital status***: Married, two children

Biographical sketch: Who's who in the World, 13th edition, December, 1995

Who’s who in Science & Engineering, 4th edition, 1997

***EDUCATION/RESEARCH EXPERIENCE***

January 1993-current Docent Plant Biotechnology, University of Helsinki; Abo Academy University; and Jyvaskyla University, **Finland**

April-May 2006 Visiting Professor, University K. Malaysia, Bangi, **Malaysia,**

**May, 1999-2005 Plant Breeder/Geneticist (P4 level), International Atomic Energy Agency, Vienna, Austria (Nobel Peace Prize winner, 2005).**

June-August, 1997 Senior STS fellow, Japan Science & Tech. Corp, Tsukuba**, Japan**

December 1994-May'95 CNR/RAISA Visiting Professor, Universita Degli della Tuscia, Viterbo**, Italy**

July 1990-January'93 Research Scientist, University of Helsinki**, Finland**

December 1988-89 Chief Biotechnologist and Head-in Charge, Botany Department, Tocklai Experimental Station, Jorhat India; Advisor, Agriculture Biotechnology, Assam Science Tech & Environ, CSIR, Assam**, India**

January 1987- Research Associate, Forest Science, Texas A & M University, College

November 1988 Stn., Texas, **USA**

October-December' 86 Senior Research Fellow, State Biotechnology Lab., VTT, **Finland**

July 1984-October'85 Visiting Scientist, Calgene Inc, Davis, CA, **USA**

July 1984-October'86 Research Scientist, Kemira Oy, Espoo, **Finland**

January 1983-June'84 Post doc ARCO, Plant Cell Research Institute, Dublin, CA, **USA**

Feb. 1982- Jan 1983 Post doc, Dept. Horticulture, Purdue University, W. Lafayette, IN, **USA**

September-October'80 Visiting Scientist, University of Kiel, Botany Institute, Kiel, **Germany**

Dec 1979- Jan., 1982 DAAD Post doc, Plant Genetics, Weizman Inst. Sci., Rehovot, **Israel**

1978-1979 Research Associate, Council of Scientific & Industrial Research, **India**

***HONORS AND AWARDS***

1966-69 University merit scholarship holder

1973-1978 Junior and senior research fellowship, Council of Scientific & Industrial Research, India

July-August 1978 Fellowship, International course on "Pest and Vector Management Systems", ICIPE/UNEP, Nairobi, Kenya

June 2006 **Award of Nobel Peace Prize, 2005 in commemoration the awarding to the International Atomic Energy Agency of the Nobel Peace Prize for 2005**

***INVITED LECTURES PRESENTED***

1. Invited speaker on agricultural biotechnology in an International Conference on Seed Science and technology, New Delhi, India, February, 1990
2. Invited speaker on tea biotechnology, BIOTEK INDIA-90, New Delhi, India, December, 1990
3. Invited speaker on “Plant biotechnology for sustainable agriculture under fragile environmental conditions” in an International conference on sustainable crop production in fragile environments, Haryana Agricultural University, Hissar, India, November 25-28, 1996.
4. Invited to participate in a FAO workshop on role of biotechnology in developing countries, New Delhi, India, November 14-16, 1996.
5. Invited to participate in a Workshop on Management of agricultural drought, organized by Global grain legumes drought research network (GGLDRN), New Delhi, India, November 23, 1996.
6. Invited speaker on “Recent advances in somatic embryogenesis”, International Foundation for Science Workshop on Recent Advances in Biotechnology for Trees Conservation and Management, Florianoplis, SC- Brazil, September 15-19, 1997.
7. Invited speaker on “Somaclonal variation and mutagenesis in crop improvement”, in Second Plant Biotechnology Workshop, Hanoi, Vietnam, December 15-19, 1997.
8. Invited speaker on “Recent advances in somatic embryogenesis in forest trees”, IUFRO (Research Group 2.04.07) International symposium on Micropropagation and spread of superior genetic material of forest trees, New Delhi, India, April 10-13, 1998.
9. Invited speaker on “an overview on somatic embryogenesis in forest trees”, 7th Annual International Conference of BIO-REFOR, Challenges for Biotechnology in the next millennium, Manila, Philippines, November, 1998.
10. Invited speaker on Micropropagation for mass-scale reforestation of forests, Workshop on Plant Biotechnology, Paris, France, March 15, 1999.
11. Invited speaker on Mechanisms of spontaneous and induced mutations in plants, in 10th International Congress on Radiation Research, Dublin, Ireland, July, 1999.
12. **Keynote invited speaker** on Genetic stability and variability in Third International Symposium the series of recent Advances in Plant Biotechnology from cell to crops, Slovak Republic, Sept 4-10, 1999.
13. Invited speaker on applications of biotechnology in forestry, For-99, Spain, Sept., 1999
14. Invited speaker for a Plant Molecular Biology course, Hanoi, Vietnam National University, December 5-8, 1999.
15. Invited speaker on Induced mutations in crop plants, Third Plant Biotechnology Workshop, Hanoi, Vietnam, July, 2000.
16. Invited speaker on Induced mutations in fruits, International conference on tropical and subtropical fruits, Cairns, Australia, November- December, 2000.
17. Invited speaker on Shaping up ornamental plants for commercialization, MINT Flora-2001, Malaysian Institute of Nuclear Technology, Malaysia, November 2001.
18. **Keynote speaker** on Feeding the world- mutations and genetic engineering. International Nuclear Conference, 2002, Kuala Lumpur, Malaysia, 15-18 October 2002.
19. *Invited speaker, Morocco, 2005, date palm*
20. Invited speaker, Palermo, 2005, doubled haploid
21. Invited speaker, Slovakia, 2005-08-18 tissue culture and mutations
22. Invitation to participate COST Meeting, Copenhagen, 2005.
23. I*nvited speaker, International date palm conference, Abu Dhabi, 19-22 February 2006.*
24. Invited speaker, COST Meeting, Doubled haploids, Vienna, Austria, February 2006.
25. Invited speaker, San Remo, Italy EUCARPIA Meeting, mutation breeding ornamental plants, September 2006.
26. Invited speaker, Plant tissue culture and induced mutations in genetic improvement of cassava (*Manihot esculenta).* First International conference on cassava improvement, Brasilia, Brazil, November 2006
27. *Invited speaker, 4th International date palm conference, Al Hassa, Saudi Arabia, May 2007.*
28. Invited speaker, International Conference on plant biotechnology, Slovakia, June 2007.
29. Invited speaker, International Conference on Propagation of Ornamental Plants, Sofia, Bulgaria, 5-8 September 2007.
30. Invited speaker, International Symposium on Genetic Modifications – Challenges and Opportunities for Horticulture in the World, 16 - 20 September 2007 at Ski, near Oslo, Norway.
31. Invited speaker, International Conference on ‘[New Approaches to Orphan Crops Improvement in Africa](http://www.botany.unibe.ch/deve/orphancrops/index.htm)’ to be held from 19 to 21 September 2007 in Bern, Switzerland
32. Invited speaker, Potential of cryopreservation in sustainable agriculture, COST-871 program on cryopreservation, February 2008, Oulu University, Oulu, Finland
33. Invited speaker, International conference on induced mutations, Vienna, Austria, August 2008.
34. Invited speaker, International banana conference, Mombasa, Kenya, April 2008.
35. Invited speaker, International conference on Peaceful applications of Atoms, organized by IAEA and Bhabha Atomic Energy Agency, September 29-October 1 2009, Delhi, India.
36. Invited speaker, International plant biotechnology conference, Pietsy, Romania, February 2010
37. *Invited speaker, International date palm conference, Abu Dhabi, UAE. April 2010*
38. Invited speaker, Induced mutations for enhancing nutrition for food production. Plant breeding and management for human nutrition How we can produce more healthful crops and food products? NJF seminar 419, June 2010, Forssa, Finland,
39. Invited speaker, Mutagenesis for developing biotic stress tolerant banana varieties, International conference on banana, Tamil Nadu, India, December 9-13 2010
40. *Invited speaker, The first date Arab palm conference, Riyadh, Saudi Arabia, 4-7, December 2011*
41. Invited speaker, International conference on banana, Chennai, India, February 2012
42. Key note speaker, Genetic improvement of crops under the climate change, 4th Annual Meeting of ESNA, Slovakia, September 2012
43. Keynote speaker, Neglected and underutilized crops for sustainable agriculture, Nitra, Slovakia, October 21-24, 2012
44. Invited speaker, Biotechnology and mutagenesis for crop improvement, 3rd International Agronomy Congress, New Delhi, India, November 26-30, 2012
45. Key speaker, Pharmacognosy, Phytochemistry and Natural Products, Hydrabad, India, October 20-23, 2013.
46. Invited speaker, 5th International date palm conference, Al Hassa, Saudi Arabia, November 2013.
47. Invited speaker in FAO-Workshop, Kuwait, December 8-12, 2013

***MEMBERSHIP IN PROFESSIONAL SOCIETIES***

1. International Association of Plant Tissue Culture

2. International Horticulture Association

***ACTED AS A REFEREE***

Review manuscripts forAfrican Journal of Biotechnology,J. Forest Research (Japan), HortScience (USA), Plant Cell Tissue & Organ Culture, Plant Cell Reports, Plant Science, Pakistan J. Sci. & Industrial Res., Propagation of ornamental plants, In Vitro-Plant, Annals of Botany, Tree Physiology, TAG, Mutation Research, South African J. of Botany, and Euphytica submitted for the publication, and also referee for 5 Ph.D. thesis from India and pre- examiner of a Ph.D. thesis, University of Helsinki, Finland.

***CHAIRPERSON OF SCIENTIFIC SESSIONS/Member of International organizing committee***

1. Chairperson of a session- Biotic stress: viral and fungal disease resistance- in Third International Symposium In Vitro Culture and Horticultural Breeding, Jerusalem, Israel, June 16-21, 1996.
2. Chairperson of a session Bioremediation and tissue culture- In 2nd Vietnam Plant Biotechnology workshop, Hanoi, Vietnam, December 15-19, 1997.
3. Member of International organizing committee of IUFRO (Research Group 2.04-07), International Symposium on Micropropagation and spread of superior genetic material of forest trees, New Delhi, India, April 10-13, 1998.
4. Member of the International Scientific Committee, 4th International symposium on In Vitro culture and horticultural breeding, Tampere, Finland, July 2-7, 2000.
5. Chairperson of a session on Commercialization of plant tissue culture, In Vitro culture and horticultural breeding, Tampere, Finland, July 2-7, 2000.
6. *Chairperson, International date palm conference, Abu Dhabi, 19-22 February 2006*
7. Member of the International organizing Committee, and Chairperson 5th International Conference on Propagation of Ornamental Plants , Sofia, Bulgaria, 5-8 September 2007.
8. Member of the International organizing Committee, and Chairperson, International Conference on plant biotechnology, Slovakia, June 2007.
9. Chairperson, 4th International date palm conference, Al Hassa, Saudi Arabia, May 2007.
10. Chairperson, International Symposium on Genetic Modifications – Challenges and Opportunities for Horticulture in the World, 16 - 20 September 2007 at Ski, near Oslo, Norway.
11. International scientific committee, 4th International symposium on acclimatization and establishment of micropropagated plants, Bangalore, India, December, 2008
12. International plant biotechnology conference, Pietsy, Romania, February 2010
13. International date palm conference, Abu Dhabi, UAE, March 2010.
14. Chairperson, Amaranthus conference, Slovakia, October 2012
15. Pharmacognosy, Phytochemistry and Natural Products, Hydrabad, India, October 20-23, 2013.

***CONSULTANCY***

1. Author’s contract with Enzo Forest Development, Imatra, Finland, July- August, 1996 for a book chapter contribution on Biotechnology of Industrially Important Tree Species in Developing Countries, K. Watanabe and E. Pehu (eds.), Academic Press, USA.
2. Scientific advisor, International Foundation of Science, Stockholm, Sweden
3. Consultant, Estonian Science Foundation, Tallin, Estonia
4. Member of Selection Panel of INCO-DEV Program of European Union, Brussels, Belgium, October, 2000, 2001, 2003, 2004, and 2005
5. By invitation, participated in the consultant meeting on Biotechnology and Rural Livelihood-Enhancing the benefits, organized by ISNAR’s biotechnology service, The Hague, The Netherlands, June 25-28, 2001.
6. Consultant, National Research Foundation, Pretoria, South Africa
7. Invitation by the University of Guelph, Guelph, Canada to consultancy on induced mutations in medicinal plants and international collaboration, May 2002, and June 2004
8. Invitation by European Union (EU) to participate in a consultant meeting on biotechnology, Kuala Lumpur, Malaysia, June 22-24 2002.
9. Consultant, 5th FAO/IAEA Interregional Training Course on Mutant Germplasm Characterization using Molecular markers through providing theory lectures and practical demonstrations on *in vitro* techniques in mutation induction for crop improvement, Siebersdorf, Austria, August 15-16 2005, May 2006, and 2007.
10. IAEA Expert on banana, a visit to Tanzania for project evaluation, November 7-17 2005.
11. Member of the Advisory Group for International Scientific Cooperation for Framework Programme-7 of the European Community, Brussels, Belgium, July 2006 and April 2008
12. Member of Selection Panel of Genetic resources conservation Program of European Union, Brussels, Belgium, September 2006, 2008
13. IAEA Expert, a visit to Yemen for mutation breeding project evaluation, October 2006, and November 2007.
14. IAEA Consultant, Vienna, Austria, March-September 2008.
15. IAEA Expert, a visit to Freetown, Sierra Leone, April 2008
16. Consultant to European Union, Brussels, for project annual technical report evaluation, 2008, 2009, 2010.
17. Consultant, Team leader/spice breeder expert, European Commission funded project ‘Revitalization of nutmeg and spice industries in Grenada’ to assist the Government of Grenada, Lot1 - Rural Development, July-August 2010.
18. International expert for Biotechnology Project evaluation, Science and Technology Development Funds (STDF), Cairo, Egypt, November 3-7 2010.
19. IAEA Expert, a visit to Chiang Mai University, Thailand for setting up Low ion energy beam program, November 2010.
20. IAEA expert, a visit to Department of Science, Sfax, Tunisia for a training course on plant tissue culture, May 8-15 2011
21. IAEA expert, Atomic Energy Research Institute (AERI), King Abdulaziz City for Science and Technology (KACST), Riyadh, Saudi Arabia, July 14-28 2011.
22. Visit to Costa Rica University to assist in setting up mutation breeding program, August 28- September 10, 2011
23. Member of the selection panel on International Scientific Cooperation for Framework Programme-7 of the European Community, Brussels, Belgium,2012
24. Member, Board of Directors, Conserve Biodiversity Project, Assam, India, 2012, (meghalaya.servenature.in/about\_the\_project.html
25. Visit to University of Latvia , Riga, Latvia to deliver invited lectures on Breeding strategies for crop improvement; and In vitro conservation and doubled haploidy., March 26-298, 2013

***EDITORIAL BOARD MEMBER***

***Previously***

1. The Chief-Editor, Reviews of Plant Biotechnology and Applied Genetics- special edition of Plant Cell Tissue and Organ Culture journal. Kluwer Publishers, The Netherlands. (2002-2005).
2. Guest editor, Euphytica, VOLUME 118 (2), 121 (2), 2001. Kluwer Publishers, The Netherlands
3. Chief Editor, International Journal of Food, Agriculture and Environment (JFAE), Helsinki, Finland (2000- 2004)
4. Associate Editor, Plant Cell Tissue and Organ Culture. Springer, The Netherlands (2006-2008)

***Currently***

1. Editorial Board member, Propagation of ornamental plants journal, Sofia, Bulgaria (2002--).
2. Associate Editor, Euphytica, Springer (2006- current).
3. Associate editor, In Vitro Cellular and Developmental Biology- Plant (August 2007----)
4. Associate editor, Gene Conserve, S.M Jain electronic journal Brazil (July 2007-----).
5. Editorial Board member, Series on Forest Biotechnology, Springer (June 2009------
6. Editorial Advisor, Emirates J Food and Agriculture, Abu Dhabi, (March 2010-----)
7. Editorial Board member, Romanian Biotechnological Letters, (March 2010----)
8. Editorial Board, J Plant Genetics and transgenic, February, 2011
9. Editorial Board, J Plant Molecular Biology & Biotechnology, February 2011
10. Associate editor, [International J. Agriculture Sciences](http://www.bioinfo.in/contents.php?id=26), India (February 2011)
11. Associate editor, Journal of Agricultural Science and Technology B, USA (March 2011)
12. Editorial Board, International Journal of Plant Research. March, 2012
13. Editor, Academia J. Agricultural Research, July, 2012
14. Editorial Board, American Journal of Experimental Agriculture, July 2012
15. Editorial Board, Journal of Biology and Earth Sciences, January 2012
16. Editor-in-Chief, Academia J. of Biotechnology, December 2012
17. Editorial Board member, Journal of Horticultural Research, April 2013.

***TEACHNING EXPERIENCE***

At the University of Helsinki, I teach courses: tissue culture in crop improvement and mutation breeding to post graduate students.

***PUBLICATIONS***

***Refereed journals***

1. Jain, S.M., Sunita Talwar, Sudhir K. Sopory and Sipra Guha Mukherjee. 1978. Effect of light on distribution of peroxidase activity in Zea mays. Z. Pflanzenphysiol. 88:169
2. Binding, H., S.M. Jain, J. Finger, G. Mordhorst, R. Nehls and J. Gressel. 1982. Somatic hybridization of an atrazine resistant biotype of Solanum nigrum and S. tuberosum. I. Clonal variation in morphology and in atrazine sensitivity. Theor. Appl. Genet. 63: 273-277.
3. Jain, S.M., R.J. Newton and N. Tuleen. 1988. Tissue culture and gene transfer in barley. Current Science (India) 57: 59-70.
4. Jain, S. M., R.J. Newton, and E.J. Soltes. 1988. Induction of adventitious buds and plantlet regeneration in *Pinus sylvestris* L. Current Science (India) 57: 677-679.
5. Jain, S.M., E.A. Shahin and Sam Sun. 1988. Interspecific protoplast fusion for the transfer of atrazine resistance from *Solanum nigrum* to tomato (*Lycopersicon esculentum* L.). Plant Cell, Tissue and Org. Cult. 12: 189-192.
6. Jain, S.M. and R.J. Newton. 1989. Evaluation of protoclonal variation versus chemically induced mutagenesis in *Brassica napus* L. Current Sci. 58: 176-180.
7. Jain, S.M., E.J. Soltes and R.J. Newton. 1988. Enhancement of somatic embryogenesis in Norway spruce (Picea abies L.). Theor. Appl. Genet. 76:501- 506.
8. Jain, S.M., N. Dong and R.J. Newton. 1989. Somatic embryogenesis in slash pine (Pinus elliottii) from immature embryo cultures in vitro. Plant Sci. 65: 233-241.
9. Jain, S.M. and R.J. Newton. 1990. Prospects of biotechnology for tea improvement. Proc. Indian Natl. Sci. Acad. 56B: 441-448.
10. Jain, S.M., S.C. Das and T.S. Barman. 1991. Induction of roots from regenerated shoots of tea (*Camellia sinensis* L.). Acta Hort. 289: 339-340.
11. Jain, S.M. and E. Pehu. 1992. The prospects of tissue culture and genetic engineering in strawberry improvement. Acta Agric. Scand., Sec B, Soil & Plant Sci., 42: 133-139.
12. Jain, S.M., C. Oker-Blom, E. Pehu and R.J. Newton. 1992. Genetic engineering: An additional tool for plant improvement. Agric. Sci. Finland 1: 323-338.
13. Jain, S.M. 1993. Studies on somaclonal variation in ornamental plants. Acta Hort. 336: 365-372.
14. Jain, S.M. 1993. Somaclonal variation in *Begonia x elatior and* *Saintpaulia ionantha* L. plants. Sci. Hort. 54: 221- 231.
15. Jain, S.M. 1993. Recent advances in plant genetic engineering. Current Sci. 64: 715-74.
16. Jain, S.M., S.C. Das and T.S. Barman. 1993. Enhancement of root induction from *in vitro* regenerated shoots of tea (Camellia sinensis L.). Proc. Indian Natl. Sci. Acad., Sec B 59: 623-628.
17. Jain, S.M., 1997. Somaclonal variation and mutagenesis for crop improvement. In: Maatalouden tutkimuskeskuksen julkaisuja, Vol 18, Sirkka Immonen (ed.), pp 122- 133.
18. Jain, S. M., 1997. Micropropagation of selected somaclones of Begonia and Saintpaulia. J. Biosci. 22: 585-592
19. Jain, S.M., 1997. Creation of variability by mutation and tissue culture in improving plants. Acta Hort. 447: 69-77.
20. Alen, K. and S.M. Jain, 1997. *In vitro* multiplication of Catharanthus roseus. Acta Hort. 447: 167-169.
21. Jain S.M., D. Vitti, M. Tucci, A. Grassotti, E. Rugini and F. Saccardo, 1998. Biotechnology and agronomical aspects in gerbera improvement. Advances in Hort. Sci. 12: 47-53.
22. Jain, S.M., 1998. Induction of somaclonal variation and mutation in developing new improved cultivars. MIIT PUNE J, pp 23-31 (special edition on agriculture).
23. Jain, S. M. and G.J. DeKlerk, 1998. Somaclonal variation: improvement of ornamental plants. Plant Tiss. Cult. & Biotech. 4: 63-75.
24. Thakur, R., J. Gotto, S.M. Jain and K. Ishii. 1999. Monitoring genetic stability in Quercus serrata embryogenesis using RAPD markers. Japanese. J. Forestry 4: 157-160
25. Jain, S.M., 2000. Mechanisms of spontaneous and induced mutations in plants Radiation Res. 2: 255-258.
26. Jain, S.M., B.S. Ahloowalia, G.S. Khush, and L.Zhu. 2001.[Plant Genetics For a Better Life-Proceedings of the 18th International Congress, Beijing, China](https://www.researchgate.net/publication/251266219_Plant_Genetics_For_a_Better_Life-Proceedings_of_the_18th_International_Congress_Beijing_China?ev=prf_pub) Euphytica 118(2):3-4.
27. Jain, S.M., 2001. Tissue culture-derived variation in crop improvement Euphytica 118: 153-166.
28. Maluszynski, M., B.S. Ahloowalia, K. Nichterlein, S.M. Jain et al 2001. Mutating genes to meet the challenge for crop improvement and food security. AgBiotechNet: 3:1-5.
29. Newton, R.J., J.C. Bloom, D.H. Bivans and S.M. Jain, 2001. Stable genetic transformation of conifers. Phytomorphology (Golder Jubilee Issue) pp 421-434.
30. Jain, S.M. 2001. *In vitro* approach for natural and induced biodiversity conservation of forest trees. EFTREN News 34(1): 8-10
31. Jain, S.M. 2001. Genetic modifications of forest trees. EFTREN News 34 (1): 10-12.
32. Jain, S.M., 2002. A review of induction of mutations in fruits of tropical and subtropical regions. Acta Hort. 575: 295-302.
33. Siobhan, M. C., A. Cassells, and S. M. Jain, 2003. Stress and aberrant phenotypes *in vitro* culture. Plant Cell Tissue and Organ Culture 74: 103- 121.
34. Rout, G. and S.M. Jain 2004. Micropropagation of ornamental plants- cut flowers. Propagation of ornamental plants 4 (No.2): 3-28.
35. Jain, S.M. 2005. Major mutation-assisted plant breeding programs supported by FAO/IAEA. Plant Cell, Tissue and Organ Culture, 82: 113-123
36. Jain, S.M. 2006. Book review - Liquid culture systems for *in vitro* plant propagation. Plant Cell Tissue and Organ Culture, 84: 253-254.
37. Jain, S.M. 2006. Book review- Haploids in crop improvement II. Plant Cell Tissue and Organ Culture, 84: 251.
38. Jain, S. M., M .A. Jenks, G. Rout, and L. J. Radojevic. 2006. Micropropagation of ornamental potted plants. Propagation of ornamental plants **6**(2): 67-82
39. Rout, G.R., A. Mohapatra, and S.M. Jain. 2006. Tissue culture of ornamental pot plant: a critical review on present scenario and future prospects. Biotechnology Advances 24: 531-560.
40. Jain, S. M. 2006. Mutation-assisted breeding in ornamental plant improvement. Acta Hort. 714: 85-98
41. Jain, SM. 2007. Biotechnology and mutagenesis in genetic improvement of cassava (*Manihot esculenta*). Gene Conserve, 6 (23): 329-343.
42. Jain, S. M. 2007. Recent advances in plant tissue culture and mutagenesis. Acta Hort 736:205-211.
43. F. Masmoudi-Allouche, Anissa Chaˆari-Rkhis, Walid Kriaa, Radhia Gargouri-Bouzid, Shri Mohan Jain, and Noureddine Drira. 2009*. In vitro* hermaphrodism induction in date palm female flower. Plant Cell Rep 28:1–10
44. Jain, S.M. 2010. Mutagenesis in crop improvement under the climate change. Romania Biotech. Letters 15 (2), supplement, 88-106.
45. Jain, S.M. 2010. In vitro mutagenesis for banana (*Mus*a spp.) improvement. Acta Hort. 879: 605-614.
46. Jain, S.M., Ochatt, S.J., Kulkarni, V.M. and Predieri, S. 2010. In vitro culture for mutant development. Acta Hort. 865:59-68
47. Jain, S.M. 2011.Date palm genetic diversity conservation of for sustainableproduction, Acta Hort. 882:785-791.
48. Jain, S.M. 2011. Prospects of in vitro conservation of date palm genetic diversity for sustainable production. Emirates J Food and Agric 23 (2): 110-119*.*
49. Jain, S.M. and P. Suprasnna. 2011. Induced mutations for enhancing nutrition and food production. Gene Conservation, 10 (41):201-215.
50. Jain, S.M. 2012. Date palm biotechnology: current status and prospective-an overview. Emirates J Food and Agric. 24 (5). 400-407
51. Jain, S.M. 2012. In vitro mutagenesis for improving date palm (*Phoenix dactylifera* L.) Emirates J Food and Agric. 24 (5). 386-399.
52. Jameel M. Al-Khayri, Dennis V. Johnson, Nasser S. Al-Khalifah and S. Mohan Jain.2012. [Special issue on date palm papers presented at the “Arab Palm Conference 2011”](http://ejfa.info/index.php/ejfa/article/view/13493). Emirates J Food and Agric. 24 (5): 1.
53. D. V. Johnson, J. M. Al-Khayri and S. M Jain. 2013. Seedling date palms (*Phoenix dactylifera*) as genetic resources. Emirates J Food and Agric. 25:809-830
54. J. M. Al-Khayri, S. M. Jain, D. V. Johnson 2013. Date palm current research. Emirates J Food and Agric. 25:1-2 (editorial note).
55. V. Kumar and S. Mohan Jain. 2013. Plants and Algae Species: A Promising Renewable Energy Production Source Emirates J Food and Agric. (submitted)
56. J (submitted)

***Book chapters***

1. Gressel, J., G. Ezra and S.M. Jain. 1982. Genetic and chemical manipulation of crops to confer tolerance to chemicals. In: Chemical Manipulations of Crop Growth and Development, (ed) J.S. McLaren, Butterworth, London, pp 79-91.
2. Newton, R.J., K.A. Marek-Swize, M.E. Magallanes-Cedeno, N. Dong, S. Sen and S.M. Jain. 1995. Somatic embryogenesis and plant regeneration in slash pine (*Pinus elliottii* Engelm.). In: Somatic Embryogenesis in Woody Plants- gymnosperms, Vol. 3, S. Jain, P. Gupta and R. Newton, (Eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands. pp 183-195.
3. Jain, S.M. and N. Bhalla-Sarin. 1996. Haploidy in Petunia. In: In Vitro haploid Production in Higher Plants, Vol 5, S.M. Jain, S.K. Sopory and R.E. Veilleux, (Eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands , pp 53-71.
4. Jain, S.M., 1997. Biotechnology of industrially important tree species in developing countries, a book chapter, K Watanabe and E . Pehu (ed.), Academic Press, New York. pp 227-238.
5. Jain, S.M., M. Buiatti, F. Gimelli and F. Saccardo. 1998. Somaclonal variation in improving ornamental plants. In: Somaclonal variation and induced mutations in crop improvement, S.M. Jain, D.S. Brar and B.S. Ahloowalia (eds). Kluwer Academic Publishers, Dordrecht, The Netherlands. pp 81-105.
6. Jain, S.M., B.S. Ahloowalia and R.E. Veilleux, 1998. Somaclonal variation in crop plants. In: Somaclonal variation and induced mutations in crop improvement, S.M.Jain, D.S. Brar and B.S. Ahloowalia (eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands. pp 203 – 218
7. Brar, D.S. and S.M. Jain, 1998. Somaclonal variation: mechanism and applications in crop improvement. In: Somaclonal variation and induced mutations in crop improvement, S.M. Jain, D.S. Brar and B.S. Ahloowalia (eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands. Pp 15-38.
8. Watt, M.P., F.C. Blakeway, F.C. Termignoni and S.M. Jain, 1999. Somatic embryogenesis in *Eucalyptus grandis* and *E. dunni.* In: Somatic Embryogenesis in Woody Plants, Vol. 5. S.M. Jain, P.K. Gupta and R.J. Newton (eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands. Pp 63-78.
9. Ishii, K., R. Thakur and S.M. Jain, 1999. Somatic embryogenesis and evaluation of variability in somatic seedlings of in *Quercus serrta* by RAPD markers. In: SM Jain, PK Gupta and RJ Newton (eds), Somatic embryogenesis in woody plants, Vol. 4, pp 403-414.
10. Jain, S.M., 1999. An overview of progress on somatic embryogenesis in forest trees. In: Plant Biotechnology and In Vitro Biology in the 21st Century. A. Altman, M.Ziv, and S. Izhar (eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands. Pp 57-63.
11. Minocha, R and S.M. Jain, 2000. Tissue culture of woody plants and its relevance to molecular biology.In: Molecular biology of woody plants, volume 1, 315-339. S.M. Jain and S.C. Minocha (eds.), Kluwer , The Netherlands.
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6. Jain, S.M. 1993. Growth hormonal influence on somaclonal variation in ornamental plants. In: Creating Genetic Variation in Ornamentals. T. Schiva and A. Mercuri (Eds.). Istituto Sperimentale per la Floricoltura, Sanremo, Italy, pp. 93-113.
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19. Jain, S.M. 2010. Induced mutations for enhancing nutrition for food production. Plant breeding and management for human nutrition How we can produce more healthful crops and food products? NJF seminar 419, June 2010, Forssa, Finland
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21. D. V. Johnson, J. M. Al-Khayri and S. M Jain. 2013. Utilization of seedling date palms (khalts), *Phoenix dactylifera*, as genetic resources for biotechnology and traditional fruit use, to be publish in 5th Arab Date palm conference, Al Hassa, Saudi Arabia
22. Jain, S.M. 2013. In vitro culture and mutagenesis in genetic improvement of date palm (*Phoenix dactylifera* L.) *Proceedings of The Fourth Symposium on Date Palm in Saudi Arabia, King Faisal University, Alahsa, 5-8 May 2007, pp* 693-705.

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2. Jain, S.M. 1994. Asian-Pacific region: Advances in agricultural biotechnology. Universitas Helsiniensis 13: 42-44.
3. Jain, S.M. 2007. Atom for Peace and prosperity- root and tuberous crops- cassava improvement Universitas Helsingiensis XXVI (1): 41-43
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***Special edition of journals***

1. Euphytica- International Genetics Conference, 2000
2. Emirates Journal of Food and Agriculture- First Arab Date Palm Biotechnology conference. Riyadh, Saudi Arabia, October 2012
3. Emirates Journal of Food and Agriculture, Date palm current research, November 2013.

***FAO/IAEA JOINT DIVISION PUBLICATIONS***

1. FAO/IAEA report of the third Research Co-ordination meeting on Cellular biology and biotechnology including mutation techniques for creation of new useful banana genotypes, held in Colombo, Sri Lanka, 4-8 October 1999, pp 1-167, IAEA publication, IAEA-312-D2.RC.579.3 (2001).
2. FAO/IAEA Working material on Improvement of tropical and subtropical fruit trees through induced mutations and biotechnology. IAEA-312.D2.RC.823 (2001).
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4. FAO/IAEA report on the first Research Co-ordination meeting on Improvement of tropical and subtropical fruit trees through induced mutations and biotechnology”, held in Vienna, Austria, 25-29 September 2000. IAEA Publication, 2001, pp 1-89. IAEA-312.D2.RC.823
5. FAO/IAEA report on the fourth and final Research Co-ordination meeting on Cellular biology and biotechnology including mutation techniques for creation of new useful banana genotypes, held in Leuven, Belgium, September 2001 (published as a book) in 2004.
6. FAO/IAEA report on Low cost plant tissue culture for developing countries.
7. FAO/IAEA report on the third Research Coordination Meeting on”Genetic improvement of underutilized and neglected crops in LIFDCs through irradiation and related techniques”, Pretoria, S. Africa, IAEA-TECDOC- 1426 (November 2004).
8. FAO/IAEA Working Material on Identification and pyramiding of mutated genes: novel approaches for improving crop tolerance to salinity and drought. IAEA-312.D2.RC.972 (2005).
9. FAO/IAEA Working Material on Induction of mutations in tropical and subtropical fruits, IAEA TECHDOC publication, 2009

***PAPERS PRESENTED IN SCIENTIFIC CONFERENCES WORLDWIDE:*** 65

***PUBLISHED BOOKS***

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2. Somatic Embryogenesis in Woody Plants-angiosperms, Vol 2, 1995. S.M. Jain, P.K. Gupta, and R.J. Newton (eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands.
3. Somatic Embryogenesis in Woody Plants-gymnosperms, Vol 3, 1995. S.M. Jain, P.K. Gupta and R.J. Newton (eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands.
4. In Vitro Haploid Production in Higher Plants, Vol 1-fundamental aspects and methodology. 1996. S. M. Jain, S.K. Sopory, and R.E. Veilleux (Eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands.
5. In Vitro Haploid Production in Higher Plants, Vol 2 –applications.1996. S. M. Jain, S.K. Sopory, and R.E. Veilleux (Eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands..
6. In Vitro Haploid Production in Higher Plants, Vol 3-important selected plants. 1996. S.M. Jain, S.K. Sopory, and R.E. Veilleux (Eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands.
7. In Vitro Haploid Production in Higher Plants, Vol 4-cereals. 1996. S.M. Jain, S.K. Sopory, and R.E. Veilleux (Eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands.
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9. Somaclonal Variation and Induced Mutations in Crop Improvement. 1998 S. M. Jain, D.S. Brar and B.S. Ahloowalia (Eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands..
10. Somatic embryogenesis in woody plants, Vol 4. S.M. Jain P.K. Gupta and R.J. Newton (eds.), 1999. Kluwer Academic Publishers, The Netherlands.
11. Somatic embryogenesis in woody plants, Vol 5. S.M. Jain, P.K. Gupta and R.J. Newton (eds.),1999 Kluwer Academic Publishers, The Netherlands.
12. Somatic embryogenesis in woody plants, Vol. 6. S.M. Jain, P.K. Gupta and R.J. Newton (eds.), 2000. Kluwer Academic Publishers, The Netherlands
13. Molecular Biology of woody plants. S.M. Jain and S.C. Minocha (eds.), 2000. Volume 1.Kluwer Academic Publishers, The Netherlands.
14. Molecular biology of woody plants. S.M.Jain and S.C.Minocha (eds.), 2000. Volume 2. Kluwer Academic Publishers, The Netherlands.
15. Crop management and post harvest handling of horticultural products- Quality Management. Ramdane Dris, Raina and S.M.Jain (eds.), Volume 1, 2001. Science Publishers, New Hampshire, USA.
16. Molecular techniques in crop improvement. S. M. Jain, DS Brar and BS Ahloowalia (eds.),2002. Kluwer Academic Publishers, The Netherlands.
17. Environment and Crop Production. Ramdane Dris, I.Khan and S.M. Jain (eds.). 2002. Science Publishers, New Hampshire, USA.
18. Plant nutrition-growth and diagnosis. Ramdane Dris, F. H. Abdelaziz and S.M. Jain (eds.), 2002. Science Publishers, New Hampshire, USA.
19. Crop management and post harvest storage and plant nutrition in horticultural crops- Fruits and vegetables. Ramdane Dris, Raina and S.M. Jain (eds.), Volume 2, 2003. Science Publishers, New Hampshire, USA.
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21. Crop management and post harvest storage and plant nutrition in horticultural crops- Diseases and disorders of fruits and vegetables. Ramdane Dris, Raina and S.M. Jain (eds.), Vol. 4, 2004. Science Publishers, New Hampshire, USA.
22. Micropropagation of woody plants and fruits. S.M. Jain and K Ishii (eds.), 2003. Kluwer Academic Publishers, The Netherlands.
23. Banana improvement: cellular, molecular and mutagenesis approaches. S.M.Jain and R. Swennen (eds.), 2004 Science Publishers, New Hampshire, USA.
24. Production Practices and Quality Assessment of Food Crops- Preharvest Practices. R. Dris, and S.M. Jain (eds.). 2004.Kluwer.
25. Production Practices and Quality Assessment of Food Crops-Plant Mineral Nutrition and Pesticide Management. R. Dris, and SM. Jain. (eds.). 2004. Kluwer.
26. Production Practices and Quality Assessment of Food Crops-Quality Handling and Evaluation. R. Dris, and SM. Jain. (eds.). 2004. Kluwer.
27. Production Practices and Quality Assessment of Food Crops-Postharvest Treatment and Technology. R. Dris and SM. Jain. (eds.). 2004. Kluwer.
28. Protocols of somatic embryogenesis in woody plants. S M. Jain and Pramod Gupta (Eds.), 2005. Springer, Dordrecht, The Netherlands.
29. Advances in Molecular Breeding towards Drought and Salt Tolerant Crops. M.A. Jenks, P.M. Hasegawa, and S.M. Jain (Eds.) 2007, Springer
30. Protocols for micropropagation of woody and fruit trees. S.M. Jain and H. Haggman (Eds.) 2007, Springer
31. Haploid breeding – Alisher, Forster and Mohan Jain (Eds.). 2009, Springer
32. Protocols for micropropagation and secondary metabolite analysis of medicinal plants. SM Jain and PK Saxena (Editors), 2009 Humana Press (Springer).
33. Breeding of neglected and under-utilized crops, spices and herbs. S. Ochatt and S. M. Jain (Eds.). 2009 Science Publishers, New Hampshire, USA.
34. Breeding of Plantation crops. Vol.1, M. Priyadarshan and S.M. Jain (Eds.) 2009 Springer
35. Breeding of Plantation crops. Vol.2, M. Priyadarshan and S.M. Jain (Eds.) 2009 Springer
36. Protocols for micropropagation of ornamental plants – SM Jain and Sergio Ochatt. 2009. Humana Press (Springer).
37. Molecular techniques in crop improvement. S. M. Jain and DS Brar (eds.), 2nd edition, 2010, Springer
38. Date palm biotechnology, SM Jain, J.A. Al-Khayri, D.J. Johnson (Eds.). 2011 SPRINGER
39. Protocols for micropropagation of selected economically-important horticultural plants, Vol.1- Maurizio Lambardi, E. Aylin Ozudogru, S. Mohan Jain (editors) 2012. SPRINGER.
40. Al-Khayri, J.M., M.F. Abdullah, AM Al-Bahrany. 2014. Arabic translation of the Date Palm Biotechnology, Springer 2011 edited by S.M. Jain, J.M. Al-Khayri, D.V. Johnson*.* King Faisal University Press, Al-Hassa, Saudi Arabia.
41. Biotechnology of neglected and underutilized crops- SM Jain and SK Dutta Gupta, editors, 2012, SPRINGER.
42. Date palm Genetic Resources, Cultivar Assessment, Cultivation Practices and Novel Products, SM Jain et al editors, 2013 (in preparation).
43. Advances in Plant Breeding, Vol.1 Springer, Al-Khyari, Jain, Johnson (eds), 2013 (under preparation)
44. Advances in Plant Breeding, Vol. 2, Springer, Al-Khyari, Jain, Johnson (eds), 2013, (under preparation)
45. Genetic erosion and biodiversity, Springer, M.R. Ahuja and S. Mohan Jain (eds.), under preparation

***GRANTS IN FINLAND***

1. Grant by Finnish Academy of Science, June-July, 1992, for attending World Cell and Tissue Culture Cong., Washington, DC, USA and In Vitro Culture and Horticulture Breeding, Baltimore, USA.
2. Grant by Finnish Academy of Science, March, 1993, for attending XVIIth EUCARPIA Ornamental Conf., Sanremo, Italy.
3. Grant by Finnish Academy of Science for editing a book entitled Somatic embryogenesis in woody plants, Kluwer academic Publishers, The Netherlands, 1993.
4. Grant by Finnish Academy of Science, June, 1993, for attending COST Programme for gametic embryogenesis, Norway.
5. Award of Helsinki University Research Docent Stipend to work on our research project Cell and Tissue Culture in the Development of Disease Resistance in Strawberry, 1993-94. Term: 1 year 6. Grant by Finnish Academy of Science, March, 1994, for attending 2nd Asia- Pacific Conference, Madras, India.
6. Grant by University of Helsinki for continuing work on our research project Cell and Tissue Culture in the Development of Disease Resistance in Strawberry, 1994. Term: 6 months.
7. Fellowship awarded by CNR/RAISA, Roma, Italy to work on our joint project Genetic transformation and molecular characterization of olive emblings and transgenic plants, 1994-95, Prof. Eddo Rugini, collaborator. Term: 6 months.
8. Award of Helsinki University Research Docent Stipend to work on our project Transgenics in strawberry, 1995. Term: 1 year.
9. Award of grant Finland-China exchange researcher by Finnish Academy to visit Prof. Hu Han, Chinese Academy of Science, Beijing, July 1996.
10. Award of grant by University of Helsinki for attending Third Asia- Pacific conference, Hua Hin, Thailand, November 10-15, 1996.
11. **Departmental grant, Plant Production Department, University of Helsinki, for disease resistance in strawberry, 1997. Term: 6 months.**
12. **Award of a fellowship by Japanese Science and Technology Foundation, Japan to work on a joint project “Genetic transformation and monitoring genetic fidelity of conifer somatic embryo plants, June-August, 1997. Dr. K. Ishii is the collaborator. Term: 3 months.**
13. Award of travel grant, Chancellor of University of Helsinki, Finland to participate in Second Plant Biotechnology conference, Hanoi, Vietnam, December, 1997.
14. Award of travel grant, Chancellor of University of Helsinki, Finland to participate in IUFRO meeting, Forest tree multiplication with micropropagation, New Delhi, India, April, 1998.
15. Award of Finish-Chinese grant to visit Prof. Guo, Institute of Botany, Beijing, China. August 1998.
16. **Award of developmental research grant entitled Development of insect resistant rice varieties, Finnish Academy of Science, Finland. 1998-99. Term: 1 year.**
17. Award of Center for International Mobility (CIMO) grant, Helsinki to visit University of Mahidol, Thailand and University of Malaya, Kuala Lumpur, Malaysia. December 1998.
18. **Award of a grant by Skandinavia-Japan Sasakawa Foundation to work on joint project between Dr. K. Ishii, Japan, and Finland, 1998-99.**
19. Award of a grant from the University of Helsinki for attending International Congress on Radiation Research, Dublin, Ireland, July, 1999.
20. **Award of a grant from Finnish Academy and Korea Sciences and Engineering, Korea to work on somatic embryogenesis, September, 1999.**
21. Award of a grant from University of Helsinki to visit Beijing Forestry University, Beijing, China to give lectures on forest biotechnology, December 28, 2005- January 7 2006.
22. Award of travel grant, Chancellor of University of Helsinki, Finland to participate in Date palm meeting in Abu Dhabi, UAE meeting, February, 2006.
23. Award of grant, Finnish Academy of Science under scientific exchange between China and Finland, March 2006.
24. Award of a grant from University of Helsinki to visit Nanjing Forestry University, Nanjing, China to give lectures on forest biotechnology, December 2006.
25. Award of a grant from University of Helsinki to visit Kasesart University, Bangkok, Thailand, August 2007. organized a Workshop on Biotechnology and mutagenesis in ornamental plants.
26. Award of travel grant, Chancellor of University of Helsinki, Finland to participate in International conference in Sofia, Bulgaria, September 2007.
27. Award of a grant from University of Helsinki to visit Chiang Mai University, Thailand to give lectures on mutations in plants, December 2008.
28. Award of a grant from University of Helsinki to South Korea University, Seoul, S. Korea to give lectures Mutagenesis, September 2009.
29. Award of a grant from University of Helsinki to University of Costa Rica, San Jose, Costa Rica give lectures Mutagenesis, September 2010.
30. Award of a grant from University of Helsinki to University of Otago, Dunedin, New Zealand give lectures Mutagenesis, October 2011.
31. Invited by University of Tuscia, Viterbo, Italy for giving a series of lectures on Plant biotechnology for food production, March 2012
32. Invited by University of Florence, Italy, for invited lectures, March 2012

***PREVIOUS PROFESSIONAL ACTIVITIES AT IAEA***

I was involved in Technical cooperation projects, dealing with induced mutations in cassava, fruits, date palm, banana, ornamental plants in South Asia, South East Asia, Near East, Africa, and Latin America; and international coordinated research projects on underutilized and neglected crops, medicinal and herbal plants including black pepper and nutmeg, and salinity and drought, banana and tropical and subtropical fruits, and in addition improvement of biomass production for renewable energy. The focus was to develop value added biomass for efficient in bio-energy by using induced mutations and breeding, e.g. cassava. So far, the main focus has been on the processing technology for producing e.g. bio-ethanol. Our focus was first to improve the quality of biomass, the basis for renewable energy, and identify mutants suitable for bio-energy production. Finally, we also looked at the socio-economic impact of bio-energy crops in terms of job creation and raw material for the industry.My job was to evaluate research proposals and supervise the progress of on- going projects, provide to the counterparts chemicals, equipments and experts for project implementation. We collaborated with international organizations INIBAP, FAO, and CGIAR institutes such as ICRISAT, and IRRI. I also participated in making budget, project evaluation, and organize workshops in developing countries. I taught tissue culture and mutations in crop improvement.

**Major Coordinated Research Projects (CRP) and Technical Cooperation Projects (TCP) at IAEA**

**CRP**

1. Cellular biology and biotechnology including mutation techniques for creation of new useful banana genotypes. 7-year project ended in 2002. Amount: USD 1.5 million. This project was in collaboration with Belgium donor country.
2. Improvement of Tropical and Subtropical Fruit Trees through Induced Mutations and Biotechnology

 5-year project, ended in 20045. Amount: USD 700,000/-

3. **Genetic improvement of underutilized and neglected crops in LIFDCs through irradiation and related techniques. 5-year project ended in 2004. USD 700,000/-**

4. Identification and pyramiding of mutated genes: novel approaches for improving crop tolerance to salinity and drought. 5-year project, Amount: USD 700,000/-. This project will continue until 2010.

**TCP**

1. Developing salt-tolerant crops for sustainable food and feed production in saline lands, INT/5/147. Started in 2003-2006). Amount: USD 300,000/-. It is an inter-regional project.
2. Enhancing agricultural productivity through radiation technology in Mindanao, Philippines, PHI/5/029. Started in 2003. Amount USD 250,000/-
3. **Mutation techniques for improving medicinal plants with a curative effect on human diseases, Congo. ZAI/6/009. Started in 2003. Amount: USD 150,000/-**
4. Mutation breeding of horticultural crops, Indonesia. INS/5/031. Started in 2001. Amount USD 250,000/-.
5. Improvement of cassava through mutation breeding, Ghana. GHA/5/26. Amount: USD 300,000/-.
6. Enhancing cassava production through supplementary nutrient application, Ghana. GHA/5/031. Amount USD 250,000/-.
7. Mutation breeding of ornamental plants, Indonesia. INS/5/027. Amount USD 250,000/-.
8. Sustainable agriculture development in Yogyakarta, Indonesia. INS/5/030. Started in 2001. Amount USD 250,000/-.
9. **Mutation breeding of horticultural crops, Indonesia. INS/5/031. Amount USD 250,000/-.**
10. In vitro mutagenesis for horticultural crop plants. MAL/5/024. Amount USD 250,000/-.
11. Control of Bayoud disease in data palm. RAF/5/035. Amount USD 250,000/-.
12. Field Evaluation of Bayoud-Resistant Date Palm Mutants. RAF/5/049. Started in 2001. Amount: USD 700,000/-. It is a Regional project in Africa.
13. **Radiation-induced mutations for black pepper improvement. Sri Lanka. SRL/5/036. Amount USD 250,000/-.**
14. Applying nuclear techniques for improvement of crop yield. Yemen. YEM/5/003. Amount USD 250,000/-.
15. Induction of mutations in crops through in vitro culture, Iraq. IRQ/5/015. Amount USD 250,000/-.
16. Radiation induced mutations for beans and chrysanthemum, Thailand. THA/5/045. Amount USD 250,000/-.
17. **Genetic improvement of fruits and pepper. Venezuela. VEN/5/018. Amount USD 250,000/-.**

***FAO/IAEA TRAINING WORKSHOPS***

1. Regional training workshop on Hands-on experience on molecular and mutation techniques, Siebersdorf, Austria, 13-24 September 1999.
2. Banana 3rd RCM on Cellular biology and biotechnology including mutation techniques for creation of new useful banana genotypes, Colombo, Sri Lanka,4-8 October 1999.
3. First RCM on Improvement of tropical and subtropical fruit trees through induced mutations and biotechnology, Vienna, Austria, 25-29 September 2000.
4. FAO/IAEA Regional Workshop on In vitro protocols and mutant selection using Bayoud toxin, Marrakech, Morocco, 20-26 November 2000.(Also, lecturer to teach tissue culture and mutations)
5. FAO/IAEA National Workshop on In vitro mutagenesis, tissue culture, and molecular marker analysis of ornamental plants, Bangkok, Thailand, 17-23 December 2000. (Also, lecturer to teach tissue culture and mutations)
6. FAO/IAEA Regional Workshop on Mutagenesis, molecular pathology and markers in date palm improvement, 18-22 June, 2001, Sfax, Tunisia. (Also, lecturer to teach tissue culture and mutations)
7. Fourth and final banana RCM on Cellular biology and biotechnology including mutation techniques for creation of new useful banana genotypes, Leuven, Belgium, 24-28 September 2001.
8. FAO/IAEA National Workshop on In vitro plant multiplication, selection, mutagenesis and molecular marker studies in plant improvement, MINT, Bangi, Malaysia, 29 October– 2 November 2001.(Also, lecturer to teach tissue culture and mutations)
9. FAO/IAEA National Workshop on Induced mutations and biotechnology in ornamental plant improvement, Cipanas, West Java, Indonesia, November 4-8 2001(Also, lecturer to teach tissue culture and mutations).
10. FAO/IAEA Regional Training Workshop on “Application of molecular markers in disease diagnostic and mutant characterization in date palm”, Algiers, Algeria, 24-28 August 2002 (Also, lecturer to teach tissue culture and mutations).
11. Second Research Co-ordination Meeting on “Improvement of Tropical and Subtropical Fruit Trees through Induced Mutations and Biotechnology, Vienna, Austria, 2-6 September 2002.
12. FAO/IAEA National Workshop on Applications of induced mutations and molecular tools in horticultural crops including ornamental plants”, 7-12 October 2002, held at MINT, Bangi, Malaysia (Also, lecturer to teach tissue culture and mutations).
13. FAO/IAEA National Workshop on Black Pepper improvement –cell and tissue culture, induced mutations and molecular markers, December 9-13 2002, Matale, Sri Lanka (Also, lecturer to teach tissue culture and mutations).
14. Third Research Coordination Meeting on Genetic improvement of underutilized and neglected crops in LIFDCs through irradiation and related techniques, Pretoria, S. Africa, 19-23 May 2003.
15. FAO/IAEA 1st interregional training course on Mutation, biotechnology and screening techniques for tolerance to salinity, 26-30 April 2004, Faisalabad, Pakistan.
16. FAO/IAEA national training course on In vitro large-scale plant production and cryopreservation of mutants, Bangi, Malaysia, 28 June- 2 July 2004.
17. FAO/IAEA 2nd interregional training course on Application of induced mutations and biotechnology for salt tolerance improvement, 2-6 August 2004, Beijing, China.
18. Third and final Research Coordination Meeting on “Improvement of Tropical and Subtropical Fruit Trees through Induced Mutations and Biotechnology, Nelsprut, South Africa, 4-8 October 2004
19. FAO/IAEA regional training course on cost effective up scale in vitro plant production and long-term storage of mutant plant material, Sfax, Tunisia, 29 November- December 2 2004.

 ***BUSINESS/ TRAVEL EXPERIENCE***

 **Africa and Carribian:** Algeria, Congo, Egypt, Ghana, Grenada, Kenya, Morocco, South Africa, Sierra Leone, Tanzania, Tunisia

 **Asia/Far East Asia:** Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, New Zealand, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Thailand, Vietnam

 **Near East:** United Arab Emirates, Iran, Kuwait, Saudi Arabia, Yemen.

**Europe:** Austria, Belgium, Bulgaria, Serbia and Motenegro, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Lithvania, Latvia, Netherlands, Norway, Poland, Russia, Spain, Slovakia, Sweden, Switzerland, U.K., Ukraine,

 **North and South America:** Brazil, Canada, Cuba, USA

**Central America:** Costa Rica

***DETAILED WORKING EXPERIENCE***

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| **Countries** | **Organizations** | **Responsibilities** |
| Egypt, China, Cuba, Ghana, India, Indonesia, Pakistan, Thailand, Tunisia,Turkey and Vietnam, Israel, Italy and USA | International Atomic Energy Agency (IAEA), AustriaAmount: USD 700,000 | Project leader: Coordinated Research Project (CRP): Identification and pyramiding of mutated genes: novel approaches for improving crop tolerance to salinity and drought. 5-year project.The crops worked on were cereals (wheat, barley, maize, rice, and sorghum), legumes (soybean, chickpea, and peanut), and others (mustard and tomato). The diversity in crops is because of local priorities and much of the technology is common for the development of each crop. The principal goal was to increase yield and yield stability of breeding lines under drought and salinity conditions; conservation of existing germplasm, utilization, germplasm exchange among the participants, organizing training courses, publication of results, distribution of newly developed mutant varieties to farmers. The specific technical strategies and tactics that used were a) Mutation-assisted breeding; b) Candidate gene approach for improving tolerance to drought and salt tolerance of plants, c)Biotechnology, d) Plant cell and tissue culture techniques for identification and pyramiding of mutated genes for improving crop tolerance to drought and salinity, e) Application of DNA markers, f) High through-put mutation detection technology (TILLING), g) Salt and drought tolerance and yield stability screening and selection methods. Gene pyramiding would develop value added crops for enhancing salt tolerance either with transgenic approach and conventional plant breeding. Gene bank would be established for functional genomics of available genes for salt tolerance. THIS PROJECT IS BEING CARRIED OUT AT IAEA BY MY REPLACEMENT. |
| Ghana | IAEA Amount USD 250,000 | Project leader: Technical cooperation Project (TCP): Enhancing cassava production through supplementary nutrient application, Ghana. GHA/5/031. To identify integrated crop, soil, water, and fertilizer management practices for sustainable production of cassava. The Government has recognised the high potential of cassava in terms of alleviating hunger, sustaining food security, and generating foreign exchange from industrial starch production. The "Presidential Special Initiative Programme" has been set up to increase cassava production through improved management of available resources and inputs. This initiative is also in line with the objectives of the Government's Medium-Term Agricultural Development Programme (MTADP), and the National Agricultural Research Project (NARP). The project started under GHA/5/026 for the development of high yielding and disease resistant varieties through induced mutations, thereby highlighting the importance of the combined use of mutagenesis and biotechnology for rapid multiplication of new and improved crop varieties. The objective of the current project is to identify integrated crop, soil, water, and fertilizer management practices for sustainable production of cassava. The project focuses on the use of mutant varieties in conjunction with improved fertilizer, soil, crop and water management practices to enhance cassava production and sustain soil fertility. Nuclear techniques such as nitrogen-15 and neutron moisture probes will be used for obtaining valuable information for identification of suitable fertilizer, and water management practices. Furthermore, mutants were isolated to develop improved varieties with respect to resistance to viruses, starch quality, quality for animal feed and abiotic stress tolerance. It was very important to index viruses of planting material for producing virus-free material. |
| Philippines | IAEA Amount USD 250,000 | Project leader: Technical cooperation Project (TCP): Enhancing agricultural productivity through radiation technology in Mindanao, Philippines, PHI/5/029. Started in 2003. The objective of this project was to improve rice, Brassica, and ornamental plants by induced mutations for promoting agriculture production in Mindano. Mutant varieties were developed and provided to the growers, and that helped to enhance the socio-economic condition of the growers. Newly induced genetic diversity with gamma radiation was conserved and molecular data base was set up by using molecular markers like AFLP. Ultimately a website would be developed of mutant data base and local plant germplasm. Some of the ornamental mutants were given to the florists for commercial exploitation. One traning course was organised.- Training course: Application of In Vitro Culture, Mutations and Molecular Markers in Horticultural Crop Improvement, Manila, Philippines, 25–29 October 2004  |
| Congo | IAEAAmount USD150,000 | Project leader: Technical cooperation Project (TCP): Mutation techniques for improving medicinal plants with a curative effect on human diseases, Congo. ZAI/6/009 This project dealt with genetic improvement of medicinal plants by induced mutations, with an objective to enhance the quantity of anti-malaria active ingredient (s) in mutant plants, and identify specific compounds responsible to cure malaria. In vitro cultures were initiated and cell suspension and callus were used to analyse active ingredients. Initial results showed that the crude extract controlled malarial parasites. Crude extract would be further analysed to study nature of compounds responsible for anti-malarial activities, finally pharmaceutical company will be contacted for low cost commercial production of anti-malarial drugs. All mutants would be protected and patented before signing the contract with a company. All mutants would be molecularly analysed and identify genes for specific compound production, and establish gene bank for medicinal plants both in vitro and in vivo. All mutant cell lines would be cry-preserved for long-term storage |
| Yemen | IAEAAmount USD250,000 | Project leader: Technical cooperation Project (TCP): Applying nuclear techniques for improvement of crop yield. Yemen. YEM/5/003. This project deals with to improve wheat, cotton, seseme, lentils, and chick pea by gamma radiation. They have already isolated mutants of these crops. In wheat- disease resistance, drought tolerance and early maturation; lentil and chick pea- early maturing; seseme- high yield and insect resistant; cotton- high yield. These mutants are in farmer field trials. Cotton mutant produced three times more than parental lines, and would benefit greatly the country cotton industry. We have also helped them in setting up plant tissue culture lab and greenhouse. Training course: Biotechnology, Induced Mutations, and Molecular Markers for Genetic Improvement of Crop Plants” Dhamar, Yemen, 20-24 December 2003 |
| Morocco, Tunisia, Algeria | IAEAAmount USD700,000 | Project leader: Technical cooperation Project (TCP): Field Evaluation of Bayoud-Resistant Date Palm Mutants. RAF/5/049. Started in 2001. It is a Regional project in Africa. This project was further extended to carry out the field trials of putative mutants of date palm tolerant to Bayoud disease. These mutant lines were grown in the hot spot for filed evaluation in Algeria. These mutants will be evaluated for yield, flowering time, disease resistance, fruit quality and nutritive value. After complete evaluation of these mutants, and finally will be released clones of mutant plants. The impact of these mutants will be evaluated in terms of economic impact..The following project evalation meetings were held,- Field Evaluation of Bayoud-resistant Date Palm Mutants”, (Project RAF/5/049), Sfax, Tozeur, Tunisia, 5-10 May 2003- Field Evaluation of Bayoud Resistant Date Palm Mutants” RAF/5/049, Sfax |
| Thailand | IAEAAmount USD250,000 | Project leader: Technical cooperation Project (TCP): Radiation induced mutations for beans and chrysanthemum, Thailand. THA/5/045. The objectives were to develop mutant varieties in beans and chrysanthemum by radiation treatment. Bean seeds were irradiated and developed two mutants with higher yield and high protein, and released to the growers. In chrysanthemum var. Regan, in vitro cultures were used to regenerate plants. In vitro material was mutated and obtained mutants of a wide range of flower colour, shape, and morphology. All mutants of chrysanthemum and other flowers are being maintained in germplasm bank for the distribution to researchers and growers. Mutation participatory program was developed by inviting nursery owners to bring their material for irradiation and plant them back in their nursery. Many growers have benefited economically immensely by growing flower mutants, and that has generated a lot of interest among growers to irradiate their planting material and produce useful mutants. Training course: In vitro mutagenesis and molecular marker analysis of ornamental plants, Bangkok, December 2000 |
| Ghana | IAEAAmount USD300,000 | Project leader: Technical cooperation Project (TCP): Improvement of cassava through mutation breeding, Ghana. GHA/5/26. Cassava improvement was done by gamma radiation treatment for producing mutants showing tolerance to African cassava mosiac virus (AFMC) and starch quality for cooking quality and industrial applications. One mutant was isolated that showed high cooking quality and partial tolerance to AFMC. Farmers like this mutant and became very popular variety among farmers. In general overall cassava yield is very poor in Ghana mainly due to lack of fertilizer and water for irrigation. The President of Ghana has made this crop a top priority crop for food, feed and commercial, and expected to create new jobs. Cassava germplasm collection is poorly maintained and mostly were infected with virus. The success of this project would benefit the country economically as well as raw material for agro-based industries and bio-ethanol production. One training course was organised on tissue culture and mutations. |
| Indonesia | IAEAAmount USD250,000 | Project leader: Technical cooperation Project (TCP): Sustainable agriculture development in Yogyakarta, Indonesia. INS/5/030. Started in 2001. To increase overall crop production by integrating newly developed drought-tolerant crops into existing cropping systems; to identify drought- and salt-tolerant crop varieties by radiation-induced mutation techniques; and to develop sustainable agricultural practices for increased crop production in Gunung Kidul area in Yogyakarta. The objectives were (i) increasing overall crop production by integrating newly developed drought tolerant crops into existing cropping systems; (ii) identifying drought and salt tolerant crop varieties by radiation induced mutation techniques; (iii) identifying promising fertilizer management practices for improved crop rotations (iv) developing sustainable agricultural practices for increased crop production in the Gunung Kidul area of Yogyakarta. The initial phase of this project focused on identification of promising crops, soil, water, and fertilizer management practices to increase crop production in drought regions. The project was then extended to transfer promising technologies for improved crop rotation practices to extension workers and farmers. The activities implemented in the framework of the project included (i) germplasm collection for locally potential crop; (ii) germplasm enrichment by mutation techniques; (iii) screening crop mutants for adverse conditions and field trials of promising lines; (iv) introducing alley crops; (v) recycling biomass and (vi) study of soil-water-plant relationships. As a result of this project, hundreds of mutant sorghum lines have been tested against severe drought. Through this process, eight mutant sorghum lines were found to be high yielding with better biomass or vegetative growth compared with the parental lines. Overall, the project led to an increase in productivity of marginal lands, a rise in farmers’ income, availability of drought tolerant crops and the creation of a germplasm centre in Indonesia. |
| Indonesia | IAEAAmount USD250,000 | Project leader: Technical cooperation Project (TCP): Mutation breeding of horticultural crops, Indonesia. INS/5/031. In this project, genetic improvement of fruits and ornamental plants by using biotechnology and gamma radiation. The main crops were citrus, banana, and papaya, roses, and orchids. Several mutants were isolated: One seedless citrus mutant, citrus mutant with pink flesh; 3 mutants of roses that have been released to the growers. They have also established germplasm collection center for soybean and wheat.One training courses were organised. Mutation and Molecular Breeding in Crop Improvement, Jakarta, Indonesia, 29 Sept – 3 October 2003 |
| Sri Lanka | IAEAAmount USD250,000 | Project leader: Technical cooperation Project (TCP): Radiation-induced mutations for black pepper improvement. Sri Lanka. SRL/5/036. To assist in developing high-yielding black pepper and other spices including nutmeg mutant varieties with good field establishment and drought tolerance over a period of eight years. In Phase I (2001-2003), to develop and screen a large mutant population of black pepper for field establishment; and develop molecular markers to distinguish mutants and parental lones and evaluated the field perfornace. In vitro cultures were initiated, especially somatic embryogenic cultures and clonal propagation in black pepper and nutmeg. All putative mutants were evaluated for yield, quality, and drought tolerance; all mutants were maintained in the greenhouse; efforts are continued to develop long-term storage- cold storage and cryopreservation so that gene bank could be established. Mutant plants were subjected for large-scale plant production on a commercial set up so that black pepper mutants could be supplied to the growers. Furthermore functional genomics of spices would be very useful to develop after trait specific genes are identified and establishment of genetic data base. In Sri Lanka they maintain germplasm bank of major spices, which are valuable as an export item. Any value added mutant would certainly improve exports and benefit economically the country.We also helped them in setting up plant tissue culture and molecualr biology laboratory as well as greenhouse.Training course: Black Pepper Improvement – Cell And Tissue Culture, Breeding And Induced Mutations And Molecular Markers, Matala, Sri Lanka, 9-13 December 2002.  |
| Australia, China, India, Indonesia,Iran, Israel, Pakistan, Malaysia, S, Africa, Thailand,U.K., USA | IAEAAmount USD700,000 | Project leader: Coordinated Research Project (CRP): Improvement of Tropical and Subtropical Fruit Trees through Induced Mutations and Biotechnology. The fruit crops worked on were: papaya, citrus, avocado, mango, jujube, cashew, guava, litchi, annona, carambola, pitanga, and jaboticaba. The main objectives of this project is to develop new mutant varieties tolerant to abiotic and biotic stresses, fruit quality, tree architecture, sustainable high yield and food security by using biotechnological tools. Somatic embryogenic cell cultures were developed and treated with gamma radiation for mutation induction, and that would facilitate cryo-storage of mutant lines in setting up gene bank. The achievements were made include: exchange of genetic material through the bilateral understanding for research purposes; collaborative linkages through training and courses; molecular markers application in collaboration with developed and developing countries; mutation induction with gamma radiation treatment and selection of mutants; preservation, conservation, and utilisation of genetic diversity/germplasm for sustainble production; publication of results as Technical document as distributed to all participants. The seedless citrus and guava mutants, papaya disease free mutants, jujube fruit morphology mutants were isolated.  |
| Indonesia | IAEAAmount USD250,000 | Project leader: Technical cooperation Project (TCP): Mutation breeding of ornamental plants, Indonesia. INS/5/027. In this project, in vitro cultures were initiated of several ornamental plants including orchids, roses, chrysanthemum, and curcuma. In vitro cultures were used for mutation induction. In vitro plants were hardened and maintained in the greenhouse and the mutant flowers were selected having commercial value. These plants were further evaluated for genetic stability, and finally supplied to the consumers and commercial growers. All mutants were conserved in the greenhouse and used for further improvement |
| Iraq | IAEAAmount USD250,000 | Project leader: Technical cooperation Project (TCP): Induction of mutations in crops through in vitro culture, Iraq. IRQ/5/015. This project was kept on hold due to UN sanctions on Iraq. |
| Bolivia, Costa Rica, Colombia, Ecuador, France, Germany, Ghana, India, Indonesia, Mexico, Slovakia, S. Africa, Syria, Thailand | IAEAAmount USD700,000 | Project leader: Coordinated Research Project (CRP): Genetic improvement of underutilized and neglected crops in Low income food deficit countries (LIFDC) through irradiation and related techniques. An overall objective was to improve food security, enhance nutritional balance, and promote sustainable agriculture in LIFDCs, and addressed major constraints to productivity of neglected and under-utilised crops by genetic improvement in order to enhance economic viability, sustain and conserve crop species diversity, utilization and distribution of local and imported germplasm, and in future to benefit small farmers. The results were published as a TECDOC highlighting plant regeneration strategies in *Dioscorea* spp., grass pea and bambara groundnut, root rot disease tolerant putative mutants of cocoyam, genetic diversity bank of bitter potato, shortening of generation cycles in seed legumes, several mutants of taro, bambara groundnut, quinoa, narajilla, okra, *Amaranthus tricolor,* and *Amaranthus cruentus* The selected mutants were maintained and exchanged among the partners for research purposes. The potential of using crops like Amaranthus and bambara ground nut in regular human diet was recognised; and use them as source of nutrition to supplement in regular meal. The bambara groundnut mutant lines were used for breeding in Ghana. The mutant lines would be used for reverse genetics to find out set of genes responsible for specific traits and study the functional genomics and gene bank. |
| Morocco, Tunisia, Algeria | IAEAAmount USD250,000 | Project leader: Technical cooperation Project (TCP): Control of Bayoud disease in data palm. RAF/5/035. This project dealt with development in vitro cultures and produce mutants resistant to Bayoud disease, early flowering types without compromising total yield. Somatic embryogenic cultures were initiated and whole plantlets were regenerated. Embryogenic cultures were used for radiation treatment. Putative mutants are in the field for the last 6 years and growing happily without showing any sign of disease. The following training courses were organised.- Training course: In vitro protocols and mutant selection using bayoud toxin- a workshop was organised in Morocco. November 2000.- Training course: Application Of Molecular Markers In Disease Diagnostic And Mutant Characterization In Date Palm”, Algiers, Algeria, 24-28 August 2002- Training course: Hardening and Commercialization of In-vitro Plants, Disease Indexing, and Greenhouse Technology in Date Palm” , Sfax, Tunisia,1-5 December 2003- Training course: Cost Effective Up Scale In Vitro Plant Production and Long-Term Storage of Mutant Plant Material”, Tunisia, 29 November–3 December 2004 |
| Austria,Belgium, Colombo, Czechoslovakia, Cuba, Guyana, France, Germany, Malaysia, Philippine, Sri Lanka & USA | IAEAAmount USD1.5 million | Project leader: Coordinated Research Project (CRP): Cellular biology and biotechnology including mutation techniques for creation of new useful banana genotypes. This project was in collaboration with Belgium donor country. The main objective was to develop disease resistant banana by the use of nuclear technology, and assist banana growers to enhance banana production and socio-economic aspect. The achievements were development of in vitro tools for plant regeneration, useful new mutated banana clones, screening protocols for disease resistance and linkages with participating research groups that facilitated exchange of SSR primers, technology and germplasm transfer. Genetic engineering protocols for transferring useful genes were developed in banana. Dissociation of cytochimera and karyological changes in embryogenic cell suspension culture, somatic seedlings or micropropagated plant material was successfully performed with flow cytometry. All the results were published as a book and distributed to all participants. Every year Research Coordinated Meetings were held in different countries to assess the progress and Technical document was prepared and distributed to all participants. All banana mutant germplasm is maintained by each country and exchange the material for banana improvement. In Sri Lanka women were taught in vitro techniques for the propagation of banana in order to supply banana propagules to the farmers. Rice growers switched over to banana plantation and benefited immensely economically by earning 200-300 % profit and that up-lifted their standard of living. A training course was organized to teach molecular techniques and in vitro culture protocols. (THIS PROJECT STARTED BEFORE I JOINED IAEA IN MAY 1999) |
| Venezuela | IAEAAmount USD250,000 | Project leader: Technical cooperation Project (TCP): Genetic improvement of fruits and pepper. Venezuela. VEN/5/018. The objective was to train staff and equip laboratories for mutation breeding techniques for application to the genetic improvement of mango, passion fruit and black pepper. This project was initiated in 1995 to develop human resource capability and supply laboratory equipment and chemicals for the genetic improvement of mango, passion fruit and pepper by radiation-induced mutations. Radiation-induced mutations combined with the appropriate tissue culture technology is an ideal approach to obtain newly improved cultivars with desirable characteristics such as fruit shape, high productivity and disease resistance. In 1995-1996, the best genotypes of mango, black pepper, passion fruit and cashew were identified by their desirable characteristics. The most suitable selected lines were further tested in farmers’ fields. This project has developed the human resources of Venezuela, in vitro mutagenesis, tissue culture and selection of mutants in fruits through radiation-induced mutations.  |
|  |  | ALL ABOVE MENTIONED PROJECTS WERE CARRIED OUT DURING MAY 1999-APRIL 2005 WHILE I WORKED AS A TECHNICAL OFFICER (P4) AT IAEA, VIENNA, AUSTRIA. The main objective of all projects is genetic improvement of crops by the use of nuclear tools, mainly gamma radiation; monitor release of mutant varieties to the farmers and economic impact of these varieties. I was project leader of all these projects and monitor and evaluated and advised in the running the project. We had organised hand on training courses in the respective countries. |
| Grenada | Consultant, Team leader/spice breeder expert | European Commission funded project ‘Revitalization of nutmeg and spice industries in Grenada’ to assist the Government of Grenada, Lot1 - Rural Development, July, 2010 –February 2011 (total 90 working days). The spice industry in Grenada is the life line of the people, which is highly dependent on the exports and stands second after the Indonesian exports. After the hurricane Ivan Grenada lost substantial agricultural sector including 90% loss of nutmeg and other spices especially clove, cinnamon. Nutmeg and mace contribute approximately 90% of spice industry in this country. The farming activities are gradually getting normal, however still plenty of farms remain uncultivated and the production is much lower than pre-hurricane level. For this a regular supply of low cost, healthy and improved planting material is needed to provide farmers for sustainable spice production and industrial growth. The setting up of a field germplasm bank or field gene bank is to conserve wide genetic diversity of local and imported spices for the sustainable production of spices would result in high economic growth in spice industry and enhance socio-economic status of small farmers. The genetic material in the bank is for lifelong storage and a continuous process for updating core collection by adding new plant material, utilization for breeding purposes, grafting for clonal propagation, multiplication of selected elite material, distribution of seeds to farmers and industry, website database of all core collection, and food security. |
| Egypt | Prof. M, Hanafyinvitation | National research project evaluation, on biotechnology,November 2010 |
| Saudi Arabia | IAEA consultant | To set up Plant tissue culture lab, May-June 2011 |
| Thailand | IAEA consultant | To set up Plant tissue culture lab, November 2010 |