Curriculum Vitae: Summary

Hari C. Sharma

Former Vice Chancellor – Dr YS Parmar University of Horticulture & Forestry, Nauni 173230, Solan, Himachal Pradesh, India.

Principal Scientist - International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502324, Telangana, India.

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Vision Statement

I endeavor to pursue excellence in education and science for food security and conservation of the environment.

Date Birth/Citizenship

15th June 1954, Behra, Bilaspur, Himachal Pradesh, India. Passport No. J0644308. Married - Wife: Veena Sharma; and Children: Dr Anu Sharma and Ankita Sharma.

Educational Qualifications

B.Sc. (1974) and M.Sc. (1976), and Ph.D. (1979), IARI. Visiting Scientist, University of Wisconsin, Madison, USA (1986/87), and QDPI, Toowoomba, Australia (1996).

Employment Record

- Vice Chancellor, Dr YS Parmar University of Horticulture & Forestry, Nauni 173230, Solan, Himachal Pradesh, India (2016-2019).
- Principal Scientist - Entomology (since 2001), Senior Scientist (1994 - 2001), and Scientist S1&II (1979 - 1993) at ICRISAT. Visiting Scientist, University of Wisconsin, Madison, USA (1987), and Department of Primary Industries, Australia (1996).

Scientific Contributions

- My scientific contributions are in the areas of Biological Sciences, Agriculture and Conservation of the Environment. My research was focused on developing insect-resistant varieties, use of transgenic crops for pest management, biosafety of GMOs, climate change effects on agriculture, and sustainable crop production for food security. These contributions have not only helped to reduce the huge losses due to insect pests, but also curtailed the pesticide use for sustainable crop production and food security.
- I have also served as Coordinator of several projects at ICRISAT **(**Integrated pest management (1999/2000); Biotechnological applications for insect resistance (2003/06); and Genetic enhancement of cereals and legumes in Asia (2006/08). Supervised over 20 projects funded by the national and international funding agencies.
- Worked in close collaboration with scientists in USA, Australia, Germany, UK, Belgium, France, and Switzerland. I have also undertaken collaborative research on crop production and pest management with over 20 NARS in Asia and Africa and Latin America.

Language Skills: English and Hindi - Excellent, and Urdu - Good, and French - Fair.

Honors and Awards

- **CGIAR Excellence in Science Award: Outstanding Scientist 2001**: Consultative Group on International Agricultural Research (CGIAR), Washington, USA –$5,000 and a Citation.
- **International Plant Protection Award of Distinction**: 2007 - International Association of Plant Protection Sciences, A Momento and a Citation.
- **King Baudovin Award 2002:** Chickpea Research Teams of ICRISAT and ICARDA: Consultative Group on International Agricultural Research (CGIAR), Washington, USA – Prize $10,000 and a Citation**.**
- **Doreen Mashler Award: 2002** - Chickpea Research Team, and **2004 –** Sorghum Research Team. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, India.
- **Millennium ICRISAT Science Award**: **Outstanding Scientist 2001**: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, India – A Citation by the Governing Board of ICRISAT.

- **Hari-Om Trust Award: 2007** - Indian Council of Agricultural Research, A prize Rs 40,000/-, and a Citation.
- **Prof. T.N. Ananthakrishnan Award** 2002: Prof. TN Ananthakrishnan Foundation, Chennai, India. Outstanding contributions in host plant resistance to insects- A prize of Rs. 5,000, Plaque, and a Citation.
- **Dr D Bap Reddy Award:** Integrated Pest Management 2002, Plant Protection Association of India – Prize of Rs 2,500, Plaque, and a Citation.
- **Lifetime Achievement Award**: 2005 – Academy of Environmental Biology, Lucknow, Uttar Pradesh, India – A Plaque and a Citation.
- **Commendation Medal** by the Academy of Environmental Biology, 2011.
- **Archana Gold Medal 2000:** Academy of Environmental Biology, Lucknow, Uttar Pradesh, India – A Gold Medal and a Citation.
- **Award of Honor 2016:** For contributions in plant protection and environmental conservation. Indian Society of Ecology, - A Plaque and a Citation.
- **Prof GS Shukla Gold Medal, 2017:** For contributions in Pest Management and Toxicology, Academy of Environmental Biology – A Gold Medal and a Citation.
- **ISPRD Excellence in Science Award 2017:** For excellent contributions in pulses research and development. Indian Society of Pulses Research and Development - A Plaque and a Citation.
- **Life Achievement Award 2019:** International Association of Plant Protection Sciences (IAAPS), A Momento and a Citation.
- **Lal Bahadur Shastri Memorial Gold Medal** - BSc Ag, Government of Himachal Pradesh (1974).
- **Himachal Pradesh University Gold Medal** - BSc Ag (1974).
- **NN Mohan Memorial Gold Medal** in MSc, Mohan Meakins Breweries Ltd., Solan (1976).
- **Himachal Pradesh University Gold Medal** - MSc (1976).

Professional Contributions to Academic Societies

Editor: i) Indian Journal of Plant Protection (1989-94), ii) International Sorghum and Millets Newsletter (1997/06), iii) **Honorary Editor** - Asian Agri-History (1997 - 2014), iv) **Associate**

Editor - Journal of Eco-physiology and Occupational Health (since 2002), v) **Editor** - *e*-Journal of SAT Agricultural Research (since 2007), vi) **Editor**, Journal of Food Legumes (since 2013).

Member, Editorial Boards: i) Indian Journal of Plant Protection (1986-88, 2006-09), ii) Pest Management and Economic Zoology (since 1995), iii) Insect Science and its Application (1997-05), iv) Journal of Environmental Biology (since 1997), Indian Journal of Entomology (since 2004), and Entomological Research (since 2007).

Fellowship of Professional Societies

- **Fellow,** Entomological Society of America (2014)
- **Fellow,** National Academy of Agricultural Sciences (2012)
- **Fellow**, Plant Protection Association of India (1990).
- **Fellow**, Academy of Environmental Biology (1999).
- **Fellow,** Indian Society of Crop Improvement (2011)
- **Life Fellow**, Entomological Society of India (1983).

Leadership Role in Entomology/Crop Protection

- **President,** Council of International Congresses of Entomology (2008-16): ICE2012 - Korea and ICE2016 - USA.
- **President,** 19th International Plant Protection Congress (IPPC2019), Hyderabad (2019)
- **Member Governing Board,** International Association of Plant Protection Sciences (2008-15).
- **Co-Chair,** Biological Consequences of Global Change, International Union of Biological Sciences (IUBS) (2009 - 15).
- **Vice-President:** Academy of Environmental Biology (2000-03).
- **Vice-President:** Plant Protection Association of India (2002-05).
- **Brand Ambassador,** Hyderabad Convention and Visitors Bureau (2013).
- **Delivered** >100 Keynote Addresses and Memorial Lectures at National/International Conferences.

Human Resource Development

Ph D = 25, MSc = 3, Interns: 15, and PDF/Visiting Scientists = 10.

Several students received distinction in thesis research and/or were awarded prizes in research paper/poster presentations.

- **Jawahar Lal Nehru Best Thesis Award** by ICAR, and **Young Scientist Award** by Academy of Environmental Biology - MK Dhillon.
- **Young Scientist Award** of the Indian Science Academy - Girija Shankar.
- **Gold Medal** for best thesis research by Tamil Nadu Agricultural University - M Vinayan.
- **Gold Medal** for best paper presentation of the Academy of Environmental Biology - AR War and O Shaila
- **Gold Medal** for best poster presentation – Riyazuddin and Prashanti by AEB.
- **Best Poster Award** – Md Akbar, Parmasiva, Shankar, and Bharathi by Academy of Environmental Biology.
- **Best Poster Award** – Satyanarayana, T., Sivasubramani, S, Polavarapu B Kavi Kishor, Hari C Sharma, Santosh P Deshpande, S.P. 2018. Identification of SNPs and candidate genes for shoot fly, *Atherigona soccata* resistance in sorghum (*Sorghum bicolor*) using genome-wide

association studies (GWAS). Sorghum in 21st Century, 9- 12 April 2018. Cape Town, South Africa.

- **Training Courses** - Conducted five training courses, and interacted with several scientific and farmers groups in field days in India, Australia and Africa.

Scientific Contributions

My scientific contributions are in the areas of insect bio-ecology and population dynamics, economic thresholds, natural plant products, host-plant resistance, transgenics and molecular assisted selection for insect resistance, biosafety of GMOs to non-target organisms, and integrated pest management.

Identified *Bacillus thuringiensis*,trypsin inhibitor, and plant lectin genes for their effectiveness against *Atherigona*, *Chilo*, and *Helicoverpa*. Mapping populations have been being characterized to identify molecular markers associated with resistance to shoot fly, stem borer, and *Helicoverpa*. Developed artificial diets for rearing *Helicoverpa, Earias*, *Chilo*, and *Mythimna*, and techniques to screen for resistance to insects in cotton, soybean, sorghum,pigeonpea, and chickpea.

Sorghum midge-resistant varieties ICSV 197, ICSV 745, ICSV 735, ICSV 758, and ICSV 804 have been released for cultivation. Resistance to sorghum midge, shoot fly, and stem borer has been transferred into cytoplasmic male-sterile (CMS) lines, which is a vital step for producing insect-resistant hybrids. Several lines with resistance to *Helicoverpa* in pigeonpea (ICPL 332, ICPL 84060, and ICPL 187-1) and chickpea (ICC 506EB, ICSV 10, and ICCL 86111) were identified, and distributed to the NARS for use in crop improvement.

High levels of resistance to insects were identified in the wild relatives of sorghum, groundnut, pigeonpea, and chickpea to increase the levels and diversifying the bases of resistance to the target insect pests. Mechanisms and inheritance of resistance to *Earias* and *Amrasca* in cotton*; Atherigona*, *Chilo, Stenodiplosis, Calocoris,* and *Eurystylus* in sorghum; *Trichoplusia* in soybean; and *Maruca* and *Helicoverpa* in pigeonpea and chickpea have been identified. Resistance to sorghum midge, head bugs, grain molds, and leaf diseases in sorghum is governed by additive gene action, and is needed in both the parents to produce pest-resistant hybrids.

Extensive information was generated on the biosafety of GMOs to non-target organisms, which is crucial to develop strategies for deployment of transgenic crops for pest management. Developed processes to obtain enriched neem and custard apple extracts for use in insect control. IPM modules for pest management in sorghum, chickpea, and pigeonpea were developed, which is crucial for sustainable crop production. Conducted extensive studies on climate change effects on pest management and crop production and food security.

These contributions will have a major impact on minimizing the losses due to sorghum midge (valued at $500 million annually) worldwide. The pest-resistant cultivars and the IPM programs developed for pest management in cotton, cereals and grain legumes will not only help reduce the huge losses caused by insect pests in, but also curtail the pesticide use, and thus minimize environment pollution, and lead to sustainable crop production and food security.

International Collaboration

i) Institut Economie Rurale (IER), Sotuba, Mali, 1985/86 (Techniques to screen for resistance to insects in sorghum); ii) INRAN, Farako Ba, Burkina Faso, 1986 (Host-plant resistance to insects

in midge and bugs); iii) University of Wisconsin, Madison, USA, 1986/87 (Biochemical mechanisms of resistance in soybean); iv) Institute of Agricultural Research, Addis, Ethiopia, 1990 (Screening for host-plant resistance to insects in sorghum); v) Agriculture University, Yezin, Myanmar, 1995 (Development and testing of sorghum midge-resistant varieties); vi) Ministry of Agriculture and Cooperation, Bangkok, Thailand, 1995 (Screening for resistance to sorghum shoot fly); vii) Queensland Department of Primary Industries, Toowoomba, Australia, 1995 (Mechanisms of resistance to sorghum midge); viii) Biochemical mechanisms of resistance to *Helicoverpa* in wild relatives of pigeonpea); ix) CSIRO, Perth, 2004/08 (Mechanisms of resistance to *Helicoverpa* in wild relatives of chickpea); x) USDA, Pullman, USA, 2007/09 (Wild relatives of chickpea for resistance to *Helicoverpa*); xi) CSIRO, Canberra, Australia (Development of transgenic chickpea for *Helicoverpa* resistance), xii) FAL, Zurich, Switzerland, 2005/11 (Bio-safety of transgenic crops to nontarget organisms); and xiii) Penn State University, USA, 2013/14 xii) Molecular mechanisms of resistance to insects in sorghum.

Research Coordination

i) **Sub-project Coordinator -** IPM in sorghum (1994-95); ii) **Coordinator** - HPR, genetic transformation, and IPM of cereal stem borers and legume pod borers in the SAT (1999 - 2000); iii) **Regional Project Coordinator**: Biotechnological applications for resistance to insect pests (2003-06). **Project Coordinator** – Genetic enhancement of open pollinated varieties of cereals and legumes to increase crop production in the Asia SAT, and IPM research at ICRISAT (2006/08). **ICRISAT Coordinator -** SP-IPM (2004 - 2012).

Special Project Funding

i) What makes it so tasty for *Helicoverpa*? - DFID (1998/01); ii) Survey of virulent strains of HaNPV - CSIRO (1999); iii) Utilization of wild relatives of pigeonpea for resistance to *Helicoverpa armigera* - AP-NL Biotechnology Project (2000/03); iv) Natural enemies of spotted stem borer, *Chilo partellus* - ICIPE (1999/01); v) BUV/ICRISAT collaborative project on biotechnology (1999/01); vi) CIRAD/ICRISAT project on genetic transformation of sorghum stem borer and *Helicoverpa* (2001/3); vii) ADB project on molecular breeding of sorghum, chickpea, and groundnut (2001/03); viii) Evaluation of wild relatives of chickpea for resistance to *Helicoverpa armigera* – GRDC (2002/05); ix) Indo-Swiss Project on effect of transgenic chickpeas on nontarget organisms (2003/07), x) Mechanisms of resistance to *Helicoverpa* in wild relatives of chickpea, USAID (2003/06), xi) Development of transgenic chickpeas for resistance to *Helicoverpa* – ABSP II, USAID (2003/04), DBT (2007/9), xii) Exploitation of wild relatives of pigeonpea for resistance to *Helicoverpa* – AP Netherlands Project on Biotechnology (2002/07), xiii). Exploiting host plant resistance for the management of *Helicoverpa* in chickpea and pigeonpea (NFSM, 2008/12)), xiv) Protein receptors for *Bt* toxins in mid gut of *Helicoverpa armigera*, DBT (2007-09), xv) Improvement of crop productivity through MAS in pulses (Gates Foundation, TLI, 2006/011), xv) Tropical legumes for Asia and Africa (Gates Foundation, 2007/14), xvi) HOPE project (Gates Foundation, 2009/14), xvii) Marker assisted selection for stem borer resistance in sorghum (SSFM, 2006/08), xviii) Development of transgenic chickpeas for *Helicoverpa* resistance (DBT/ACIAR, 2007/09), xix) Development of Bt transgenic chickpea against *Helicoverpa armigera* (IndoSwiss, 2009/11), and xx) DST-ICRISAT Center of Excellence (CoE) on Climate Change Research for Plant Protection (2011/14).

Organization of Workshops and Conferences

i) Member, Organizing Committee - **International Sorghum Entomology Workshop**, 1983, Texas A&M Univ., USA; ii) Member, Organizing Committee - **Plant Protection in Field Crops in India**, 1986, Hyderabad, India; iii) Member, Organizing Committee - **Changing Scenario in Pests and Pest Management in India**, Hyderabad, A.P., India; iii) Member, Organizing Committee - **Consultative Workshop on Panicle Feeding Insect Pests of Sorghum and Pearl Millet**, 1993, ICRISAT Sahelian Center, Niamey, Niger; iv) Convener - **Host Plant Resistance to Insects in Sorghum**, 1995, ICRISAT, Patancheru, A.P., India; v) ***Helicoverpa*** **Management - The Journey Ahead**, 2001, ICRISAT, Patancheru, A.P., India; vi) **Training Course on Screening for Host Plant Resistance to *Helicoverpa***, 2003, 2009, ICRISAT, Patancheru, A.P., India; and vii) National symposium on, '**Bio-safety and Environmental Impact of Genetically Modified Organisms and Conventional Technologies for Pest Management**', 20-21 Nov 2009, ICRISAT, Patancheru, AP, India. 9th **Brain Storming Conference of the Vice Chancellors** of Association of Indian Agricultural Universities - 2018; Alternative Farming Systems – 2017; **Foundation Days and Convocations** of the YSP-UHF (2016 - 2019); **International Congress of Entomology** as President of ICE, 2012 – Deagou, South Korea, 2016 - Orlando Florida, USA. President - **International Congress of Plant Protection** 2019, Hyderabad, Telangana, India.

Membership of Institutional Committees

Member - Greenhouse Advisory Committee, ICRISAT (1985-90); ii) Member - Chemical Safety Committee, ICRISAT (1989-90); iii) Member - Germplasm Health and Quarantine Committee, ICRISAT (1992- 94); iv) Member - Space Consolidation Committee, ICRISAT (1997-02); v) Member - Farm Research Committee, ICRISAT (2000-01); vi) Member - Plant Material Release Committee, ICRISAT (since 2000), vii) Institute Bio-safety Committee (since 2008).

Member, Quinquenial Review Team, Cotton R&D in India (2013); Research Committee on Genetically Modified Organisms (RCGM), DBT, Govt of India 92014/17); Environment Risk Assessment of Genetically Engineered Plants, Ministry of Environment and Forests, Govt of India; and AHTEG Committee, CBD/UNEP, Montreal, Canada.

Member, Board of Management - National Law University, Shimla, and Himachal Pradesh Krishi Vishav Vidyalaya, Palampur. Member, Board of Governors - Indian Council of Forest Research and Extension (MoEFCC), Dehradun. Member, Research Coordination Committee, Central Silk Board, Bangaluru; Member, Himachal Pradesh Biodiversity Board, Shimla; Chairman, Committee for Doubling farmers income in Himachal Pradesh; and Member, Planning Board, Government of Himachal Pradesh.

Extension

Carried out large-scale on-farm testing of sorghum midge-resistant varieties (ICSV 197 and ICSV 745) in Karnataka, and *Helicoverpa*-resistant pigeonpea and chickpea varieties in Andhra Pradesh and Karnataka in India. Interacted with several NGOs, farmers self-help groups, and NARS scientists in Asia and Africa to implement IPM programs in cereals and grain legume based cropping systems. I have also worked with scientists in Myanmar, Thailand, Mali, Burkina Faso, Nigeria, Niger, Ethiopia, and Kenya on research and extension involving insect-resistant cultivars and IPM.

Administrative Leadership

I had been Project/Theme leader for Integrated pest management, Development of open pollinated

varieties of cereals and legumes in the semi-arid tropics, and Application of biotechnological tools for the management of biotic stresses at ICRISAT. I have also been president of Council of International Congresses of Entomology, and Chair of 19th Plant Protection Congress (IPPC2019).

During my tenure as Vice Chancellor of Dr YS Parmar University of Horticulture & Forestry (2016 to 2019), the university has made tremendous strides in financial management (from a net deficit of 43 crores in Aug 2016 to ample funds for the next 6 months in 2019). Following are a few highlights of the major activities undertaken during this period.

- The university bagged research projects for over **250 crores**, and a grant of 25 crores from ICAR to upgrade the teaching and research facilities in the university. Set up a Botanical Center for North West Himalayan Region with support from MoEFCC, and a Center of Excellence in Climate Change Research in the Himalayas with support from DST.
- The YSPUHF College of Horticulture & Forestry at Neri, Hamirpur, was given accreditation by ICAR, while another College of Horticulture is being opened at Thunag in Mandi district. The student enrollment increased from 350 to 550 in the UG courses in Horticulture & Forestry, and overall student strength increased from **1,250 to over 2,250** in different colleges of the university.
- MSc classes have been started at CoH&F, Neri, and PhD programs were initiated in Business Administration and Environmental Sciences. The student hostels have been renovated, and all the classes are now being held in Smart Class Rooms. The students have been provided with a state-of-the-art Gymnasium and Kabbadi ground, and a **Sports Stadium** is being built at the main campus with grants from the State Govt and ICAR.
- Major achievements have been made developing high-yielding varieties of fruits, vegetables and flowers. Major emphasis has been placed on **high-density planting** of fruit crops, **protected cultivation** of vegetables, **Hi-tech floriculture**, medicinal and aromatic plants, water conservation and storage, apiculture, mushroom cultivation, and agroforestry. Himachal Pradesh has now emerged as the major producer of temperate fruits, vegetables and flowers, and earns over Rs 10,000 crores in the national markets.
- The University of Horticulture and Forestry has been ranked among the top 100 institutions in the country by NIRF rankings for three consecutive years (**84th rank** in 2017among 3,119 institutions; **71st** rank in 2018 among 850 universities; and **80th** among 913 universities in 2019). The YSPUHF also improved its ranking from **51st** in 2016 to **12th** in 2019. During this period, we organized over 20 National/International conferences/workshops, including the 9th Brain storming conference of the Vice Chancellors of the Agricultural Universities, and three convocations. The Honorable President of India was the chief guest during the 9th Convocation in May 2018.

Participated and contributed to improving education and research in India, including Digital education - addressed by Honorable President of India, Shri Pranab Mukherjee; Research for Resurgence addressed by the Honorable Prime Minister of India, Shri Narender Modi, and Future of education and research in India - addressed by the MHRD Minister, Shri Prakash Javedkar in Vigyan Bhavan, New Delhi.

List of Selected Scientific Publications

Scientific publications: 729 [Books - 8, Information bulletins – 13, Research papers – 302, Book chapters – 80, Conference papers – 63, Newsletter articles –15, Technical reports – 5, Plant material descriptions - 4, Conference paper presentations/posters – 225, Book reviews – 2, and Web page articles – 12]. More than 300 research papers have been listed in Thomson Science Citation Index/Web of Science with 9,136 citations, Hi 47, and iH10 index of 187.

More than 300 research papers have been listed in Thomson Science Citation Index/Web of Science with 9,136 citations, Hi 47, and iH10 index of 187.

A Scientometric analysis of my research has been carried out by: Garg, K.C. and **Kumar N.** 2019**.** Scientometric Portrait of Dr. Hari Chand Sharma: A Renowned Agricultural Scientist. *Journal of Library and Information Technology* 39: 109-115. A rare distinction to have for a scientist.

My research contributions figure among the **top 2% scientists in the world** (placed at 217 position in the world), and top ranked Scientist in Entomology in India, with a C-score of 3.54780554 (among the top 0.84% scientists), based on a study conducted by Stanford University in 2020.

Books

Sharma, H.C. (ed.). 2005. *Heliothis/H*elicoverpa Management: Emerging Trends and Strategies for Future Research. New Delhi, India: Oxford & IBH, and Science Publishers, USA. 469 pp.

Sharma, H.C. 2009. Biotechnological Approaches for Pest Management and Ecological Sustainability. CRC Press/Taylor and Francis, New York, USA. pp. 526.

Chen, W., Sharma, H.C. and **Muehlbauer, F.** (eds.). 2010. Chickpea and Lentil Crop Protection Compendium. American Phytopathological Society, St Paul, Minnesota, USA.

Sharma, H.C., Dhillon, M.K. and **Sahrawat, K.L**. 2012. Environmental Safety of Biotech and Conventional IPM Technologies. Studium Press LLC, Houston, Texas, USA. 416 pp.

Sharma, H.C. 2018. Strategies for Doubling Farmers Income in Himachal Pradesh. YSP University of Horticulture & Forestry, Nauni, Solan, Himachal Pradesh, India. 46 pp.

Journal Articles – Biochemistry/Biotechnology

Parde, V.D., Sharma, H.C., and **Kachole, M.S.** 2010. In vivo inhibition of *Helicoverpa armigera* gut pro-proteinase activation by non-host plant protease inhibitors. *Journal of Insect Physiology* 56: 1315–1324

Paramasiva, I., Sharma, H.C. and **Krishnaya, P.V.** 2014. Antibiotics influence the toxicity of the delta endotoxins of *Bacillus thuringiensis* towards the cotton bollworm, *Helicoverpa armigera*. *BMC Microbiology* 14:200.

Chamarthi, S.K., Sharma, H.C., Deshpande, S.P., Hash, C.T., Rajaram, V., Ramu, P., and **Narasu, L.M.** 2012. Genomic diversity among sorghum genotypes with resistance to sorghum shoot fly, *Atherigona soccata*. *Plant Biochemistry and Biotechnology* 21: 242–251.

Dhillon, MK, Fazil, H., Aditya, T., Jagdish, J., Naveen, S., and **Sharma, H.C.** 2020. Genetic regulation of diapause and associated traits in *Chilo partellus* (Swinhoe). Scientific Reports 10(1) DOI: 10.1038/s41598-020-58640-.

Visweshwar, Kuruba S., Mohammad A.S., and **Sharma H.C.** 2016. Isolation and characterization of gut bacterial proteases involved in inducing pathogenicity of *Bacillus thuringiensis* toxin in cotton bollworm, *Helicoverpa armigera. Frontiers in Microbiology.* 7:1567. doi: 10.3389/ fmicb.2016.01567.

Visweshwar R, Sharma HC, Akbar SMD and **Sreeramulu K.** 2015. Elimination of Gut Microbes with Antibiotics Confers Resistance to *Bacillus thuringiensis* Toxin Proteins in *Helicoverpa armigera* (Hubner). *Applied Biochemistry and Biotechnology* 177: 1621-1637.

Dhillon, M.K., Sharma, H.C., Folkertsma, R.T., and **Chandra, S.** 2005. Genetic divergence and molecular characterization of shoot fly-resistant and -susceptible parents and their hybrids. *Euphytica* 149: 199-210.

Girijashankar, V., Sharma, H.C., Sharma, K.K., Swathisree, V., Sivarama Prasad, L., Bhat, B.V., Royer, M., Secundo, B.S., Lakshami Narasu, M., Altosaar, I., and Seetharama, N. 2005. Development of transgenic sorghum for insect resistance against spotted stem borer (Chilo partellus). *Plant Cell Reports* 24: 513-52.

Sharma, H.C., Sharma, K.K, Seetharama, N., and **Crouch, J.H.** 2004. Genetic transformation of crops for insect resistance: potential and limitations. *Critical Reviews in Plant Sciences* 23: 47-72.

Bio-safety of Genetically Modified Plants

Dhillon, M.K., and **Sharma, H.C**. 2009. Effects of *Bacillus thuringiensis* δ-endotoxins Cry1Ab and Cry1Ac on the coccinellid beetle, *Cheilomenes sexmaculatus* (Coleoptera, Coccinellidae) under direct and indirect exposure conditions. *Biocontrol Science and Technology* 19: 407-420.

Sharma, H.C., and **Ortiz, R.** 2000. Transgenics, pest management, and the environment. *Current Science* 79: 421-437.

Sharma, H.C., Dhillon, M.K., and **Arora, R.** 2008. Effects of *Bacillus thuringiensis* δ-endotoxin fed *Helicoverpa armigera* on the survival and development of the parasitoid *Campoletis chlorideae*. *Entomologia Experimentalis et Applicata* 126: 1-8.

Sharma, H.C., Pampapathy, G., and **Arora, R.** 2007. Influence of transgenic cottons with *Bacillus thuringiensis cry1Ac* gene on the natural enemies of *Helicoverpa armigera*. *BioControl* 52: 469-489.

Sharma, K.K., Sharma, H.C., Seetharama, N., and **Ortiz, R**. 2002. Development and deployment of transgenic plants: Biosafety considerations. *In Vitro Cellular and Developmental Biology - Plant* 38: 106-115.

Mechanisms of Resistance to Insects

Sharma, H.C., Pampapathy, G., Dwivedi, S.L., and **Reddy, L.J.** 2003. Mechanisms and diversity of resistance to insect pests in wild relatives of groundnut. *Journal of Economic Entomology* 96: 1886-1897.

Sharma, H.C., and **Agarwal, R.A.** 1982. Effect of some antibiotic compounds in *Gossypium* on the post-embryonic development of spotted bollworm (*Earias vittella* F.). *Entomologia Experimentalis et Applicata* 31: 225-228.

Sharma, H.C., Sujana, G., and **Manohar Rao, D.** 2009. Morphological and chemical components of resistance to pod borer, *Helicoverpa armigera* in wild relatives of pigeonpea. *Arthropod Plant Interactions* 3: 151-161.

Sharma, H.C., Mukuru, S.Z., Manyasa, E., and **Were, J.** 1999. Breakdown of resistance to sorghum midge, *Stenodiplosis sorghicola*. *Euphytica* 109: 131-140.

Sharma, H.C., and **Norris, D.M.** 1991. Chemical basis of resistance in soybean to cabbage looper, *Trichoplusia ni*. *Journal of Science of Food and Agriculture* 55: 353-364.

Sharma, H.C., Pampapathy, G., Lanka, S.K., and **Ridsdill-Smith, T.J**. 2005. Antibiosis mechanism of resistance to legume pod borer, *Helicoverpa armigera* in wild relatives of chickpea. *Euphytica* 142: 107-117.

Sharma, H.C., Sujana, G., and **Manohar Rao, D.** 2009. Morphological and chemical components of resistance to pod borer, *Helicoverpa armigera* in wild relatives of pigeonpea. *Arthropod Plant Interactions* 3: 151-161.

Induced Resistance to Insects

Kumar, S. Ch., Vijay, M.P., Sharma, H.C., and **Narasu, L.M.** 2012. Constitutive and inducible resistance to *Atherigona soccata* (Diptera: Muscidae) in *Sorghum bicolor* *Journal of Economic Entomology* 105:1069-1076.

War, A.R., Sharma, H.C., Paulraj, M.G., War, M.Y., and **Ignacimuthu, S.** 2011. Herbivore induced plant volatiles - their role in plant defense for pest management. *Plant Signaling and Behavior* 6 (12): 1973-1978.

War, A.R. and **Sharma, .HC.** 2014. Effect of jasmonic acid and salicylic acid induced resistance in groundnut on *Helicoverpa armigera*. *Physiological Entomology* 39(2) 139-142.

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