Dr. Mehboob-ur-Rahman

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Field of research: Plant Breeding & Genetics (specialization, Molecular breeding in cotton)

Awards/Honours:

National

a- Civil Award: ***Presidential Award for Pride of Performance—2012, presented by the President of Pakistan***

b- Farmer Associate of Pakistan Award in Agriculture 2012.
c- LCCI Research Scientist Award-2010 along with Rs. 0.50 million, presented by Prime Minister of Pakistan on 18 Sept 2010.
d- A Letter of Appreciation by Seed Association of Pakistan dated 31 Jan 2011
e- Outstanding Scientist: Biotechnology (1st Position) Award-2009
f- Pakistan Atomic Energy Performance GOLD MEDAL-2009
g- Won five research productivity awards. **Stood first in "Agriculture Sciences" for Research Produtivity Award 2013-14**
h- Presidential Young Innovator Award-HEC, 2007

International:

a. **Third World Academy of Sciences Award in Applied Science-Technology in Agriculture (under 40 in Agriculture)--2011**
b. Borlaug Fellow (Sept 2012 to Nov 2012)

Publications:

Book Chapters (Foreign Publishers, In Total: 8)

1. **Rahman M**, T. Shaheen, S. Irem and Y. Zafar. Risk assessment of genetically modified crops containing *Cry* genes. Environmental Chemistry for Sustainable World. (Press)
2. **Rahman M.**, M.A. Iqbal, N. Shaheen, Y. Zafar. 2013. Microsatellites: Methods & Protocols. In: M. Miransari (Ed) Stress and Plant Biotechnology. Stadium Press LLC.
3. **Rahman M.,** T. Shaheen, M. Ashraf and Y. Zafar. 2012. Bridging Genomic and Classical breeding approaches for improving crop productivity. Crop Production for Agricultural Improvement. Springer Publisher. DOI 10.1007/978-94-007-4116-4_2. pp 19-41.
4. Ashraf, M., N. A. Akram, **M. Rahman** and M. R. Foolad. 2012. Marker-assisted selection in plant breeding for salinity tolerance. Springer Publisher. Methods Mol Biology 913:305-333.

5. **Rahman M.,** and A. H. Paterson. 2010. Comparative Genomics in Crop Plants. In: S.M. Jains & D.S. Brar (Eds). Springer Publisher, pp 23-60.
6. **Rahman M**., M. Asif, T. Shaheen, N. Tabbasam, Y. Zafar and A.H. Paterson. 2011. Marker-assisted breeding in Higher Plants. Sustainable Agriculture Reviews. In: Eric Lichtfouse (Ed) Alternative Farming Systems, Biotechnology, Drought Stress and Ecological Fertilization. Springer Publisher.
7. **Rahman M**., Yusuf Zafar and Andrew. H. Paterson. 2009. Gossypium DNA markers types, number and uses. In: Andrew H Paterson (Ed) Genomics of Cotton. Springer, Dordrecht.
8. Yusuf Zafar, S. Mansoor, S. Asad, **M. Rahman**, Z. Mukhtar, M. Asif, A. Bashir and K.A. Malik. 2007. Current Status and Prospectus of Biotech Cotton in Pakistan. Proceeding of the regional consultation on genetically modified cotton for risk assessment and opportunities for small-scale cotton growers (CFC/ICAC/34Ft). pp 87-93.

National Publisher (Total= 6)

1. **Rahman, M**, D Hussain and Y Zafar. "DNA Markers: A review". Proceedings, First SESCOB Biotechnology Conference, January 11, 1996, Univ. of Agric. Faisalabad.
2. Y. Zafar, S. Mansoor, **M. Rahman**, W. A. Haris and K.A. Malik. Cotton Biotechnology: Contribution of NIBGE Cotton biotechnology conference, Nov, 2000, Univ. of Agric. Faisalabad.
3. **Mehboob-ur-Rahman**. DNA Fingerprinting:. "Modern Techniques in Biotechnology", 2-7 March 2003, at NIBGE, Pakistan.
4. **Mehboob-ur-Rahman.** Development of IR-cotton: a case study. "Capacity building in Biosafety of genetically modified crops GMOs detection", 14-17 June 2004, NIBGE Pakistan.
5. **Mehboob-ur-Rahman**. DNA Fingerprinting:. "Modern Techniques in Biotechnology", 4-8 April 2005, at NIBGE, Pakistan.
6. **Mehboob-ur-Rahman.** DNA Fingerprinting of Crop Plants: Plant Molecular Genomics", 6-10 June, 2005, at National Agricultural Research Center (NARC) Islamabad

Peer Reviewed Papers (Total publications: 57 including **two in Nature**—as co-author, and four registration documents of **cotton varieties** as a submitting author; **Impact Factor: ~130 with more than 1500 citations**)

1. Shaheen, T., Y. Zafar and **M. Rahman**. Single nucleotide polymorphism analysis of Ubiquitin extension protein genes (*UBQ*) of *Gossypium arboreum* and *Gossypium herbaceum* in comparison with Arabidopsis thaliana. *Pak J Bot* (in press)
2. Tabassam, N., Y. Zafar. And **M. Rahman**. 2014. Pros and cons of using genomic SSRs and EST-SSRs for resolving phylogeny of the genus *Gossypium*. *Plant Systematics and Evolution*, 300:3: 559-575.
3. Shaheen, T., Y. Zafar and **M. Rahman**. 2013. QTL mapping of some productivity and fiber traits in *Gossypium arboreum*. *Turk J Bot*. 37:802-810.
4. Shaheen, T., Y. Zafar., J.M. Stewart and **M. Rahman**. 2013. Development of short gSSRs in *G. arboreum* and their utilization in phylogenetic studies. *Turk J Agric Fort*. 37: 288-299.
5. Paterson, A.H., J.F. Wendel,….**M. Rahman**, D.S. Rokhsar, X. Wang and J. Schmutz. 2012. Repeated polyploidization of Gossypium genomes and the evolution of spinnable cotton fibres. ***Nature*** 492: 423-428.

6. **Rahman M**., and Y. Zafar. Registration of NN-3. 2012. Journal of Plant Registrations 6:342-347.
7. **Rahman M**., T. Shaheen, N. Tabbasam, M. A. Iqbal, M Ashraf, Y. Zafar and A. H. Paterson. 2012. Genetic resources in cotton and their improvement. *Agronomy for Sustainable Development*. DOI: 10.1007/s13593-011-0051-z.
8. Sarwar, M.K.S., M. Y. Ashraf, **M. Rahman** and Y. Zafar. 2012. Genetic variability in different biochemical traits and their relationship with yield and yield parameters of cotton cultivars grown under water stress conditions. *Pakistan Journal of Botany* 44 (2): 515-520.
9. Saeed, M., W. Guo, I.Ullah, N. Tabbasam, Y. Zafar, **M. Rahman** and T. Zhang. 2011. QTL mapping for physiology, yield and plant architecture traits in cotton (Gossypium hirsutum L.) grown under well-watered versus water-stress conditions" Electronic Journal of Biotechnology. DOI: 10.2225/vol14-issue3-fulltext-3
10. Shaheen, T., Y. Zafar and **M. Rahman.** 2010. Detection of single nucleotide polymorphisms in the conserved ESTs regions of *Gossypium arboreum*. *Electronic J Biotechnology*: DOI: 10.2225/vol13-issue5-fulltext-3.
11. Azhar, M.T., **M. Rahman**, S. Aftab, Y. Zafar and S. Mansoor. 2010. Utilisation of natural and genetically-engineered sources in Gossypium hirsutum for the development of tolerance against cotton leaf curl disease and fiber characteristics. *Int J Agric. Biol*. 12-744-748
12. Lin, L., G.J. Pierce, J.E. Bowers, J.C. Estill, R.O. Compton, L.K. Rainville, C. Kim, C. Lemke, J. Rong, H. Tang, X. Wang, M. Braidotti, A.H. Chen, K. Chichola, K. Collura, E. Epps, W. Golser, C. Grover, G. Ingles, S. Karunakaran, D. Kudrna, J. Olive**,** N. Tabassum**,** E. Um**,** M. Wissotski**,** Y. Yu**,** A. Zuccolo**, M. Rahman,** D. G. Peterson**,** R. A. Wing**,** J. F. Wendel and A. H. Paterson. 2010. A draft physical map of a D-genome cotton species (*Gossypium raimondii*) BMC Genomics 11: 395.
13. Paterson A.H., J. Rong…..**Mehboob-ur-Rahman**, Y. Zafar…2010. Sequencing and utilization of the Gossypium genomes. Tropical Plant Biology. DOI: 10.1007/s12042-010-9051-4.
14. Arshad M, M.I. Khan, C.R. Ali, M. Afzal and **M. Rahman.** 2009. Registration of 'CIM-496' cotton cultivar. *Journal of Plant Registrations*, 3:231-235.
15. Ali, I., A. Malik, **M. Rahman**, Y. Zafar, M. Asif, M Ashraf, S. Riaz, S. Zafar, A. Wahid, S. Maqsood, M. Niaz and S. Q. Abbas. 2009. Development of genetic linkage map of hairiness in *Gossypium hirsutum* (cotton) using molecular markers. *Pak J Bot* 41(4): 1627-1635.
16. Ali, I., M. Ashraf, **M. Rahman**, Y. Zafar, M. Asif, A. Kauser, S. Riaz, M. Niaz, A. Wahid and S. Q. Abbas. 2009. Development of genetic linkage map of red leaf colour in cotton (Gossypium hirsutum) using DNA markers. *Pak J Bot* 41(3): 1127-1136.
17. Asif, M. **M. Rahman**, J.I. Mirza and Y. Zafar. 2009. Parentage confirmation of cotton hybrids using molecular markers. *Pak J Bot* 41 (2): 695-701.
18. Shaheen, T., M. Asif, Y. Zafar and M. Rahman. 2009. Single nucleotide polymorphism analysis of MT-SHSP gene of Gossypium arboreum and its relationship with other diploid cotton genomes, *G. hirsutum* and *Arabidopsis thaliana*. *Pak J Bot* 41(1): 117-183.
19. Asif, M., **M. Rahman**, J.I. Mirza and Y. Zafar. 2008. High resolution metaphore agarose gel electrophoresis for genotyping with microsatellite markers. Pak J Agric Sci 45(1): 75-79.
20. **Rahman**, **M**., T. Yasmin, N. Tabassum I. Ullah, M. Asif and Y. Zafar. 2008. Studying the extent of genetic diversity among *Gossypium arboreum* L. genotypes/cultivars using DNA fingerprinting. *Genetic Resour Crop Evol* 55: 331–339.
21. **Rahman, M.**, I. Ullah, M. Ashraf and Y. Zafar. 2008. A study of genotypic variation for drought tolerance in cotton. *Agronomy for Sustainable Development*, 28:439–447.
22. Ullah, I., **M. Rahman**, M. Ashraf and Y. Zafar. 2008. Genotypic Variation for Physiological and Productivity Traits in Cotton (*Gossypium hirsutum L.*) Under two Contrasting Water Regimes. *Flora* 203: 105-115.

23. Ahmad, S., T. Zhang, Noor-ul-Islam, T. Shaheen and **M. Rahman**. 2007. Identifying genetic variation in Gossypium based on single nucleotide polymorphism. Pak J Bot. 39(4): 1245-1250.
24. Ahmad I, S.A. Malik, **M. Rahman**, A.U. Malik and R. Anwar. 2007. Exploring the potential of new promising mango (Mangifera indica L.) hybrid cv. Faiz Kareem. *Hort Science* 42 (4): 913-913.
25. **Rahman, M**. and Y. Zafar. 2007. Registration of NIBGE-115. *Journal of Plant Registrations* (Crop Science Society of America), 1: 51-52.
26. **Rahman, M**. and Y. Zafar. 2007. Registration of NIBGE-2. Crop Science Society of America), 2:113-114.
27. Z. Jeffrey Chen, ….**Mehboob-ur-Rahman**, Yusuf Zafar, John Z. Yu, Russell J. Kohel, Jonathan Wendel and Andrew H. Paterson. 2007. Towards sequencing cotton (*Gossypium*) genomes. *Plant Physiology*, 145: 1251-1263.
28. Sarwar, M.K.S., I. Ullah, **M. Rahman**, M.Y. Ashraf and Y. Zafar. 2006 Glycinebetaine accumulation and its relation to yield and yield component in cotton genotypes grown under water deficit condition. *Pak J Bot*. 38 (5): 1449-1456.
29. Shaheen, T., **M. Rahman** and Y. Zafar. 2006. Chloroplast RPS8 gene of cotton reveals the conserved nature through out taxa. *Pak J Bot*. 38 (5): 1467-1476.
30. Tabassam, N., **M. Rahman** and Y. Zafar. 2006. DNA-based genotyping of sorghum hybrids. *Pak J Bot*. 38 (5): 1599-1604.
31. Ullah, I., **M. Rahman**, M. Ashraf and Y.Zafar. 2006. Genotypic variations for drought tolerance in cotton (*Gossypium hirsutum* L.): seed cotton yield responses. *Pak J Bot*. 38 (5): 3679-1687.
32. **Rahman, M**., T.A. Malik, D. Hussain and Y. Zafar. 2005. Genetics of resistance to cotton leaf curl virus disease in *Gossypium hirsutum*. *Plant Pathology (BSPP)* 54: 764-772.
33. Ali, I., M. Ashraf, **M. Rahman**, I. Ullah, M. Niaz, M. Hanif, M. Hassan and Y. Zafar. 2004. Screening of cotton varieties regarding hairiness trait for DNA fingerprinting. J. Nat. Sci 2(1), 91-99.
34. Ali, I., M. Ashraf, **M. Rahman**, I. Ullah, M. Niaz, M. Hassan, Y. Zafar and M. Hanif. 2004. Optimization of PCR conditions for DNA fingerprinting in cotton. *J. Nat. Sci* 2(2), 47-51.
35. **Rahman, M.,** T. A. Malik, M.J. Iqbal, Y Zafar, and K. A. Malik. 2004. Gene tagging for salinity resistance in wheat by RAPD. *Pak J Bo t.* 36 (3): 595-602
36. Amir, A.H., T.A. Malik., H. Raza and **M. Rahman**. 2002. DNA marker studies for leaf nectaries in upland cotton. Asian J Plant Sci. 1(4): 395-396.
37. Amir, A.H., T.A. Malik., M. Rizwan and **M. Rahman**. 2002. Genetics of leaf nectaries in upland cotton. *Asian J Plant Sci*. 1(4): 423-424.
38. **Rahman, M.**, D Hussain and Y Zafar. 2002. Estimation of genetic divergence among elite cotton (*Gossypium hirsutum* L.) cultivars/genotypes by DNA fingerprinting technology. Crop Science 42: 2137-2144.
39. **Rahman, M.**, T.A. Malik, N. Aslam, M. Asif, R. Ahmad, I. A. Khan and Y. Zafar. 2002. Optimization of PCR Conditions to Amplify Microsatellite Loci in Cotton (*Gossypium hirsutum* L.*). Int. J. Agric. Biol*. 2(4):282-284.

<u>Other related Publications in peer reviewed Journal:</u>

40. Iqbal, M.J., **M. Rahman**., M. Ashraf., M.A. Sheikh and A. Jamil. 2012. Trehalose Expression in Hexaploid Wheat (*Triticum aestivum* L.) Germplasm under Drought Stress. Pak. J. Life Soc. Sci. 10(2): 106-110
41. Ali, H., S.S. Alam, R.N. Attanayake, **M. Rahman** and W. Chen. 2012. Population structure and mating type distribution of the chickpea blight pathogen Ascochyta Rabie from Pakistan and United States. Journal of Plant Pathology 94 (1): 99-108.

42. Ali, H., M. I. Haq, T.M. Shah, **M. Rahman** and W. Chen. 2011. Validation of molecular markers for resistance among Pakistani chickpea germplasm to races of *Fusarium oxysporum* f. sp. ciceris. Eur J Plant Pathol. DOI 10.1007/s10658-011-9868-1.
43. Khan, S.M., A. Nawaz, W. Malik, N. Javed, T. Yasmin, **M. Rahman**, A. Qayyum, Q. Iqbal, T. Ahmed and A.A. Khan. 2011. Morphological and molecular characterization of Oyster mushroom (Pleurotus spp.). African J Biotechnology 10(14): 2638-2643.
44. Awan, M. S., N. Tabbasam, N. Ayub, M. E. Babar, **M. Rahman**, S. M. Rana and M. I. Rajoka. 2010. Gamma radiation induced mutagenesis in *Aspergillus niger* to enhance its microbial fermentation activity for industrial enzyme production. *Molecular Biology Report*. DOI 10.1007/s11033-010-0239-3.
45. Ali, S., M.E. Baber, P. Akhter, A. Ali, **M. Rahman**, J.I. Sultan and H.L. Shaheen. 2009. Genetic divergence and relationship among five buffalo breeds of Pakistan using random amplified polymorphic DNA (RAPD) analysis. *Pak J Zool*. 9:303-308.
46. Paterson, A.H., John E. Bowers, …… **M. Rahman**, Doreen Ware, Peter Westhoff, Klaus F.X. Mayer, Joachim Messing, Daniel S. Rokhsar (2009). The *Sorghum bicolor* genome and the diversification of grasses. ***Nature*** 457: 551-556.
47. Rajwana I.A., N. Tabbasam, A.U. Malik, S.A. Malik, **M. Rahman** and Y. Zafar. 2008. Assessment of genetic diversity among mango (Mangifera indica L.) genotypes using RAPD markers. *Scientia Horticulturae* 117: 297-301.
48. Asif, M., **M. Rahman** and Y. Zafar. 2006. Genotyping Analysis of Maize (*Zea mays* L.). Hybrids Using DNA Fingerprinting Technology. *Pak J Bot*. 38 (5): 1425-1430.
49. Fauzia Y. Hafeez, Sumera Yasmin, Dini Ariani, **Mehboob-ur-Rahman,** Yusuf Zafar and Kauser A. Malik. 2006. Characterization of plant growth promoting bacteria (PGPB) from geographically different regions. *Agron. Sustain. Dev*. 26: 143–150.
50. Shafeeq, S., **M. Rahman**, M. Ashraf and Y. Zafar. 2006. Genetic variability of different wheat (*Triticum aestivum* L.) genotypes/cultivars under induced water stress. *Pak J Bot*. 38 (5): 1671-1678.
51. Zafar I., **M. Rahman,** A. Saleem and Y. Zafar. 2006. Genetic diversity among *Fusarium subglutinans* isolates causing mango Malformation disease in Pakistan. *World J Microbiol. Biotech.* 22: 1161-1167.
52. Asif, M., **M. Rahman** and Y. Zafar. 2005. DNA fingerprinting studies of some wheat (*Triticum aestivum* L.) genotypes using random amplified polymorphic DNA (RAPD) analysis. *Pak J Bot*. 37 (2): 271-277.
53. Tanveer, A., K. Akhtar, M.A. Ghouri, M. A. Anwar, M. Rehman, **Mehboob-ur-Rahman,** Y. Zafar & A.M. Khalid. 2005. Phylogenetic relationship among acidophilic bacteria from diverse environments as determined by random amplified polymorphic DNA analysis (RAPD). *World J Microbiol. Biotech*. 21: 645-648.
54. Mukhtar, S., **M. Rahman** and Y Zafar. 2002 Assessment of genetic diversity among wheat cultivars using random amplified polymorphic DNA (RAPD) analysis. *Euphytica* 128: 417-425.
55. **Rahman, M.** and Y Zafar. 2001. Genotyping of four varieties of lentil (*Lens culinaris* Medik) by DNA fingerprinting. *Pak J Bot.* 33 (4): 423-428.
56. Rehman S, M. S. Shaheen, **M. Rahman** and T. A. Malik. 2000. Evaluation of Excised Leaf Water Loss and Relative Water Content as Screening Techniques for Breeding Drought Resistant Wheat. *Pak. J. Biol. Sci*. 3 (4): 663-665.
57. **Rahman, M.,** T. A. Malik, M.J. Iqbal, Y Zafar, K. Alam, Z Perveen and S. Rehman. 1998. DNA Marker For salinity Resistance. *Rice Biotechnology Quarterly*, USA, 35:12-13.

<u>Conferences attended, national and international</u> (I don't keep record of conferences/meetings in which I was not invited speaker)

1. **Rahman, M.**, N. Aslam, M. Asif, T.A. Malik, K.A. Malik and Y. Zafar. 2002. Identification of DNA markers for Cotton Leaf Curl Virus Disease (CLCD) in Cotton (*Gossypium hirsutum* L.). *Cotton Science*. 14: 17. (ICGI China)
2. **Rahman, M.,** M. Asif, I. Ali, S.A. Randhawa, T.A. Malik, K.A. Malik and Y. Zafar. 2002. Isolate a Gene for Velvet Hairiness in Cotton (*Gossypium hirsutum* L.) by Map-Based Cloning. *Cotton Science* 14: 25. (ICGI China)
3. **Mehboob-ur-Rahman**, Muhammad Asif, Iftikhar Ali, Zulfiqar Hayder, Kausar A Malik and Y. Zafar, (2003). DNA marker studies in cotton. Final meeting of CFC/ICAC 07 project held at ICBA, Dubai 28-30 September 2003.
4. Ghulam Sarwar, Shahid Mansoor, Atiq-ur-Rehman, **Mehboob-ur-Rahman**, Iftikhar Ahmed Khan and Y. Zafar, (2003). Mechanism of resistance and diversity in sources of natural resistance against cotton leaf curl disease. Final meeting of CFC/ICAC 07 project held at ICBA, Dubai 28-30 September 2003.
5. **Mehboob-ur-Rahman,** Muhammad Asif, Ihsan Ullah, Yusuf Zafar and Kausar A Malik. 2004. Cotton genomic studies at NIBGE. International Cotton Genome Initiative (ICGI) Workshop, 10-13 Oct Hayderabad India. PP32.
6. **Rahman, M**., M. Asif, I. Ullah, K.A. Malik and Y. Zafar. 2005. Overview of cotton genomic studies in Pakistan. Plant & Animal Genome Conference XIII. San Diego, CA. USA. PP81.
7. **Rahman, M**., I. Ullah, M. Asif, K.A. Malik and Y. Zafar. 2005. Genomics studies for drought tolerance in cotton. Biotechnology for salinity & drought tolerance in plants. 28-31 March, Islamabad Pakistan. PP48.
8. Malik T.A., S. Rahman, **M. Rahman** and Y Zafar. 2005. Tagging genes for drought resistance by DNA markers in wheat. Biotechnology for salinity & drought tolerance in plants. 28-31 March, Islamabad Pakistan. PP50.
9. **Rahman, M**. and Y. Zafar. 2005. Practical National Biosafety Framework and Institutional Implementation in Agriculture Biotechnology Research. 10th International Congress of SABRAO, 22-23 August, Tsukuba Japan PP S6-3.
10. Rahman, S., T.A. Malik, **M. Rahman** and Y. Zafar. 2005. DNA markers for drought tolerance in wheat. The 2nd International conference on integrated approaches to sustain and improve plant production under drought stress, Univ of Rome La Sapienza Rome Itly.. 24-28 September, 2005
11. **Mehboob-ur-Rahman**, Ali Manan Mohsin & Yusuf Zafar. 2006. Wheat genomic studies in Pakistan. International Wheat Seminar. February 20-21, Wheat Res Inst. Faisalabad Pakistan PP. 80-81.
12. **Mehboob-ur-Rahman**, Ali M Mohsin & Yusuf Zafar. 2006. Development of genetic linkage map for drought tolerance in wheat. International Wheat Seminar. February 20-21, Wheat Res Inst. Faisalabad Pakistan PP. 81-82.
13. Ishtiaq Ahmad, **Mehboob-ur-Rahman**, Aman Ullah Malik, Yusuf Zafar. 2006. Application of DNA Fingerprinting Technology to Estimate Genetic Divergence among Mango Cultivars-Genotypes. 27th International Horticultural Congress 13-19 August 2006, Seoul Korea.
14. **Rahman**, M., I. Ullah, M. Ashraf, J.M. Stewart and Y. Zafar. 2006. Genotypic variation for drought tolerance in cotton (*Gossypium hirsutum* L.): Productivity, osmotic adjustment and

cellular membrane stability. International symposium on strategies for crop improvement against abiotic stresses. September 18-20, Dept. Bot. Univ Agric Faisalabad Pakistan PP. 14.

15. Ullah, I., **M. Rahman**, M. Ashraf and Y. Zafar. 2006. Genotypic variation for physiological and productivity traits in cotton (*Gossypium hirsutum* L.) under contrasting water regimes. International symposium on strategies for crop improvement against abiotic stresses. September 18-20, Dept. Bot. Univ Agric Faisalabad Pakistan PP. 14-15.
16. **Rahman**, M., A. Tabassam, M. Kazi and Y Zafar. 2006. A step towards wheat genome initiative studies to combat drought in Pakistan using DNA fingerprinting tool.. International symposium on strategies for crop improvement against abiotic stresses. September 18-20, Dept. Bot. Univ Agric Faisalabad Pakistan PP. 15.
17. Javed, Y., M. Rahman, N. Tabassam, R.W. Briddon and Y. Zafar. 2006. Identification of resistant sources against Burewala virus disease. International Cotton Genome Initiative (ICGI) Workshop, 18-20 Sept Brasilia Brazil. PP 9-10.
18. **Rahman, M., N. Ahmed**, M.Asif and Y. Zafar. 2006. Identification of DNA markers linked with cotton leaf curl disease (CLCD). International Cotton Genome Initiative (ICGI) Workshop, 18-20 Sept Brasilia Brazil. PP 77-78.
19. **Rahman, M.,** M. Nawaz, M.Asif, T.A. Wilkins and Y. Zafar. 2006. A step towards expression profiling of cotton fiber. International Cotton Genome Initiative (ICGI) Workshop, 18-20 Sept Brasilia Brazil. PP 49-50.
20. **Rahman M.** National Seminar on Biodiversity Conservation on Dec 21, 2010 at IABGR, Islamabad
21. **Rahman M.** 2011. Combating cotton leaf curl disease: A way forward. 5th meeting Asian Cotton Research & Development Network, 23-25 Feb 2011, Lahore Pakistan.
22. Beltwide Cotton Conference Jan 3-6, 2012
23. **ICGI meeting 9-12 Oct 2012**
24. **Rahman** et al., 2013. Genetic and Genomic strategies for combating cotton leaf curl disease. Biotechnology: Prospects & Challenges in Agriculture, Industry, Health and Environment. 22-26 April 2013.
25. **I**nternational Conference on Plant Genetics and Breeding Technologies, 18-20 February 2013, Vienna, Austria
26. Key note lecture entitled Exploitation of genomic resources for sustaining crop productivities in Pakistan. The International Conference of Biochemical and Chemical Sciences. 24-26 Feb 2014

National Conferences

1. Yasmin, S., D. Ariani, D. Naranchimeg, B. Delgermaa, **M. Rahman,** Y. Zafar and F.Y. Hafeez. 2002. Genetic diversity among plant growth promoting *Rhizobacteria* (PGPR) from geographically different areas using RAPD technique. 9th International Congress of Soil Science. March 18-20, 2002. NIAB, Faisalabad Pakistan. pp 33.
2. Zafar Iqbal, **Mehboob-ur-Rahman**, Altaf Ahmad Dasti, Ahmad Saleem Akhtar and Yusuf Zafar (2003). Genetic diversity among Fusarium subglutinans isolates causing mango malformation disease in Pakistan.. Fourth National Conference of Plant Pathology held on 14-16 October 2003 at University of Arid Agriculture, Rawalpindi, Pakistan.
3. **Rahman, M**., K.A. Malik and Y. Zafar. 2004. Application of DNA fingerprinting for drought tolerance in wheat. First National Conference on Agricultural Biotechnology 16-18 August, 2004 Green Retreat Hotel, Nathiagali, Pakistan.
4. **Rahman, M**., T. Yasmin, H.L. Shaheen, T. Shaheen, N. Tabassum and Y. Zafar. 2006. Harvesting genetic diversity in the cotton genome. National symposium on biotechnology for economic prosperity. July 24-26, 2006 Green Retreat Hotel, Nathiagali, Pakistan.pp.38.

5. Asif, M., H. Mumtaz, J.I. Mirza, **M. Rahman** and Y. Zafar. Development of Genetic Linkage Map for quality traits in cotton. National symposium on biotechnology for economic prosperity. July 24-26, 2006 Green Retreat Hotel, Nathiagali, Pakistan. pp. 134.
6. Ullah, I., **M. Rahman** and Y. Zafar. Development of Genetic Linkage Map for Drought Tolerance in cotton. National symposium on biotechnology for economic prosperity. July 24-26, 2006 Green Retreat Hotel, Nathiagali, Pakistan. pp. 136.
7. Tabbasam N., H.L. Shaheen, M. Rahman and Y. Zafar. 2008. Characterization and genetic diversity analysis of Gossypium hirsutum L. genotypes/cultivars using microsatellites. Genomics for health and prosperity. Dec 20-23, 2008 University of Karachi, Pakistan.

List of innovative achievements:

Cotton varieties/cultivars (07 +01)

1. We gained insight into the extent of genetic diversity among several crop plants including cotton. This information has been utilized for planning crosses and taking pro-active decisions in routine cotton breeding programs. Our group remained an active part of many international mega projects including physical mapping of D-genome (Lin et al. 2010, BMC Genomics), D-genome sequencing project (Paterson et al. 2012, Nature), etc. All these efforts were appreciated by bestowing me "Gold Medal-2009 by PAEC, Pakistan.
2. Utilized DNA markers associated with cotton leaf curl disease (Multan strain, appeared in 1990s in epidemic form), resulted in the development of three cotton varieties NIBGE-2, NIBGE-115 and NN-3. The material developed by my group has been declared the most tolerant to Burewala virus disease by the Ministry of Food and Agriculture Livestock (MinFAL) Islamabad. This material was transferred to other organizations for using in cotton breeding programs. Also share authorship on international registration document of CIM-496 (Arshad *et al.,* 2009, J Plant Reg. Reg. No. CV-125, PI 657627, Pak 024263)). This variety covered up to 43% area of the Punjab in 2006, and remained very popular for four consecutive years (2004—2007). All these efforts towards development of new cotton varieties were appreciated by Ministry of Food and Agriculture by awarding me "Outstanding Award in Biotechnology—first position on 26 May 2009.
3. Dr Rahman has been remained at forefront in generating data for the safe use of Bt cotton containing Cry1Ac gene in local environment (Pakistan) and was submitted to the National Biosafety Committee, EPA, Islamabad Pakistan as a preliminary requirement for getting approval of cultivation of Bt cotton in Pakistan. Presently, Bt cotton varieties developed by us and other public/private entrepreneurs covers ~82% of the total cotton cultivated area of Pakistan. All these efforts toward sustaining cotton production were appreciated by the Prime Minister of Pakistan by awarding me the LCCI Achievement Award 2010.
4. Dr Rahman has also been instrumental in developing four Bt cotton varieties (IR-NIBGE-3701, IR-NIBGE-1524, IR-NIBGE-3 & IR-NIBGE-901) as a principal breeder. All these varieties covered up to 35%, 25%, 20%, 13% area of Pakistan in 2009, 2010, 2011, 2012 & 2013, respectively. Total increase in production over the control was ~7.39 million bales during these years. President of Pakistan has awarded him "Presidential Award for Pride of Performance in 2012" for sustaining cotton production, and later by TWAS and Farmer Associate of Pakistan.

Other relevant information related to cotton varieties

1- NIBGE-2: approved on 14 Dec 2006 for general cultivation; and also got international Registration (Reg. No. CV-124, PI 647088, Pak 022845). (Dr. Rahman is the Principal Breeder)

2- NIBGE-115: Approved on Feb 16, 2012 for general cultivation; and also got international registration as germplasm (Reg. No GP-880, PI 643972). (Dr. Rahman is the Principal Breeder)
3- CIM-496: Approved in 2005. Reg. No. CV-125, PI 657627, Pak 024263).

Breeders: M. Arshad, M.I. Khan, C.R. Ali, M. Afzal and **M. Rahman**

- Covered 12.15% area of Punjab in 2004
- Covered 32.03% area of Punjab in 2005
- Covered 42.90% area of Punjab in 2006
- Covered 33.30% area of Punjab in 2007
- Covered ~20% area of Punjab in 2008
- Covered ~20% area of Punjab in 2009

4- IR-NIBGE-3701 (Approved on 31 March 2010, **Dr. Rahman** is the Principal Breeder)

- Covered less than 2% area of Punjab Province in 2008
- Covered ~15% area of Punjab Province in 2009
- Covered around 30% area of Punjab in 2010
- Covered around 13% area of Punjab in 2011
- Covered around 3% area of Punjab in 2012
- Covered around ~2% area of Punjab in 2013

Sindh Province

- Covered less than 2% area of Sindh Province in 2008
- Covered ~2% area of Sindh Province in 2009
- Covered ~10% area of Sindh in 2010
- Covered ~ 15% in Sindh Province of Pakistan in 2011
- Covered ~ 20% in Sindh Province of Pakistan in 2012
- Covered ~20% in Sindh Province of Pakistan in 2013

5- IR-NIBGE-1524: (Approved on 31 March 2010, **Dr. Rahman** is the Principal Breeder)

- Covered ~5% area in 2006
- Every year it keeps ~2-4% area of Pakistan particularly in Virus infected areas

Sindh Province

- Covered ~2% area of Sindh Province in 2009
- Covered ~4% area of Sindh in 2010
- Covered ~ 8% in Sindh Province of Pakistan in 2011
- Covered ~ 10% in Sindh Province of Pakistan in 2012

6- IR-NIBGE-901: (Approved on 07-05-2011 for Sindh, **Dr. Rahman** is the Principal Breeder)

- Covered ~1-2% area of Punjab from 2005 to 2011
- Covered ~5% area in Sindh Province of Pakistan in 2005
- Covered ~ 5% in Sindh Province of Pakistan in 2006
- Covered ~ 10% in Sindh Province of Pakistan in 2007
- Covered ~ 12% in Sindh Province of Pakistan in 2008
- Covered ~15% in Sindh Province of Pakistan in 2009
- Covered ~15% in Sindh Province of Pakistan in 2010
- Covered ~ 25% in Sindh Province of Pakistan in 2011
- Covered ~ 20% in Sindh Province of Pakistan in 2012
- Covered ~20% area in Sindh Province in 2013
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7- IR-NIBGE-3 (Approved on 16-02-2012 for Punjab)

- ❖ Suitable for early sowing.

8- **NN-3:** Approved in May 2013 for general cultivation; and also got international registration as a germplasm (Reg. No. GP-955, PI 665058, Pak 027493).

Short summaries of the nominee's best research papers.

Establishment and Application of DNA marker in cotton improvement progamme.

Dr. Rahman's lab is pioneer in initiating DNA fingerprinting assays in Pakistan. Various DNA marker assays such as RAPDs, SSRs, AFLPs and presently now SNPs have been utilized for the estimation of genetic diversity among cotton varieties/genotypes of *G. hirsutum* (published in 2002). One of the important findings was that conical crosses should be made as one of the important tool to widen the genetic base of the new cultivated cotton varieties for combating the most important menace of cotton leaf curl disease. His group has also demonstrated that there were two center of origin of various G. arboreum accessions in this Pakistan (published in 2008). Similarly, the frequency of SNPs has been identified in various cotton species and their possible usage in the cotton improvement programs. His group has identified DNA markers associated with resistance to cotton leaf curl disease (Multan strain), and identified two SSRs which were later utilized for the improvement of cotton—resulted in the development of NIBGE-2, NIBGE-115 and NN-3 cotton cultivars. Our group has also characterized the *G. hirsutum* germplasm under water limited conditions (published in 2008), and identified two cotton lines FH-901 (drought sensitive) and RH-510 (drought tolerant). These genotypes were used in developing mapping population, and QTLs associated with drought tolerance have been identified (published in 2010) using intraspecific cross (*G. hirsutum*). We have also identified QTLs associated with various traits (fiber, leaf morphology etc.) using intraspecific crosses (*G. arboreum*, published in 2013).

Genetics of cotton leaf curl disease

Cotton leaf curl, a disease of viral origin, has substantially depressed cotton production in Pakistan. The disease is threatening the other important cotton growing neighboring countries like India and China. We have taken lead in demonstrating that the resistance to the disease is conferred by three genes including one suppressor gene (published in 2005). Another strain called Burewala appeared in epidemic form in 2006 and then in 2010. We first time described the most suitable and user friendly method of scoring the cotton leaf curl disease (0-4) which is being practiced through the country for scoring the disease.

Collaborative efforts towards cotton genome sequencing project.

Dr. Rahman as one of the collaborators of Pak-US project entitled "Integrated genetic/physical mapping of Gossypium" has contributed in developing the D-genome physical map (published in 2010). Similarly, he has been the part of the cotton genome-sequencing project (Prof Paterson, UGA, was the lead PI). The sequence was made public in 2012. This information has been published in 2012 in Nature. I am too the co-author in this paper. We have surveyed the released D-genome sequence and identified more than 1200 SSRs. These were surveyed on interspecific population, and identified two QTLs conferring tolerance to the cotton leaf curl disease.