

## CURRICULUM VITAE

### Sachin Rustgi

Department of Crop and Soil Sciences, 271 Johnson Hall, Washington State University, Pullman WA-99164-6420; Phone: (509) 432-9729 (Home), (509) 335-3036 (Office), (509) 335-5288 (Laboratory); Fax: (509) 335-8674; E-mail: [rustgi@wsu.edu](mailto:rustgi@wsu.edu), [rustgi2001@yahoo.com](mailto:rustgi2001@yahoo.com); Webpage: <http://css.wsu.edu/sachin-rustgi/>

**1. Research experience:** *Twelve years of research experience working in different areas of plant sciences targeting basic and applied problems involving components of plant physiology, plant breeding and genetics, cytology, genomics, molecular biology, and bioinformatics.*

Designation	Funding agency & Project title	Duration
<b>Assistant Research Professor</b> (2011 to date)**	<u>National Institutes of Health</u> ‘ <i>TILLING wheat for reduced celiac disease causing proteins</i> ’, and <u>Life Sciences Discovery Fond</u> ‘ <i>Wheat for Celiac Patients and Improved Disease Prevention</i> ’	2 years, 11 months
Postdoctoral Research Associate (2009-11)**	<u>National Institutes of Health</u> ‘ <i>Prevention of Celiac Disease by Transgenic Removal of Prolamin T-cell Epitopes</i> ’	1 year, 7 months
Visiting Scientist (2006-09)**	<u>U.S. Department of Agriculture</u> ‘ <i>The Genetic Basis of Agronomic Traits Controlled by Chromosome 3A in Wheat</i> ’, and <u>Washington Grain Commission</u>	3 years
Senior Research Fellow (2005-06)*	<u>Council of Scientific &amp; Industrial Research (CSIR)</u> , Government of India	1 year
Senior Research Fellow (2003-05)*	<u>Department of Biotechnology (DBT)</u> , Government of India, ‘ <i>Microsatellites in Wheat Genomics</i> ’	2 years
Junior Research Fellow (2001-03)*	<u>Department of Biotechnology (DBT)</u> , Government of India, ‘ <i>Microsatellites in Wheat Genomics</i> ’	2 years

\*Ch. Charan Singh University, Meerut, India; \*\*Washington State University, Pullman, USA

**2. Teaching and training experience:** I taught an advanced graduate level course on ‘Plant Genomics and Bioinformatics’ for two academic years 2005 and 2006 at the C.C.S. University, Meerut (India). Organized a ten day workshop from April 14 to 24, 2010 at the Northeast Normal University, Changchun, China on the ‘Use of virus induced gene silencing (VIGS) for characterization of meiotic genes in bread wheat’. I mentored two of graduate students, Shanshan Wen and Claudia Osorio, who recently graduated from the Washington State University, and respectively joined the Northwest A & F University, China and the Agricultural Research Institute (INIA), Chile. I am currently mentoring two Ph.D. students, Nuan Wen and Rhoda A.T. Brew-Appiah both of them are enrolled in the Molecular Plant Sciences (MPS) program, at the WSU, Pullman.

**3. Academic background:** Took courses in plant breeding, genetics, molecular biology, plant and crop physiology, photobiology, quantitative and population genetics, biostatistics, genomics, cytogenetics, biochemistry, plant pathology, plant systematics, microbiology, ecology, soil science, plant embryology, plant anatomy, plant morphology and bioinformatics.

- **Ph.D.** (2001-2006) in Genetics and Plant Breeding with a title, “*In Silico Development and Use of SSR and SNP Markers in Bread Wheat*” from C.C.S. University, Meerut (UP), India; Dissertation advisors: Prof. P.K. Gupta and Prof. H.S. Balyan
- **M.Sc.** (1999-2001) in Botany from M.J.P. Rohilkhand University, Bareilly (UP), India

- D.I.S.M. (1999-2000) One year diploma in information systems management from Aptech, Chandausi (India)
- B.Sc. (1996-1999) in Botany and Chemistry from M.J.P. Rohilkhand University, Bareilly (UP), India

To get equipped with cutting age technology available at the time I obtained one month residential training on DNA sequencing and genotyping from Centre for Cellular and Molecular Biology, Hyderabad, India in 2002.

**4. Books authored:** The research work conducted during my Ph.D. was accepted for publication in the form of a book by VDM Verlag Dr. Mueller, LAP Lambert Academic Publishing Company. The research conducted under the auspice of two National Institutes of Health and one Life Sciences Discovery Fund projects was compiled in the form of an extensive review and sent for publication to the peer-reviewed journal *Scientia Danica*, Series B, *Biologica* published by the Royal Danish Academy of Sciences and Letters

**Rustgi S** (2011) “*In silico* development and use of SSR and SNP markers in bread wheat: Gene derived markers and genome fractionation a glimpse in the wheat genome”, VDM Verlag Dr. Mueller, LAP Lambert Academic Publishing (152 pages) ISBN# 978-3-639-33227-8.

**Rustgi S**, Wen N, Osorio C, Brew-Appiah RAT, Wen S, Gemini R, Mejias JH, Ankrah N, Moehs CP, von Wettstein D (2014) Natural dietary therapies for the ‘gluten syndrome’, *Scientia Danica, Series B, Biologica* vol. 3 (87 pages) ISBN 978-87-7304-376-9.

**5. Research publications:** Published 35 papers in peer-reviewed journals with *impact factors* ranging from 0.486 to 9.771\* with a total of 1425 *citations*\* (*h-index* = 13\*; *i10-index* = 15); made 9 contributions to Annual Wheat Newsletter, published by the Wheat Genetic and Genomic Resources Center at Kansas State University, Manhattan, KS; Authored 1 popular article in the Journal of Gluten Sensitivity and 2 chapters in internationally recognized books published by Springer.

[\*Journal impact factors as of 2013; Citations are based on Google Scholar (<http://scholar.google.com>)]

Note: The first 17 papers are product of my graduate research [Mentors: PK Gupta & HS Balyan]

1. Sharma S, **Rustgi S**, Balyan HS, Gupta PK (2002) Internal transcribed spacer (ITS) sequences of ribosomal DNA of wild barley and their comparison with ITS sequences in common wheat, *Barley Genet Newslet*, 32, 38-45. (**citation 10**)
2. Gupta PK, Balyan HS, Kumar S, Prasad M, Roy JK, Kumar N, Sharma S, Kulwal PL, **Rustgi S**, Singh R (2002) Development and use of molecular markers for genetic mapping and marker-assisted selection (MAS) in wheat, *Ann Wheat Newslet*, 48, 76-80.
3. Gupta PK, **Rustgi S**, Sharma S, Singh R, Kumar N, Balyan HS (2003) Transferable EST-SSR markers for the study of polymorphism and genetic diversity in bread wheat, *Mol Genet Genomics*, 270, 315-323. (**impact factor 2.831; citation 372**)
4. Gupta PK, **Rustgi S** (2003) Mass spectrometry: an essential tool for genome and proteome analysis, *Ind J Biotechnol*, 2, 48-64. (**impact factor 0.510; citation 1**)
5. Gupta PK, Balyan HS, Prasad M, Roy JK, Bandopadhyay R, Kumar N, Sharma S, Kulwal PL, **Rustgi S**, Singh R, Goyal A, Kumar A, Prashant SN (2003) Development and use of molecular markers for QTL mapping and genomics research in bread wheat, *Ann Wheat Newslet*, 49, 42-46. (**citation 1**)

6. Bandopadhyay R, Sharma S, **Rustgi S**, Singh R, Kumar A, Balyan HS, Gupta PK (2004) DNA polymorphism among 18 species of *Triticum-Aegilops* complex using wheat EST-SSRs, *Plant Sci*, 166, 349-356. (**impact factor 4.114; citation 62**)
7. Gupta PK, **Rustgi S** (2004) Molecular markers from the transcribed/expressed region of the genome in higher plants, *Funct Integr Genomics*, 4, 139-162. (**impact factor 2.691; citation 185**)
8. Gupta PK, Balyan HS, Bandopadhyay R, Kumar N, Sharma S, Kulwal PL, **Rustgi S**, Singh R, Goyal, Kumar A (2004) Development and use of molecular markers for wheat genomics, *Ann Wheat Newslet*, 50, 52-55.
9. Gupta PK, Kulwal PL, **Rustgi S** (2005) Wheat cytogenetics in the genomics era and its relevance to breeding, *Cytogenet Genome Res*, 109, 315-327. (**impact factor 1.905; citation 20**)
10. Gupta PK, **Rustgi S**, Kulwal PL (2005) Linkage disequilibrium and association studies in higher plants: Present status and future prospects, *Plant Mol Biol*, 57, 461-485. (**impact factor 4.072; citation 347**)
11. Balyan HS, Gupta PK, **Rustgi S**, Bandopadhyay R, Goyal A, Singh R, Kumar A, Kumar N, Sharma S (2005) Development and use of SSRs of bread wheat for genetic and physical mapping and transferability to the species of *Triticum-Aegilops* complex, *Czech J Genet Plant Breed*, 41, 141-144. (**impact factor 0.486; citation 2**)
12. Gupta PK, Balyan HS, Bandopadhyay R, Kumar N, Sharma S, Kulwal PL, **Rustgi S**, Singh R, Goyal A, Kumar A (2005) Development and use of molecular markers for wheat genomics, *Ann Wheat Newslet*, 51, 51-55.
13. Singh R, Kumar N, Bandopadhyay R, **Rustgi S**, Sharma S, Balyan HS, Gupta PK (2006) Development and use of anchored-SSRs to study DNA polymorphism in bread wheat (*Triticum aestivum* L.), *Mol Ecol Notes*, 6, 296-299. (**impact factor 5.626; citation 6**)
14. Roy JK, Bandopadhyay R, **Rustgi S**, Balyan HS, Gupta PK (2006) Association analysis of agronomically important traits using SSR, SAMPL and AFLP markers in bread wheat, *Curr Sci*, 90, 683-689. (**impact factor 0.935; citation 43**)
15. Gupta PK, **Rustgi S**, Kumar N (2006) Genetic and molecular basis of grain size and grain number and its relevance to grain productivity in higher plants, *Genome*, 49, 565-571. (**impact factor 1.668; citation 47**)
16. Gupta PK, Balyan HS, Bandopadhyay R, Kumar J, Mohan A, Kumar N, Kulwal PL, **Rustgi S**, Singh R, Goyal A, Kumar A, Kumar V, Girdharwal N, Mir RR (2006) Development and use of molecular markers for wheat genomics and breeding, *Ann Wheat Newslet*, 52, 43-47.
17. Mir RR, **Rustgi S**, Sharma S, Singh R, Goyal A, Kumar J, Gaur A, Tyagi AK, Khan H, Sinha MK, Balyan HS, Gupta PK (2008) A preliminary genetic analysis of fibre traits and the use of new genomic SSRs for genetic diversity in jute, *Euphytica*, 161, 413-427. (**impact factor 1.692; citation 36**)
18. Sidhu GK, **Rustgi S**, Shafqat MN, von Wettstein D, Gill KS (2008) Fine structure mapping of a gene-rich region of wheat carrying *Ph1*, a suppressor of crossing over between homoeologous chromosomes, *Proc Natl Acad Sci, U S A*, 105, 5815-5820. (**impact factor 9.809; citation 16**)
19. Gupta PK, **Rustgi S**, Mir RR (2008) Array-based high-throughput DNA markers for crop improvement, *Heredity*, 101, 5-18. (**impact factor 4.110; citation 166**)
20. **Rustgi S**, Bandopadhyay R, Balyan HS, Gupta PK (2009) EST-SNPs in bread wheat: Discovery, validation, genotyping and haplotype structure, *Czech J Genet Plant Breed*, 45,

- 106-116. (**impact factor 0.486; citation 9**)
21. von Wettstein D, **Rustgi S**, Kannangara CG, Ankrah N, Brew-Appiah RAT, Wen S, Wen N, Gemini R, Brueggeman R, Reisenauer P, Gill KS, Moehs CP, Liu B, Pang J, Wang X, Langen G, Kogel KH (2010) Multipronged approach to develop nutritionally improved celiac safe wheat varieties, *Ann Wheat Newslet*, 56, 261-264. (**citation 1**)
  22. Riar DS\*, **Rustgi S\***, Burke IC, Gill KS, Yenish JP (2011) EST-SSR development from 5 *Lactuca* species and their use in studying genetic diversity among *L. serriola* biotypes, *J Heredity*, 102, 17-28. (**impact factor 1.995; citation 8**) \*co-first author
  23. Lee H\*, **Rustgi S\***, Kumar N, Burke IC, Yenish JP, Gill KS, von Wettstein D, Ullrich SE (2011) Single nucleotide mutation in the barley *acetohydroxy acid synthase (AHAS)* gene confers resistance to imidazolinone herbicides, *Proc Natl Acad Sci, U S A*, 108, 8909-8913. (**impact factor 9.809; citation 13**) \*co-first author
  24. Bandopadhyay R\*, **Rustgi S\***, Chaudhuri RK, Khurana P, Khurana JP, Tyagi AK, Balyan HS, Houben A, Gupta PK (2011) Use of methylation filtration and C<sub>0</sub>t fractionation for analysis of genome composition and comparative genomics in bread wheat, *J Genet Genomics*, 38, 315-325. (**impact factor 2.924; citation 2**) \*co-first author
  25. **Rustgi S**, Balyan HS, Gupta PK (2011) MSL and SNPL: Softwares for *in silico* mining of SSRs and SNPs, *Int J Biotechnol Biosci*, 1, 353-355.
  26. Baenziger PS, Dweikat I, Gill K, Eskridge K, Berke T, Shah M, Campbell BT, Ali ML, Mengistu N, Mahmood A, Auvuchanon A, Yen Y, **Rustgi S**, Moreno-Sevilla B, Mujeeb-Kazi A, Morris RM (2011) Understanding grain yield: It is a journey, not a destination, *Czech J Genet Plant Breed*, 47 S77-S84. (**impact factor 0.486; citation 1**)
  27. Bennypaul HS, Mutti JS, **Rustgi S**, Kumar N, Okubara PA, Gill KS (2012) Virus-induced gene silencing (VIGS) of genes expressed in root, leaf and meiotic tissues of wheat, *Funct Integr Genomics*, 12, 143-156 (**impact factor 2.691; citation 18**).
  28. Osorio C , Wen N, Gemini R, Zemetra R, von Wettstein D\*, **Rustgi S\*** (2012) Targeted modification of wheat grain protein to reduce the content of celiac causing epitopes, *Funct Integr Genomics*, 12:417-438. (**impact factor 2.691; citation 14**) \*co-corresponding author
  29. **Rustgi S**, von Wettstein D, Ankrah N, Brew-Appiah RAT, Wen S, Wen N, Osorio C, Gemini R, Reisenauer P, X. Lu, Mejias JH (2012) Engineering wheat for celiac patients, *Ann Wheat Newslet*, 58:248-253. (**citation 2**)
  30. Wen S, Wen N, Pang J, Langen G, Brew-Appiah RAT, Mejias JH, Osorio C, Yang MM, Gemini R, Moehs CP, Zemetra RS, Kogel KH, Liu B, Wang X, von Wettstein D\*, **Rustgi S\*** (2012) Structural genes of wheat and barley 5-methylcytosine DNA glycosylases and their potential applications for human health. *Proc Natl Acad Sci, U S A* 109:20543-20548 (**impact factor 9.809; citation 13**) \*co-corresponding author
  31. Zhang H, Bian Y, Gou X, Zhu B, Xu C, Qi B, Li N, **Rustgi S**, Zhou H, Han F, Jiang J, von Wettstein D, Liu B (2013) Persistent whole-chromosome aneuploidy is generally associated with nascent allohexaploid wheat. *Proc Natl Acad Sci, U S A* 110:3447-3452 (**impact factor 9.809; citation 17**)
  32. Gupta PK, **Rustgi S**, Mir RR (2013) Array-based high-throughput DNA markers for cereal genetics and genomics. In: Gupta PK, Varshney RK (Eds.), *Cereal Genomics II*, Springer, ISBN: 978-94-007-6401-9. (**citation 4**)
  33. Kumar N, **Rustgi S\*** (2013) Agronomically relevant traits transferred to major crop plants by alien introgressions. In: Pratap A, Kumar J (Eds.), *Alien Gene Transfer in Crop Plants: Innovations, Methods and Risk Assessment (Vol. I)*, Springer, New York, USA, ISBN: 978-

1-4614-8584-1 \*corresponding author

34. **Rustgi S**, Shafqat MN, Kumar N, Ali ML, Dweikat I, Baenziger P, Gill KS (2013) Genetic dissection of yield and its component traits using high-density composite map of wheat chromosome 3A: Bridging gaps between QTLs and underlying genes. *PLoS ONE* 8(7): e70526. **(impact factor 3.534; citation 3)**
35. **Rustgi S**, von Wettstein D, Ankrah N, Mejias JH, Brew-Appiah RAT, Wen S, Wen N, Osorio C, Gemini R, Reisenauer P, Mohan J, Brabb I (2013) A natural dietary-therapy for gluten intolerance, sensitivity and allergenicity. *Ann Wheat Newslet*, 59: 151-155.
36. **Rustgi S** (2013) Engineering wheat genotypes compatible for gluten sensitive, allergenic and intolerant individuals. *Int J Plant Biol Res* 1(1): 1003.
37. Brew-Appiah RAT, Ankrah N, Liu W, Konzak CF, von Wettstein D\*, **Rustgi S\*** (2013) Generation of doubled haploid transgenic wheat lines by microspore transformation. *PLoS ONE* 8(11): e80155. \*corresponding author **(impact factor 3.534; citation 1)**
38. Zhang H, Bian Y, Gou X, Dong Y, **Rustgi S\***, Zhang B, Xu C, Li N, Qi B, Han F, von Wettstein D\*, Liu B\* (2013) Intrinsic karyotype stability and gene copy number variations may have laid the foundation for tetraploid wheat formation. *Proc Natl Acad Sci, U S A* 110:19466-19471 \*corresponding author **(impact factor 9.809; citation 4)**
39. **Rustgi S** (2013) Bringing barley back in crop rotation by breeding for imidazolinone resistance. *Med Aromat Plants* 2: e148. **(citation 1)**
40. **Rustgi S** (2014) Discussion with Assistant Research Professor Sachin Rustgi on the genetic modification of wheat to make it safe for celiacs. *Journal of Gluten Sensitivity* 13(2):11-14.
41. Mejias JH, Lu X, Osorio C, Ullman JL, von Wettstein D\*, **Rustgi S\*** (2014) Analysis of Wheat Prolamins, the Causative Agents of Celiac Sprue, Using Reversed Phase High Performance Liquid Chromatography (RP-HPLC) and Matrix-Assisted Laser Desorption Ionization Time of Flight Mass Spectrometry (MALDI-TOF-MS). *Nutrients* 6(4): 1578–1597. \*co-corresponding author **(impact factor 3.148)**
42. **Rustgi S\***, Matanguihan J, Mejias J, Gemini R, Osorio C, Wen N, Ankrah N, Brew-Appiah R, Murphy KM, von Wettstein D\*, (2014) Assessment of Genetic Diversity among Barley Cultivars and Breeding Lines Adapted to the US Pacific Northwest, and Its Implications in Breeding Barley for Imidazolinone-Resistance. *PLOS One* 9(6): e100998. \*co-corresponding author **(impact factor 3.534)**
43. Hu L, Li N, Xu C, Zhong S, Lin X, Yang J, Zhou T, Yuliang A, Cao X, Zemach A, **Rustgi S**, von Wettstein D, Liu B (2014) Mutation of a major CG methylase in rice causes genome-wide hypomethylation, dysregulated genome expression, and seedling lethality. *Proc Natl Acad Sci, U S A* 111(29): 10642-10647 **(impact factor 9.809)**
44. **Rustgi S**, von Wettstein D, Ankrah N, Brew-Appiah RAT, Wen N, Mitchell SM, Gemini R, Reisenauer P, Brabb I (2014) Breeding celiac-safe wheat cultivars a future market class of wheat. *Ann Wheat Newslet*, 60: 143-146.
45. Yang C, Zhao L, Yang Z, Xu C, Zhang H, Wen S, Zhang C, **Rustgi S\***, von Wettstein D\*, Liu B\* (2014) Evolution of physiological responses to salt stress in hexaploid wheat. *Proc Natl Acad Sci, U S A* 111(32): 11882-11887 \*co-corresponding author **(impact factor 9.809)**
46. **Rustgi S\***, Pollmann S, Buhr F, Springer A, Reinbothe C, von Wettstein D\*, Reinbothe S\*, (2014) *JIP60*-mediated, jasmonate- and senescence-induced molecular switch in translation toward stress and defense protein synthesis. *Proc Natl Acad Sci, U S A* 111(39):14181-14186 \*co-corresponding author **(impact factor 9.809)**
47. Bhullar R, Nagarajan R, Bennypaul H, Sidhu GK, Sidhu G, **Rustgi S**, von Wettstein D, Gill

KS (2014) Silencing of a metaphase I-specific gene results in a phenotype similar to that of the *Pairing homeologous 1 (Ph1)* gene mutations. *Proc Natl Acad Sci, U S A* 111(39):14187-14192 (**impact factor 9.809**)

**6. Papers submitted for publication:** *One paper* is currently under review process.

1. Ou X, Zhuang T, Yin W, Miao Y, Zhang Y, Lin X, Xu C, von Wettstein D, **Rustgi S**, Liu B (2014) DNA methylation changes in rice induced by excessive exogenous nitric oxide. *Plant Mol Biol Rep*

**7. Papers accepted for oral/poster presentation in conferences:** Out of 36 papers 28 were selected for poster presentations and 8 were selected for oral presentations at national and international conferences held in seven different countries including, Australia, Canada, Germany, India, Italy, Russia and USA.

Authors	Conference
1. <b>Rustgi S</b> , Singh R, Kumar N <i>et al.</i> (2002)	National Symposium on Functional Genomics, CCMB, 23-24 February, 2002 Hyderabad, India
2. <b>Rustgi S</b> , Singh R, Balyan HS <i>et al.</i> (2002)	2 <sup>nd</sup> International Group Meeting on “Wheat Technology for Warmer Areas” Agarkar Research Institute, Pune, India
3. Sharma S, Singh R, <b>Rustgi S</b> <i>et al.</i> (2004)	Agricultural Biotechnology International Conference (ABIC), September 12-15, 2004, Cologne, Germany
4. Mir RR, <b>Rustgi S</b> , Sharma S <i>et al.</i> (2006)	National Symposium on Molecular Breeding in Crop Plants, 20-21 March, 2006, IIVR, Varanasi, India
5. Sidhu GK, <b>Rustgi S</b> , Shafqat MN <i>et al.</i> (2008)	Plant & Animal Genome XVI Conference, January 12-16, 2008, Town & Country Convention Center San Diego, California, USA
6. Ali ML, <b>Rustgi S</b> , Baenziger PS <i>et al.</i> (2008)	Plant & Animal Genome XVI Conference, January 12-16, 2008, Town & Country Convention Center San Diego, California, USA
7. von Wettstein D, Kannangara G, Ankrah N, Reisenauer P, Brueggeman R, Kleinhofs A, <b>Rustgi S</b> <i>et al.</i> (2008)	2008 Dryland field day abstracts: Highlights of research progress, Pullman, WA, USA
8. Sidhu GK, <b>Rustgi S</b> <i>et al.</i> (2008)	The 11th International Wheat Genetics Symposium proceedings. Sydney, Australia, Sydney University Press, 2008. ISBN: 978-1-920899-14-1
9. <b>Rustgi S</b> <i>et al.</i> (2008)	The 11th International Wheat Genetics Symposium proceedings. Sydney, Australia, Sydney University Press, 2008. ISBN: 978-1-920899-14-1
10. <b>Rustgi S</b> , Kumar N, Gill KS (2009)*	Workshop on “Plant Genomics and Quantitative Genetics” held at Meerut, UP, India, Feb. 14-16, 2009
11. Riar DS, <b>Rustgi S</b> , Burke IC, Gill KS, Yenish JP (2009)	62 <sup>nd</sup> meeting of Western Society of Weed Science, March 9-12, 2009
12. Wen S, Brew-Appiah RAT, Ankrah N,	Academic Showcase, March 27, 2009, Washington

- Rustgi S et al.** (2009) State University, Pullman, WA, USA
13. **Rustgi S**, Kumar N, Gill KS (2010)\* Plant & Animal Genome XVIII Conference, January 9-13, 2010, Town & Country Convention Center, San Diego, CA, USA
14. Mutti JS, Bennypaul HS, **Rustgi S et al.** (2010) Joint congress of hard winter wheat workers workshop and national wheat genomics workshop, March 7-10, 2010, University of Nebraska-Lincoln, USA
15. **Rustgi S**, Kumar N, Gill KS (2010) Joint congress of hard winter wheat workers workshop and national wheat genomics workshop, March 7-10, 2010, University of Nebraska-Lincoln, USA
16. **Rustgi S**, Kumar N, Gill KS (2010)\* Plant genomics in crop improvement With reference to biotic and abiotic stresses, Department of Biotechnology & Molecular Biology, CCS Haryana Agricultural University, Hisar-125004, India, 25th – 27th February 2010
17. **Rustgi S**, Kumar N, Gill KS (2010) Maize Genetics Conference, Riva del Garda, Italy, March 18-21, 2010
18. Baenziger PS, Dweikat I, Gill KS, Eskridge K, Berke T, Shah MM, Campbell TB, Ali MD, Mengistu N, Mahmood A, Auvuchanon A, Yen Y, **Rustgi S et al.** (2010)\* 8th International Wheat Conference (IWC), 1-4 June 2010 in St. Petersburg, Russia
19. **Rustgi S**, Brew-Appiah RAT, Wen N *et al.* (2010) Joint annual meeting of the American Society of Plant Biologists and the Canadian Society of Plant Physiologists, Montreal, Canada, July 31-August 4, 2010
20. Brew-Appiah RAT, **Rustgi S**, Claar M *et al.* (2010)\*\* Joint annual meeting of the American Society of Plant Biologists and the Canadian Society of Plant Physiologists, Montreal, Canada, July 31-August 4, 2010
21. Wen N, **Rustgi S**, Wen S *et al.* (2010) Joint annual meeting of the American Society of Plant Biologists and the Canadian Society of Plant Physiologists, Montreal, Canada, July 31-August 4, 2010
22. Wen S, Kannangara G, **Rustgi S et al.** (2010) Joint annual meeting of the American Society of Plant Biologists and the Canadian Society of Plant Physiologists, Montreal, Canada, July 31-August 4, 2010
23. von Wettstein D, **Rustgi S** (2010) Washington Biotechnology & Biomedical Assoc (WBBA)/Life Sciences Discovery Fund (LSDF) Open House, Seattle, WA 98102 United States, August 12, 2010
24. Lee H, **Rustgi S**, Kumar N, Burke I, Yenish J, Ullrich SE (2011) Plant & Animal Genome XIX Conference, January 15-19, 2011, Town & Country Convention Center,

25. von Wettstein D, **Rustgi S** (2011) San Diego, CA, USA  
Washington Biotechnology & Biomedical Assoc (WBBA)/Life Sciences Discovery Fund (LSDF) Open House, Seattle, WA 98102 United States, August 11, 2011
26. Burke IC, Bell J, Riar DS, **Rustgi S** (2012)\* Plant & Animal Genome XX Conference, January 14-18, 2012, Town & Country Convention Center, San Diego, CA, USA
27. von Wettstein D, **Rustgi S** and Ankrah N (2012) 2012 Dryland field day abstracts: Highlights of research progress, Pullman, WA, USA
28. von Wettstein D, **Rustgi S**, et al. (2012) 2012 Dryland field day abstracts: Highlights of research progress, Pullman, WA, USA
29. von Wettstein D, **Rustgi S** (2012) Washington Biotechnology & Biomedical Assoc (WBBA)/Life Sciences Discovery Fund (LSDF) Open House, Seattle, WA 98102 United States, August 23, 2012
30. **Rustgi S**, et al. (2013a)\* 2013 Dryland field day abstracts: Highlights of research progress, Pullman, WA, USA
31. **Rustgi S**, et al. (2013b)\* 2013 Dryland field day abstracts: Highlights of research progress, Pullman, WA, USA
32. Brew-Appiah RAT, Ankrah N, von **Rustgi S**, Wettstein D (2013) Joint annual meeting of the American Society of Plant Biologists and the Canadian Society of Plant Physiologists, Rhode Island, United States, July 20-24, 2013
33. **Rustgi S**, et al. (2014a) 2014 Dryland field day abstracts: Highlights of research progress, Pullman, WA, USA
34. **Rustgi S**, et al. (2014b) 2014 Dryland field day abstracts: Highlights of research progress, Pullman, WA, USA
35. **Rustgi S**, et al. (2014c) 2014 Small Grains Field Day, Mount Vernon, WA, USA
36. Kaur R, Nagarajan R, Bennypaul H, Sidhu G, Sidhu G, **Rustgi S**, et al. (2014) Joint annual meeting of the American Society of Plant Biologists and the Canadian Society of Plant Physiologists, Portland, United States, July 12-16, 2014

---

\*Oral presentations; \*\*Cited once

### **8. Invited lectures:**

- Rustgi S. (2014) “Adding value to wheat and barley” in the Molecular Plant Sciences Fall 2014 Seminar Series
- Rustgi S. (2014) “Developing natural dietary therapies for gluten syndrome using next-generation tools for genome manipulation”. In the 2nd Plant Genomics Congress, London, May 12 and 13, 2014 ([http://www.nature.com/natureevents/science/events/22817-The\\_2nd\\_Plant\\_Genomics\\_Congress\\_London](http://www.nature.com/natureevents/science/events/22817-The_2nd_Plant_Genomics_Congress_London))
- Rustgi S. (2011) “A glimpse in wheat structural and functional genomics”. Department of Crop and Soil Sciences, Washington State University, Pullman, April 25, 2011.
- Rustgi S. (2011) “Gluten free wheat: Adding value to crops”. University-industry Cooperation (UIC) meeting at Washington State University, Pullman, April 14, 2011.

- Rustgi S. (2010) “Molecular studies in bread wheat and jute”. Indian National Science Academy, April 27, 2010.
- Rustgi S. (2008) “Fine structure mapping of a gene-rich region of wheat carrying *Ph1* gene”. Wheat-barley Discussion Group, Department of Crop and Soil Sciences, Washington State University, Pullman, October 29, 2008.

#### **9. Patent application:**

- Singh D, **Rustgi S**, Burke IC, Yenish JP, Gill K, Pittmann D (2009) Molecular marker tags for 2,4-D resistance in Asterids. US-patent Ref. #7980-82730-01.

#### **10. Variety:**

- Two-rowed spring feed barley ‘Richard’ (2004NZ151) was approved for release by the WSU’s cereal variety release committee for commercial production in the Western Washington (Breeders: D. von Wettstein and S. Rustgi)

**11. Sequences submitted to the database:** A total of 4731 (~2 Mb) sequences representing repetitive and unique fractions of *wheat* genome and 184 (>100 kb) SSR enriched jute genomic DNA sequences were submitted to the public domain.

- Fourteen sequences derived from MFLP fragments of bread wheat: AY428632; CG695822 to CG695834
- One hundred eighty four sequences derived from microsatellite enriched gDNA library of jute: DQ108408 to DQ108592
- Sixty seven wheat anchored microsatellite sequences (AWMC): DQ135949 to DQ135987
- Fourteen hundred high *C<sub>0</sub>t* sequences: FM196540 to FM197939
- Two thousand methylation filtered sequences: FM197940 to FM199939
- Twelve hundred fifty two reassociated DNA sequences: FM203409 to FM204661
- Six acetohydroxy acid synthase (*HvAHAS*) sequences derived from six different barley cultivars: HQ661102 to HQ661107
- Three DEMETER sequences representing wheat DEMETER homoeologues were deposited under following accession numbers: JF683316-JF683318

#### **12. Grants funded/submitted as PI/Co-PI:**

- “Wheat for Celiac Patients and Improved Disease Prevention”, funded by Life Sciences Discovery Fund (LSDF); Duration 3/8/2010 - 3/7/2015; Amount received \$109,9998; grant # 3143956 (**role: Co-PI**)
- “Breeding barley for imidazolinone resistance”, submitted to Washington Grain Commission; Duration 7/1/2012 – 6/30/2013; Amount received \$35,960 (**role: PI**)
- “Breeding barley for yield, quality and adaptation”, submitted to Washington Grain Commission; Duration 7/1/2013 – 6/30/2014; Amount received \$142,500 (**role: co-PI**)
- Equipment grant, submitted to the Washington Wheat Foundation; Duration 09/22/2014-09/21/2015; Amount received \$5,000 (**role: PI**)

#### **13. Honors and awards:**

- Award of Senior research fellowship from Council of Scientific & Industrial Research, New Delhi, India
- Nominated as the Bioclues young scientist for the month January, 2007 (<http://bioclues.org/ysjan.html>)

- One of my research articles entitle “The structural genes of wheat and barley 5-methylcytosine DNA glycosylases and their potential applications for human health” was selected as the National Human Genome Research Institute's (NHGRI) Genomic Advances of the Month (<http://www.genome.gov/27551968>).
- Nomination for 2010 Indian National Science Academy (INSA) Young Scientist Medal.
- December 2012 Nomination for Early Career Excellence Award for College of Agricultural, Human, and Natural Resource Sciences (CAHNRS), WSU, Pullman
- Received 2014 Faculty Excellence in Research Award for CAHNRS, WSU, Pullman

#### **14. Professional Service:**

- Serving as a member on the graduate committees of Esraa Adnan Alalwan, Dept. of Crop & Soil Sciences, WSU, Pullman
- Served as a member on the graduate committees of Drs. Claudia Osorio (Dept. of Crop & Soil Sciences), Nuan Wen (Molecular Plant Sciences) and Rhoda A.T. Brew-Appiah (Molecular Plant Sciences), WSU, Pullman.
- Served as a reviewer on the National Program Panel on ‘Plant Metabolism and Pathways: Physiology and Development’ to review ARS Research Project Plans for 2013.
- Served as a reviewer for the Hungarian Scientific Research Fund (OTKA).
- Serving as a member of Expert Working Group on Wheat Quality - Sub-group Allergy
- Serving as a member on the editorial boards of the Frontiers in Genomic Assay Technology, International Journal of Plant Biology & Research, Medicinal & Aromatic Plants, European Journal of Medicinal Plants, Journal of Nutrients, International Journal of Plant & Soil Science, Advances in Crop Science and Technology, and BMC Genetics.
- Served as a reviewer for the Proceedings of the National Academy of Sciences USA, PLoS One (2 manuscripts), Molecular Breeding, Euphytica, Molecules, Journal of Agricultural and Food Chemistry (2 manuscripts), Acta Physiologiae Plantarum (2 manuscripts), Plant Cell Reports (3 manuscripts), Frontiers in Genetics, Canadian Journal of Plant Science, Computer Methods and Programs in Biomedicine, the American Journal of Clinical Nutrition, Biologia section C., Plant Molecular Biology Reporter (2 manuscripts), Molecular Biology Reports, BMC Genomics, Functional and Integrative Genomics, and Applied Biochemistry and Biotechnology.
- Served as an external expert on the Ph.D. thesis, entitled “Genetic Studies Involving Molecular Mapping of Fertility Restorer Gens(s) and Exploitation of heterosis in wheat (*Triticum aestivum* L.)” of Mr. Mohammad Asad Ali from Banasthali University, Rajasthan (India).
- Served as the poster judge in the Molecular Plant Sciences Retreat, 2013, Washington State University, Pullman WA
- Served as a Judge for WSU showcase SURCA, 2014, Washington State University, Pullman WA

**15. Collaborations:** I believe impactful research needs an interdisciplinary team working at ‘system’ level. My ideology about collaborative research also reflects from the national and international collaborations that I have in public and private sectors. I have good collaborations with scientists working in WSU (including Drs. D. von Wettstein, S.E. Ullrich, I.C. Burke, K. Murphy, A. Carter, P. Okubara, D. Weller, C.F. Morris, B. Beecher, K.S. Gill, D. See, K. Sanguinet, V. Hebert), UNL (Dr. P.S. Baenziger), OSU (Dr. R.S. Zemetra), UF (Dr. J.L. Ullman), Arcadia Biosciences (Dr. C.P. Moehs), Benaroya Research Institute at Virginia Mason,

Seattle (Dr. J. Lord), Rhizoterra Inc., Lolo MT (Dr. J. Clapperton), Shepherd's Grain, Ritzville, WA (K. Kupers and F. Fleming), Centre for Immune Regulation Institute of Immunology, University of Oslo, Oslo, Norway (Dr. L.M. Sollid), Justus Liebig University, Giessen, Germany (Drs. G. Langen and K.H. Kogel), Friedrich-Alexander University, Erlangen-Nurnberg, Germany (Drs. S. Sonnewald and U. Sonnewald), Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben, Germany (Dr. N. Stein), Max Planck Institute for Developmental Biology, Tübingen, Germany (Dr. D. Weigel), Northeast Normal University (NENU), Changchun, China (Drs. B. Liu, J. Pang and X. Wang), Wuhan University, Wuhan, China (Dr. D. Yang), Birla Institute of Technology, Mesra, India (Dr. R. Bandopadhyay) and Ch. Charan Singh University, Meerut, India (Drs. P.K. Gupta and H.S. Balyan).

## **16. Interviews**

- Interviewed by Mr. Eric Sorenesen for the Washington State Magazine [Citation: Let everyone eat bread. Washington State Magazine 12(3):11].
- Newspaper article in Hindi for 'DLA Agra, India' [Citation: Wheat a boon or a curse; Published: June 27, 2014]
- Interviewed by Mr. Matthew Weaver for Capital Press [Citation: Researchers developing herbicide-tolerant barley; Published: September 5, 2014]
- Interviewed by Ms. Rebecca Phillips for WSU News [Citation: Researchers explain mystery of cereal grain defense; Published: September 15, 2014]
- Interviewed by Mr. Matthew Weaver for Capital Press [Citation: Researchers find barley 'defense' genes; Published: September 30, 2014]

## **17. Research accomplishments**

My research is a balance between applied and basic sciences, and is mostly focused on targeted improvement of cereals using tools of structural and functional genomics. For applied aspect of my research, I undertook the following three major projects: *i. development of nutritionally improved celiac safe wheat cultivars*: Wheat and its products are potential elicitors of gluten-induced disorders including gluten intolerance (celiac disease), allergies and sensitivity, collectively referred as 'gluten syndrome'. These disorders are globally widespread and affect >7.5% of the US population. Moreover, wheat and barley prolamins are in general deficient in essential amino acids in particular lysine. The only effective therapy for gluten-induced disorders known to date is lifelong adherence to abstinent diet, which often leads to deterioration of gut health associated with nutritional deficiencies in the consumer. In view of the magnitude of problem I along with four graduate students, two postdoctoral fellows, and co-operator Prof. Diter von Wettstein undertook a multipronged approach to develop natural dietary therapies for the 'gluten syndrome'. This research was supported by a five years research grant from the Life Science Discovery Funds (LSDF), where I serve as a co-principal investigator with Dr. von Wettstein. The three approaches undertaken in this direction are: i) epigenetic elimination of immunogenic prolamins [namely low molecular weight (LMW) glutenins and gliadins] using transgenic (via endosperm specific expression of *DEMETER* silencing hairpin and artificial micro RNAs) and non-transgenic (screening for TILLING mutants in wheat *DEMETER* homoeologues) approaches, ii) post transcriptional silencing of immunogenic prolamins via endosperm specific expression of chimeric hairpin construct, specifically designed to target transcripts encoded by four families of LMW glutenin and gliadin genes, and iii) post translational detoxification of prolamins by expression of 'glutenases' in wheat endosperm (the enzymes were selected such that they will degrade prolamins in the human gut only after

consumption). The outcome of this research has been published in a series of research articles - with a significant finding being characterization of a wheat transformant showing >75% reduction in the amount of immunogenic prolamins (please see curriculum vita for publications). To improve thermostability of the gluten detoxifying enzymes, *Flavobacterium meningosepticum* prolyl endopeptidase (Fm-PEP) and barley cysteine endoprotease B2 (EP-B2) from 50 to 100 °C, I along with two graduate students undertook a site-directed mutagenesis approach and recovered thermostable variants (isoforms) of these enzymes. The Fm-PEP isoform showed survival up to 90 °C and EP-B2 isoform showed survival up to 60 °C. A screen for enzyme isoforms surviving up to 100 °C is currently underway. To obtain wheat lines showing complete elimination of immunogenic prolamins two transcription activator like effector (TALE) based procedures are currently being used. The first approach involves use of a novel *Xanthomonas translucens*-based delivery system to introduce *DEMETER* specific TALE nucleases (TALENs) in the wheat immature spikes to introduce site-specific mutations in *DEMETER* homoeologues. The second approach involves use of a unique transformation procedure based on electroporation of androgenic microspores followed by their regeneration into doubled haploid transformants for introduction of *DEMETER* specific TALE-repressor in the wheat genome for endosperm specific gene silencing. In both of the above mentioned procedures the selected wheat transformants are used as ex-plants. *ii. Armouring barley and wheat for defence against root and crown rots:* The aim of this research is to address a gap in genetic resources available to wheat and barley breeders to combat the most devastating root pathogens of the dryland wheat production. Direct seeding or conservation tillage are the preferred management practice in the low rainfall areas, where crop residue left on the soil surface provides an ideal environment for the proliferation of root and crown rot pathogens *Rhizoctonia solani* AG-8, *R. oryzae*, *Fusarium culmorum* and *F. pseudograminearum*. A recent survey in the US Pacific Northwest (PNW) indicated that these pathogens exist in more than 90% of the fields, and cause 10 to 35% annual yield losses. Using biotechnology, I along with a post-doctoral fellow introduced a battery of genes (the *prn* operon) from a natural bio-control agent *Pseudomonas protegens* into wheat for root specific production of a natural antibiotic pyrrolnitrin (PRN). The screening of genetic transformants for the amount of PRN and its biosynthetic intermediates and the activity of root extract against *R. solani* AG-8 and *F. culmorum* are currently underway. Similarly an endochitinase (*ThEn42*) gene from a mycotrophic fungus *Trichoderma harzianum* was introduced in wheat and barley genomes, and expressed ectopically under the control of 35S promoter. The production of enzyme in wheat and barley transformants was determined with the help of a fluorometric assay using 4-Methylumbelliferyl Beta-D-N,N',N''-Triacetylchitotrioside (MUTC) as substrate to the crude enzyme extracted from different plant parts. Four wheat and eight barley transformants that showed high expression levels of *ThEn42* gene in roots are currently being challenged with root pathogenic fungi in glasshouse and field. *iii. Establishment of 'Clearfield' system in barley:* Acreage of spring barley, which is one of the best rotational crops after winter wheat, has significantly dropped in last two decades. This decline in acreage can be attributed to wide scale application of imidazolinone (IMI) herbicides in combination with the introduction of IMI-resistant wheat cultivars and persistence of herbicide residue in the soil for more than a year. Thus, identification of IMI-resistant mutant(s) in barley and its transfer to relevant feed, food and malting barley cultivars adapted to the US PNW is of utmost priority. In order to achieve this objective I screened with graduate students and postdoctoral fellows a population of 200,000 mutagenized barley grains and identified a point mutation responsible for a non-synonymous

serine 653 (AGC) to asparagine (AAC) substitution in the herbicide-binding site of the barley *acetohydroxy acid synthase (HvAHAS)* gene. The mutant showed survival under 10-fold field recommended dose (4 oz/Acr) of the herbicide, and is currently being transferred to six spring barleys adapted to the US PNW, which include 2 food barleys 'Clearwater' and 'WAS4', 2 feed barleys 'Lyon' and 'Muir', and 2 malting barleys 'Radiant' and 'Conrad'. This research has been supported by a Wash. Grain Commission funded research grant to me as principal investigator.

*iv. Breeding a proanthocyanidins-free barley cultivar for the high rainfall regions of the Washington state:* 2004NZ151 is broadly adapted across all rainfall zones of the Washington State as evident from the data procured from the 29 location-years under the WSU Extension Variety Testing Program (<http://variety.wsu.edu>). The yield averages from the two location-years (Mt. Vernon and Island County for 2012 and 2013) showed that 2004NZ151 yielded at least 1000 lb/a more than the large acreage varieties (i.e., Bob, Baronesse, and Champion) in the Washington State. This suggests that 2004NZ151 can replace Bob, Baronesse, and Champion in the Western Washington and will be the grower's choice for this area. The yield advantage observed for 2004NZ151 in the Western Washington can be largely attributed to the good lodging resistance and low susceptibility to the prevailing diseases in the area. In addition, 2004NZ151 breeds true for *ant-499* mutation (selected on the basis of the vanillin test) that provides it an added advantage of being free of proanthocyanidins (condensed tannins) in the seed coat that cause haze formation especially after refrigeration of the beer (by binding to the protein), and give barley porridge a characteristic gray color that makes it unsuitable as baby food and breakfast cereal.

For *basic research*, I worked on a number of different projects: At CCS University, Meerut (India) I worked on the following aspects: (a) Development and use of simple sequence repeat (SSR) and single nucleotide polymorphism (SNP) markers from wheat expressed sequence tags (ESTs) and low-copy number genomic DNA sequences. (b) Study of wheat genome organization using techniques of *C<sub>0</sub>t* fractionation and methylation-filtration. (c) Study of marker-trait associations using a panel of 519 DNA-based molecular markers and a set of 14 agronomical traits recorded on 55 elite wheat genotypes. (d) Development of SSR markers in *Corchorus olitorius*, and their use in studying genetic diversity in a set of 81 jute genotypes. (e) Development of bioinformatics tools for mining of SSRs and SNPs from ESTs and genomic DNA sequences. At WSU, I am involved in the following activities: (a) Genetic mapping of QTLs for agronomical and physiological traits in bread wheat (b) Unrevealing a meiotic gene complex on wheat chromosome 5B including *Pairing homoeologous 1* locus via gene mapping and silencing. (c) Development of genic-SSRs in prickly lettuce. (d) Optimization of two microspore transformation procedures in bread wheat for the production of doubled haploid transgenic lines. (e) Development of a novel transformation procedure using type III secretion system of Gram-negative bacteria. (f) Molecular cloning of wheat *DEMETER* homoeologues and barley high-lysine *Lys3* gene. (g) Exploration of cytogenetic and molecular changes leading to the establishment of tetraploid and hexaploid wheats as successful species. (h) Pinpoint variations in CG-methylation pattern and transcriptional differences between the rice *MET1* mutant and wild type. (i) Molecular characterization of barley *JIP60* gene, a master regulator of plant responses to biotic and abiotic stresses.