CURRICULUM VITAE

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Contact address: Dr. Abuelgasim Elzein (Associate Professor)

Striga Biological Control Specialist
Biobesticide Development Specialist

Contact address

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EDUCATION

Sept.1998 – Dec. 2002	**Ph.D**. degree, Institute of Plant Production and Agroecology in the Tropics and Subtropics, **University of Hohenheim, Germany.** Title of the thesis (Development of a granular mycoherbicidal formulation of *Fusarium oxysporum* "Foxy 2" for the biological control of *Striga hermonthica*).
Oct.1997 – March 1998	German language Diploma (die Deutsche Sprachpruefuung fuer den Hochschulzugang Auslaendischer Studienbewerber "DSH"), Goethe Institute and University of Mannheim, Mannheim, **Germany.**
Nov. 1993 – July 1996	School of Graduate Studies, **Addis Ababa University, Ethiopia.** M.Sc. Biology. The courses have included: problems of conservation, advanced plant ecology, limnology, advanced plant taxonomy, applied microbiology, advanced plant physiology, statistics for biologists and soil fertility and plant nutrition). Title of the thesis (An Investigation on the possibilities of Biological Control of *Orobanche* spp. in Ethiopia).
Aug. 1986 – Feb 1991	Faculty of Agriculture, **University of Khartoum, Sudan** (B. Sc. Agric. Honors 2nd Class, Division one). Majoring in Crop Protection.
Nov. 1985 – July 1986	Faculty of Science, **University of Khartoum, Sudan.** Preliminary year biological section certificate.

INTERNATIONAL TRAINING COURSES

27 Sept. – 02.Oct 1999	Rotational Advanced Studies Program (RASP Post Graduate Course): Phytomedicine and Plant Protection in International Agriculture, University of Hohenheim, **Germany**. The course has included Plant Pathology, Weed Science, Applied Entomology and Pesticides Development and Screening.
10 June-21 June1996	4th International Training Course on Biology and Control of Parasitic Weeds, at Kenyan Agricultural Research Institute (KARI), **Kenya**. The course was organized by Supra-regional German Agency for Technical Cooperation (**GTZ**)-project program,

	University of Hohenheim, Germany, in collaboration with the Department of Plant Production in the Tropics and Subtropics, Centre for Agriculture in the Tropics and Subtropics, International Maize and Wheat Improvement Centre (CIMMYT) and KARI.
23 May – 20 June 1989	Technical Training Course in the Department of Agricultural Botany, Queen's University of Belfast, Northern Ireland, **United Kingdom.** The course was organized by the International Association for Exchange of Students for Technical Experience (IAESTE).

LANGUAGES

1. Arabic: Mother language
2. English: Excellent
3. German: very good command (reading, writing & speaking)

ANALYTICAL TOOLS AND COMPUTER SKILLS

1. Very good experience of Windows and associated programs: Word Perfect, Harvard Graphic, Microsoft Word, Microsoft Excel, Sigma Plot, Microsoft Power Point, Microsoft Photo Editor
2. Statistical and data processing including Statistical Analysis System (SAS), and Statistical Package for Social Science (SPSS) and STATISTICA (very good experience).
3. Netscape Communicator and Internet Explore (very good experience).

EMPLOYMENT RECORDS

Period	Position held, nature of work and organization	Supervisor (s)
Sep. 2009 – present	**Full-time:** Associate Professor, Department of Botany and Agricultural Biotechnology, Faculty of Agriculture, University of Khartoum, Shambat, **Sudan:**	
Sep 2015 - Sep 2016	**Full-time:** Scientist (Aflatoxin Biocontrol Specialist), Pathology unit, International Institute of Tropical Agriculture (**IITA**), IITA headquarters, Ibadan, Nigeria. ***Duties:*** Providing stewardship and technical backstopping for various aflatoxin biocontrol research-for-development projects (Aflasafe) in West Africa. These projects specifically focus on managing and drastically reducing Aflatoxin contamination in many staple food crops in many African countries through implementation of a biocontrol technology (aflasafe) as main mitigation strategy that acts in synergy with other drying and storage technologies along the crop value chain. Aflasafe is eco-friendly innovative biocontrol technology that utilizes native atoxigenic strains proved to be effective and cost-effective in reducing drastically and consistently aflatoxins contamination during both crop development and post-harvest storage and throughout the value chain in several countries across Africa. Aflasafe technology is being promoted together with other drying and storage technologies in West and East Africa to enable farmers to harvest, store and market higher value crops to earn more profits and improve people's health. **Main activities include**: **i)** providing stewardship and technical backstopping for AgResults Aflasafe™ Project in Nigeria, including: supervising and monitoring with the team, proper sample collection, handling and processing of aflasafe-treated maize grains from different regions and aggregations where aflasafe product is applied, supervising aflatoxin extraction and quantification) and microbial analysis (aflasafe strain isolation, mutant development, complementation, aflasafe strain recovery) of collected maize grain samples, and training and sensitizing the AgResults implementers on the use of Aflasafe products, and monitoring the training and follow-up of the know-how messages delivery to farmers by implementers on the use of	Dr. Ranajit Bandyopadhyay, Senior Plant Pathologist, Head of Pathology Unit & Leader, Africa-wide Aflasafe Initiative Dr. Robet Asied (R4D Director for West Africa Hub)

	Aflasafe technology; **ii)** providing stewardship and technical backstopping for aflatoxin biocontrol projects in Ghana, including: preparing with the team the workplan including deliverables and budget for the activities of biological control of aflatoxins in maize and groundnut with Aflasafe GH01 and GH02 in Ghana, contributing in supervising and guiding the PhD student (Daniel Agbetiameh) to develop and prepare all standard protocols for establishment of field efficacy and carry-over trials and implement standard protocols for lab analyses [microbiology (strain isolation, mutant development, complementation) and chemical (aflatoxin extraction and quantification)]; **iii)** supervising and monitoring production of Aflasafe products of various countries and ensuring ensuring product quality, by IITA Aflasafe Manufacturing Plant in Ibadan, for the large-scale field efficacy validation and scaling-up with complementary projects; **iv)** contributing in training and sensitizing of different stakeholders and regulators in the maize and groundnut value chains in Nigeria (AgResults) and Ghana on the prevalence of aflatoxin contamination in crops and management and the use of Aflasafe as a mitigation strategy; **v)** helping in registration of aflasafe technology in Ghana and Burkina Faso; **vi)** building strategic partnership with Ghanaian regulatory authorities such as the EPA, and guiding the inspection of Aflasafe efficacy trials in farmers fields and strengthening national advocacy coalitions for supporting the process of aflasafe products registration in Ghana; **vii)** helping in developing a platform for partnership and networking for scaling-out and commercialization of aflasafe products, and marketing of aflatoxin reduced maize and groundnuts; **viii)** developing new formulations and delivery-carries for aflasafe biocontrol products based on potential use of the agricultural by-product (e.g. cassava peel pellets) to replace sorghum grains, and the use of Arabic Gum as coating material for the commercial delivery of the biopesticide aflasafe; ix) resource mobilization and fund raising through development of sound proposals and concept notes to be submitted to potential donors; **x)** scaling out of Aflasafe technology (products and know-how) in partnership with the complementary development organisations and projects (e.g. CIC, Spring Ghana); **xi)** preparing high quality technical reports of various aflasafe projects to IITA Project Administration Office as pre reporting requirements for donors; **xii)** Publication & communication: handling data analysis and producing high quality peer reviewed scientific articles for publication in reputable international journals, and communicating and exchanging ideas, research news and findings, challenges with with various targeted audience. **xiii)** management responsibilities include, managing technical aspects of mycotoxin/biocontrol research in pathology/Mycotoxin lab in IITA-Ibadan, managing large number of staff including lab manager, research supervisors, lab technicians, graduate students, trainees etc. at IITA HQ in Ibadan, and meetings to plan and review project activities IITA (http://www.iita.org/) is one of the world's leading research partners in finding solutions for hunger, malnutrition, and poverty, and supported primarily by the Consultative Group of International Agricultural Research **(CGIAR)**.	
July 2011 – August 2015	**Full-time:** Scientist (Biocontrol Specialist), International Institute of Tropical Agriculture (**IITA**), IITA headquarters, Ibadan, Nigeria. ***Duties:*** leading and managing the Striga biocontrol research activities in Nigeria. Striga Biocontrol (BC) Technology is a component of the project entitled "*Integrated Striga Management in Africa* –ISMA" that funded by the Bill and Melinda Gates Foundation (BMGF), and led by the Nigeria-based IITA. The project is combining and intensively promoting the best-bet proven technologies including biocontrol to combat *Striga* and to enhance food security in Sub Saharan Africa (SSA). These technologies are being promoted in participation with researchers, farmers, community based organizations, extension workers, policy makers, seed and input suppliers. **Main activities include**: i) assessing biosafety of Striga host-specific BC agents (*Fusarium oxysporum* f.sp. *strigae*), including impact on cereal hosts or any other crops, and production of mycotoxicin; ii) validating the field efficacy and potential of BC technology for Striga control across different	Dr. Robet Asied (R4D Director for West Africa Hub) Dr. David Chikoye (R4D Director, and Head, Plant Production and Health Management

	agroecological zones (AEZs); iii) evaluating the benefit and additive value of integrating BC with other complementary control technologies on *Striga* suppression and yield increase; iv) studding the compatibility of BC agents (isolates Foxy2 & PSM197) with the commonly used pesticides; v) increasing awareness of safety and benefit of BC technology with different stakeholders and regulators; vi) undertaking of socio-economic and cost benefit analysis of BC technology in collaboration with our socio-economist partners; vii) monitoring the survival and persistence of BC agent Foxy2 in maize rhizosphere soil using the developed molecular detection tools in collaboration with university of Hohenheim, Germany; viii) registration of BC technology in Nigeria; ix) transferring, domesticating and establishing BC inoculum production and seed coating technology unit at IITA HQ in Ibadan, and optimizing of cost effective mass production methods and seed coating protocols; x) building and strengthening strategic partnership for the development of the Striga BC technology, application and registration; xi) resource mobilization and fund raising; xii) Other management responsibilities include; Meetings to plan and review project activities including Regular meetings, Reports on key actions points, Meeting reports, sharing knowledge, expectations and results with donor, regulatory authorities, national research and extension staff. **Additional resrach activities include:** i) assessing and evaluating the pathogenicity and virulence of the newly isolated indigenous *F. oxysporum* f.sp. *strigae* strains collected from Striga plants and different AEZs in Nigeria, against Striga, for their future promotion as bioherbicides for Striga control; ii) evaluating the influence of the coating material on the efficacy of metsulfuron methyl (MSM) and imazapyr herbicides – treated seeds of the IR-Maize Hybrids in controlling *S. hermonthica*; and iii) contributing in investigating and understanding the genetic diversity in *S. hermonthica* with host-parasite specificity for developing maize cultivars with durable resistance to *Striga* adapted to different AEZs. IITA (http://www.iita.org/) is one of the world's leading research partners in finding solutions for hunger, malnutrition, and poverty, and supported primarily by the Consultative Group of International Agricultural Research **(CGIAR)**.	
Dec 2008 – present	**Full-time:** Associate Professor, Department of Botany and Agricultural Biotechnology, Faculty of Agriculture, University of Khartoum, Shambat, **Sudan:** ***Duties:*** i) Conception, updating and teaching agricultural biotechnology and botany courses mainly introduction to biotechnology, biological control of weeds, biopesticide development, ecology and biodiversity, ii) conducting research, iii) supervising graduate and undergraduate students and organizing other activities e.g. seminars, workshops and field days etc., iii) preparation and writing up of research projects, scientific manuscripts including papers, poster and oral presentations, and iv) Developing linkages and working relationships, joint research and collaboration with relevant international professional institutions and organizations, v) Establishing collaboration with relevant industry in the field of bio-pesticides in Germany (e.g., SUET Saat-u Ernte-Technik, Prophyta Biologischer Pflanzenschutz GmbH) and in Kenya (Real IMP) in order to transfer of innovative technologies (formulation and seed treatment) into practical field application, and vi) helping in the addminstrative work. of the faculty.	
May 2005 – Nov. 2008	**Full-time:** Research Scientist and Postdoctoral Fellow in Georg Forster Research Fellowship of the Alexander von Humboldt-Foundation (AvH), Bonn, at the Institute of plant production and Agroecoloy in the Tropics and Subtropics, **University of Hohenheim**, Stuttgart, **Germany**. Within this program**,** research projects and related activities are designed to promote the transfer of knowledge and new methods, so as to contribute to further development in developing countries. My research project dealt with the development of environmentally friendly, easy, effective and inexpensive bioherbicidal formulations and delivery systems of biocontrol agents for *Striga* in Sub-Saharan Africa for large-scale application. ***Duties*:**	Prof. Cadisch, Head of Agronomy Department & Director of the Centre for Agriculture in the Tropics and Subtropics Prof. Kroschel, Head, Agroecology/Integrated Pest Management,

	I. Conducting research: mainly on ecological weed management, which include: 1) Optimising the conditions that increase the efficacy of both seed treatment and Pesta formulations containing *Striga*-mycoherbicides; 2) Optimising the fermentation conditions that enhance the mass-production of the fungal inoculum; 3) Improving shelf life of mycoherbicides (bio-products); 4) Studying the development and survival of *Striga*-mycoherbicides *"Fusarium oxysporum"* in colonising the root system of sorghum applied as seed treatment (including histological studies using light, scanning and transmission electron microscopy); 5) Collaborating in characterizing of *Striga*-mycoherbicides "fungal pathogens" using molecular biology tools; 6) Integrating *Striga* mycoherbicidal formulations (Pesta & seed treatment) with existing *Striga* control measures such as sorghum and maize resistant varieties as well as with some selected fungicides using seed treatment technology to control simultaneously *Striga* and some sorghum and maize fungal diseases under field conditions of West Africa. **II. Teaching activity:** Participating as resource person in the teaching activities of the Department of Agronomy, Institute of Plant Production and Agrarecology in the Tropics und Subtropics, University of Hohenheim, Stuttgart, Germnay. In particular, conception, updating and teaching the issues dealing with *pest and weed biological control* of the Module 5104 **"***Advanced Crop Production Methods"*. **III. Publication & communication:** During 2005-2008, I published with co-authors, 9 scientific papers in referred Journals e.g. *Biocontrol Science and Technology, Weed Research, Journal of Plant Diseases and Protection, Nigerian Journal of Botany, The Open Mycology Journal*. In addition, I participated and presented research results (oral and posters) in international conferences and symposia on biological control of weeds, weed science, phytopathology and relevant disciplines. Moreover, I wrote technical and research reports to prestigious international scientific and development organizations including Food and Agricultural Organization of United Nation (FAO) & AvH. **IV. Other activities and duties: 1)** Developing, managing and raising funds for research projects, 2) Organizing and conducting international training courses in cooperation with international institutions. For example, I have been selected as an international expert by the technical supervision of Plant Protection Service (AGPP) of FAO and in close collaboration with ICARDA, to conduct an international training course on biological control of the parasitic weed *Orobanche* in September 2005; 3) Developing linkages and working relationships, joint research and collaboration with many international professional institutions and organizations e.g. IITA; 4) Establishing collaboration with relevant industry in the field of bio-pesticides in Germany (e.g., SUET Saat-u Ernte-Technik, Prophyta Biologischer Pflanzenschutz GmbH) in order to transfer of innovative technologies (formulation and seed treatment) into practical field application.	International Potato Center (CIP), Lima 12, Peru
Feb. 2002 – April 2004	**Full time:** Assistant scientist at the Institute of Plant Production and Agroecology in the Tropics and Subtropics, **University of Hohenheim**, Stuttgart, **Germany.** ***Duties:*** 1) Conducting research in the field biological control of weeds particularly bioherbicide development and delivery including mycoherbicide formulations, inoclum mass production, enhancement of mycoherbicides efficacy etc.; 2) Assisting in the preparation and writing of research projects; 3) Preparing and writing up of scientific manuscripts (publications) including papers and book chapters; 4) Participating as resource person in demonstrating and preparing the laboratory and greenhouse materials for practical courses for Master students; 5) Establishing collaboration with relevant industry in the field of bio-pesticides in Germany; 6) Participating and presenting research results (oral and posters) in international relevant conferences and symposia; 7) Participating in the seminars and conferences organized by the Institute etc.).	Prof. Dr. Jürgen Kroschel, Head of Agronomy Department
Oct. 1997-	PhD study at the Institute of plant production and Agroecoloy in the Tropics	Prof. Dr. Kroschel, Head of Agronomy Department

Jan. 2002	and Subtropics, **University of Hohenheim**, Stuttgart, **Germany**.	
01.08 - 10.09.2000	**Full time:** Visiting research scientist at **Danish Governmental Institute of Seed pathology for Developing Countries** (DGISP), Copenhagen, **Denmark**. ***Duties:*** During this period I developed and optimised a new technique (seed coating protocol) for delivering biological control agents for the control of root parasitic weeds as well as seed-borne pathogens. I introduced also for the first time some of the technologies used for studying biology and management of parasitic weeds to the biological control group of DGISP.	Dr. Vibeke Leth
Aug. – Oct. 1997	**Full time:** Lecturer, Department of Crop Protection, Faculty of Agriculture, **University of Zalingei**, Zalingei, **Sudan.** ***Duties:*** 1) Preparing and teaching crop protection courses, 2) Supervising graduate students, 3) Supervising and participating in organization of other activities e.g. seminars, field days etc.	
Nov. 1993 – July 1995	MSc study at the Department of Biology, Faculty of Science, **Addis Ababa University, Ethiopia.**	Prof. Dr. Fetana, Department of Biology, Faculty of Science
April 1992 – Jul. 1997	**Full time:** teaching assistant, Faculty of Agriculture, **University of EL-Fashir** (Zalingei), EL-Fashir/Zalingei, **Sudan.** ***Duties:*** (i) Teaching, preparing and demonstrating Botany courses for preliminary year of the faculties of Agriculture, Medicine, Veterinary and Education (Biology); (ii) Teaching, preparing and demonstrating microbiology courses for second year students in the department of Biology, Faculty of Education.	
July 1995 – March 1996	**Full time:** Visiting research assistant in the research program of the Supra-regional German Agency for Technical Co-operation (**GTZ**)- project "Ecology and management of Parasitic Weeds", **University of Hohenheim**, Stuttgart, **Germany**. ***Duties:*** 1) Studying the biology and control of the parasitic weed *Orobanche* spp.; 2) Evaluating data collected in Ethiopia on the infestation and distribution of the fly *Phytomyza orobanchia*; 3) Performing autecological studies with *Phytomyza orobanchia*; 4) identification and classification of microorganisms associated with diseased *Orobanche ramosa*; 5) Maintaining and preserving of fungal culture collections; 6) Testing and screening of pathogenicity of fungal isolates for biocontrol of *Orobanche ramosa;* 7) Data evaluation using different statistical analysis programs.	Prof. Dr. Jürgen Kroschel (project Co-ordinator)
July 1991 – March 1992	**Part time:** Teaching assistant in the Department of Agricultural Science and Food Technology, College of Agricultural Studies, **Sudan University of Science and Technology, Sudan**. ***Duties:*** Instructing, preparing and demonstrating Economic Entomology practical courses for the third year student,	Dr. Ibrahim A. Ibrahim, Head of Department
Feb. 1991 – Feb. 1992	**Part time:** Teaching assistant in Botany Department, Faculty of Science, **University of Khartoum, Sudan**. ***Duties:*** Teaching, preparing and demonstrating Botany courses for preliminary year students,	Dr. Sirag Ali Ibrahim, Head of Department
Feb. 1991 – Feb. 1992	**Part time:** Teaching assistant in the Department of Crop Protection, Faculty of Agriculture, **University of Khartoum, Sudan**. ***Duties:*** Teaching, preparing and demonstrating agricultural zoology practical classes for second year student**,**	Dr. M. A/Halim Sidding

RESEARCH ACTIVITIES AND FIELD OF INTERESTS:

1. Environmentally-friendly and ecological diseases weed management
2. Biological control of alfatoxins and weeds with pathogens (Phytopathology)
3. Formulation technology, delivery systems, scaling-up and commercialization of bioherbicides

4. Seed treatment (coating) with the antagonists for seed and soil-borne diseases and weed, control
5. Handling risk of biocontrol agents including identification of mycotoxins production and assessment of their environmental safety
6. Enhancing virulence of biocontrol agents
7. Biology and control of parasitic weeds
8. Host (plant)-parasite-antagonists interactions
9. Integrated pest (pathogen, disease, weed) management strategies
10. Weed science and ecology

MEMBERSHIPS IN SCIENTIFIC SOCITIES

Member of the following:

1. International Weed Science Society (**IWSS**): http://www.iwss.info/
2. European Weed Research Society (**EWRS**): http://www.ewrs.org/
3. Agricultural Engineers Union, Sudan.
4. Sudanese Inventors' General Union
5. International Parasitic Plant Society (**IPPS**): http://www.ppws.vt.edu/IPPS/
6. International Parasitic Seed Plant Research Group:
7. Parasitic Plant Discussion Group: http://www.omnisterra.com/botany//pp/html/pp_listserv.html
8. International Bioherbicides Group (**IBG**): http://ibg.ba.cnr.it/
9. Publication Distribution Service (**PDS**) of the Technical Centre for Agricultural and Rural Co-operation (**CTA**), between the Group of States **ACP-** (Africa, Caribbean and Pacific) and the **EU** (European Union): http://www.cta.int/
10. University of Hohenheim Association (Universitaetsbund Hohenheim), Germany: https://www.uni-hohenheim.de/

LIST OF PUBLICATIONS

A) BOOKS:

1. **Elzein, A.E.M. (2003):** Development of a granular mycoherbicidal formulation of *Fusarium oxysporum* "Foxy 2" for the biological control of *Striga hermonthica*. *In*: "Tropical Agriculture 12– Advances in Crop Research (2)" (J Kroschel., Ed.). Margraf Verlag, Weikersheim, Germany, 190 pp., ISBN 3-8236-1405-3.

B) BOOK CHAPTERS:

2. **Elzein A.** and J Kroschel **(2003)**. Progress on Management of Parasitic Weeds. In: *Weed Management for Developing Countries: Addendum One,* R. Labrada (Ed.)**. FAO Publication**, Rome, Italy, pp. 109-144. (http://www.fao.org/docrep/006/y5031e/y5031e0a.htm)

3. Hess, D.E., J. Kroschel, D. Traore **A.E.M. Elzein**, P.S. Marley, A.A. Abbasher, and C. Diarra (**2002**)**:** *Striga*: Biological Control Strategies for a New Millennium. In: *Sorghum and Pearl Millet Diseases,* J.F. Leslie (Ed.). Iowa State Press, Ames, Iowa, USA, 165-170.

C) ARTICLES IN REFEREED JOURNALS:

1. Unachukwu, N., Menkir, A., Rabbi, I. Oluoch, M. **Elzein, A**., Muranaka, S., Odhiambo, G., Farombi, O., Gedil, M. (2017). Genetic diversity and population structure of Striga. **Weed Research** published on line: http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1365-3180 - DOI: 10.1111/wre.12260.
2. A.B. Zarafi, **A. Elzein**, D.I. Abdulkadir, F. Beed & O.M. Akinola (**2014**): Host range studies of Fusarium oxysporum f.sp. strigae meant for the biological control of Striga hermonthica on maize and sorghum, **Archives of Phytopathology and Plant Protection**, 48(1),1-9.
3. Avedi, E.K., S. Ajanga, Ochieno D., Wainwright, H, **Elzein, A**., Beed F. (**2014**). Fusarium oxysporum f. sp. strigae strain Foxy 2 did not achieve biological control of Striga hermonthica parasitizing maize in Western Kenya. **Biological Control** 77, 7–14.
4. **Elzein, A** and F. Beed **(2013**). Eco-friendly bioherbicide approach for *Striga* control. IITA R4D Review, Issue 10, 26-32. http://r4dreview.org/
5. **Elzein, A.,** F. Beed and J. Kroschel (**2012**). Mycoherbicide: innovative approach to Striga management. SP-IPM Technical Innovations Brief, No. 16, March 2012. http://www.spipm.cgiar.org/.
6. Ndambi, B., Cadisch, G., **Elzein, A.**, Heller, A., **(2012)**. Tissue specific reactions of sorghum roots to the mycoherbicide *Fusarium oxysporum* f.sp. *strigae* versus the pathogenic *F. Proliferatum*. **Biocontrol Science and Technology** 22(2), 135-150.
7. Ndambi, B., Cadisch, G., **Elzein, A.**, Heller, A., **(2011)**. Colonization and control of *Striga hermonthica* by *Fusarium oxysporum* f.sp. *strigae* 'Foxy 2', an anatomical study. **Biological Control** 58, 149–159.
8. **Elzein, A.,** A. Heller, B. Ndambi, M. De Mol, J. Kroschel and G. Cadisch **(2010):** Cytological investigations on colonization of sorghum roots by the mycoherbicide *Fusarium oxysporum* f. sp. *strigae* and its implications for *Striga* control using a seed treatment delivery system. **Biological Control** 53, 249-257.
9. **Elzein, A.**, J. Kroschel, P. Marley, & G. Cadisch **(2009):** Does vacuum-packaging atmosphere or co-delivered amendments enhance shelf-life of *Striga*-mycoherbicidal products containing *Fusarium oxysporum* f.sp. *strigae* during storage?. **Biocontrol Science and Technology** 119 (4), 349-367.

10. **Elzein, A.**, J. Kroschel, & G. Cadisch **(2008)**: Efficacy of Pesta granular formulation of *Striga*-mycoherbicide *Fusarium oxysporum* Foxy 2 after 5-year of storage: step towards practical *Striga* control in Africa. **Journal of Plant Diseases & Protection** 115 (6), 259–262.
11. **Elzein, A.,** F. Brändle, G. Cadisch, J. Kroschel, P. Marley & M. Thines **(2008):** *Fusarium oxysporum* strains as Potential *Striga* Mycoherbicides": Molecular Characterization and Evidence for a New *forma specialis.* **The Open Mycology Journal** 2: 89-93.
12. **Elzein, A.** and J. Kroschel **(2006):** Host range studies of *Fusarium oxysporum* "Foxy 2": an evidence for a new *forma specialis* and its implications for *Striga* control. **Journal of Plant Diseases and Protection** 20, 875-887.
13. **Elzein, A.,** J. Kroschel and V. Leth **(2006):** Seed treatment technology: an attractive delivery system for controlling root parasitic weed *Striga* with mycoherbicide. **Biocontrol Science and Technology** 16 (1) 3-26.
14. Schaub, B., P.M. Marley, **A. Elzein,** and J. Kroschel **(2006):** Field evaluation of an integrated *Striga* management in Sub-Saharan Africa: Synergy between *Striga*- mycoherbicides (biocontrol) and sorghum and maize resistant varieties. **Journal of Plant Diseases and Protection** 20, 691-699.
15. Marley, P.S., J. Kroschel and **A. Elzein (2006):** Host rang of *Fusarium oxysporum* (isolate PSM 197) to be used as a mycoherbicide for the control of *Striga hermonthica* in West Africa. **Nigerian Journal of Botany** 19 (1): 17-28.
16. **Elzein, A.** and J. Kroschel **(2006):** Development and efficacy of granular formulations of *Fusarium oxysporum* "Foxy 2" for *Striga* control: an essential step towards practical field application in Africa. **Journal of Plant Diseases and Protection** 20, 889-905.
17. Marley, P.S., J. Kroschel and **A. Elzein (2005):** Host specificity of *Fusarium oxysporum* Schlect (isolate PSM 197) a potential mycoherbicide for controlling *Striga* spp. in West Africa. **Weed Research** 45 (6), 407-412.
18. Kroschel, J. and **A. Elzein (2004):** Bioherbicidal effect of fumonisin B_1, a phytotoxic metabolite naturally produced by *Fusarium nygamai*, on parasitic weeds of the genus *Striga*. **Biocontrol Science and Technology** 14(2), 117-128.
19. **Elzein, A.,** J. Kroschel and D. Müller-Stöver **(2004):** Effects of inoculum type and concentration on shelf-life of "Pesta" formulation containing *Fusarium oxysporum* "Foxy 2", a potential mycoherbicide for *Striga*, during storage **Biological Control** 30(2), 203-211.
20. **Elzein, A.E.M**. and J. Kroschel **(2004):** *Fusarium oxysporum* "Foxy 2" shows otential to control both *Striga hermonthica* and *S. asiatica*. **Weed Research** 44(6), 433-438**.**
21. **Elzein, A.E.M.,** J. Kroschel and D. Müller-Stöver **(2004):** Optimization of storage conditions for adequate (long) shelf-life of "Pesta" formulation of *Fusarium oxysporum* "Foxy 2", a potential mycoherbicide for *Striga*: effects of temperature, granule size and water activity. **Biocontrol Science and Technology** 14(6), 531-544.
22. **Elzein, A.E.M.** and J. Kroschel **(2004):** Influence of Agricultural By-products in Liquid Culture on Chlamydospore Production by the Potential Mycoherbicide Fusarium oxysporum Foxy 2. **Biocontrol Science and Technology** 14(8), 823-836.
23. **Elzein, A.E.M**., J. Kroschel, M. Fetene and A. Admassu **(1999):** Preliminary evaluation of *Phytomyza orobanchia* (Diptera: Agromyzidae) as a controller of *Orobanche* spp. in Ethiopia. **An Ethiopian Journal of Science** 22 (2), 271-282.

Articles in preparation

24. Agbetiameh, D., J. Atehnkeng, R. T. Awuah, A. Ortega-Beltran, **A. Elzein**, R. Bandyopadhyay & P. J. Cotty (**2016**). Prevalence of aflatoxin contamination in maize and groundnuts in Ghana: Population structure, distribution, and toxigenicity of the etiologic agents. Ready for submission to Plant Disease Journal (Published by The American Phytopathological Society).

25. **Elzein, A**, A. Menkir, F. Beed, et. al. (2016). Compatibility of the bioherbicide *Fusarium oxysporum* f. sp. *strigae* with chemical pesticides, and its implications for *Striga* control with dual-efficacy of single-dose seed treatment in maize. Preparation completed, corrected and it will be submitted soon. *The target Journal*: Biocontrol Science and Technology (*Publisher*: Taylor & Francis http://www.tandfonline.com/toc/cbst20/current).

26. **Elzein, A**, A. Menkir, F. Beed, A. Zarafi, (2016). Dual coating effect of bioherbicide *Fusarium oxysporum f.sp. strigae* and imazapyr herbicide in a single-dose of combined seed treatments for *Striga* control under field conditions in Nigeria. Preparation completed, corrected and it will be submitted soon. Target journal: Weed Research.

27. **Elzein A**, Ortega-Beltran A, Kaptoge, L, Zeledon, B, Atehnkeng J, Samuel, A, Cotty PJ, Bandyopadhyay R, et al. (2016). Evaluation of the potential use of the agricultural by-product cassava peels, and the coating material Arabic Gum as a delivery-carrier of the biopesticide aflasafe™.

28. **Elzein, A,** F. Beed, A. Zarafi, et al. (2016). Biosafety evidence of the potential *Striga* bioherbicide *Fusarium oxysporum* f.sp. *strigae* across wide-range of cultivated crops in west and east Africa. Target journal: Biological Control (*Publisher*: Elsevier: http://www.journals.elsevier.com/biological-control/). Partly drafted, need completion.

29. **Elzein, A**, H. Bello, T. Abdoulaye, M. Oluoch, A. Menkir et.al. (2016). Field efficacy and cost benefit of biocontrol technology in controlling *Striga* and improving maize yield in Nigeria. (Target journal: Crop Protection. (*Publisher*: Elsevier http://www.journals.elsevier.com/crop-protection/). In preparation with socioeconomic group, preparation is ongoing and we are expecting the draft to be ready soon.

30. **Elzein, A,** A. Zarafi, F. Beed, A. Menkir, et al. (2016). Influence of agroecological zones on the efficacy and potential of biocontrol technology in controlling *Striga* in Nigeria. In preparation. Target journal: Field Crops Research.

31. **Elzein, A,** A. Zarafi, F. Beed, A. Menkir, et al. (2016). Effectiveness of biocontrol technology in controlling *Striga* and improving maize yield under artificial *Striga* infestation in Nigeria. Target journal: Weed Research.

32. **Elzein, A,** A. Menkir, F. Beed (2016). Novel integration of a bioherbicide technology and imazapyr herbicide in a single-dose seed treatment, to manage the parasitic weed *Striga* in maize. Target journal: Biocontrol Science and Technology.

33. **Elzein, A.** F. Beed, A. Menkir (2016). Compatibility of *Striga* bioherbicides with Pesticides technology Delivered Using Seed Treatment Technology and its Implication For Striga and improvement of grain yield. Target journal: Biocontrol Science and Technology.

34. **Elzein, A,** F. Beed, et al. (2016). Pathogenicity and virulence of indigenous *Fusarium oxysporum* f.sp. *strigae*, against Striga: Step for their promotion as bioherbicides for Striga control in Nigeria. Target journal: BioControl.

D CONTRIBUTIONS IN CONFERENCES, SYMPOSIA AND WORKSHOPS

I. PAPERS PUBLISHED IN CONFERENCE PROCEEEDINGS OR ABSTRACT BOOKS

1. **Elzein, A.** F. Beed , A. Menkir, A. Zarafi, & D. Chikoye (2017). Bioherbicide *technology: An* eco-friendly innovative approach to parasitic *weed management* and enhancement of food security in Sub-Saharan Africa. Accepted for orral presentation at the Modern Agriculture Technology Seminar, of the 2017 China-Africa 20+20 Project that will held at the Yangzhou University, Yangzhou, China, November 19th-22th, 2017.

2. Siefeldin M. Gasim, **Abuelgasim EM Elzein**, Eltayeb SN Babikir, Abdelateif H Ibrahim, Amir B Saeed, Abdelmouiem A Mohamed, Amel M Mubarak, Hamid A Hamid, Abdelmohsien Elnadi, Yousif Elgarshi, Ahmed Hashim (**2017**). Impacts of Grand Ethiopian Renaissance Dam (GERD) on Agriculture in Sudan. Presented as orral presentation at the Workshop on Health and Environmental Impacts of the GERD that organized by the University of Khartoum in collaboration with Addis Ababa University, and held March 1-2, 2017, in AlShariga Hall in Khartoum, University of Khartoum, Sudan.
3. Agbetiameh D, Ortega-Beltran A, **Elzein A**, Atehnkeng J, Awuah RT, Cotty PJ, Bandyopadhyay R (2016). Biocontrol of Aflatoxins in Maize and Groundnuts with Aflasafe GH01 and Aflasafe GH02, two biopesticides developed for Ghana. Presented at the Annual Review and Planning Meeting of the Feed the Future Africa RISING (African Research in Sustainable Intensification for the Next Generation), held March 28 – April 1, 2016, in Tamale, Ghana.
4. Zarafi A. and **A. Elzein (2013).** Evaluation of a biocontrol agent (BCA) against *Striga hermonthica* on maize. In: Book of Abstract of the 38th annual conference of the Nigerian Society for Plant Protection (NSPP), held at Michael Okpara University, Umudike, Abia State, Nigeria on 10- 14th March, 2013. The Nigerian Society for Plant Protection (NSPP), pp. 201.
5. **Elzein, A**. J. Kroschel, & G. Cadisch **(2010)**: A bioherbicide-technology for *Striga* control: Time for commercialization and implementation to enhance food security in Sub-Saharan Africa. In: Book of Abstracts of the 2nd International Conference on Applied Biotechnology "Biotechnology for Sustainable Human Society", October 25-27, 2010, Khartoum, **Sudan**. African City of Technology, Sudan. Pp.84-85.
6. Ndambi, B., G. Cadisch, **A. Elzein**, & A. Heller (**2009**): Interactions between the mycoherbicide *Fusarium oxysporum* f.sp *strigae* and sorghum roots. Presented as oral presentation at the *Deutscher Tropentag 2009 "Biophysical and Socio-economic Frame Conditions for the Sustainable Management of Natural Resources*" (Ed., *E Tielkes),* that held October 6 - 8, 2009, in Hamburg, **Germany**. © DITSL GmbH, Witzenhausen, Germany. Pp. 165.
7. **Elzein, A.** J. Kroschel, P. Marley, F. Beed, & G. Cadisch **(2009):** Innovations for scaling-up of *Striga* Mycoherbicides application in Africa. In: *Proceedings of the 10th World Congress on Parasitic Plants* (Eds., Rubiales, D., J. Westwood, A. Uludag), 8 to 12 June, 2009 Kusadasi, **Turkey**. International Parasitic Plant Society. Pp. 84. (http://www.ippsturkey.com/default.asp?link=program).
8. Ndambi, B., A. Heller, **A. Elzein,** and G. Cadisch **(2009):** Colonisation of *Striga hermonthica* and its host sorghum by the mycoherbicide *Fusarium oxysporum* f.sp. *strigae*. In: *Proceedings of the 10th World Congress on Parasitic Plants* (Eds., Rubiales, D., J. Westwood, A. Uludag), 8 to 12 June, 2009 Kusadasi, **Turkey**. International Parasitic Plant Society. Pp. 85. (http://www.ippsturkey.com/default.asp?link =program).
9. Ndambi, B., A. Heller, **A. Elzein,** and G. Cadisch **(2009):** *Fusarium oxysporum* f. sp *strigae*: Pathogenic to the parasite *Striga* and non-pathogenic to its host sorghum?. Presented at „Tagung der Deutsche Phytomedizinische Gesellschaft (**DPG**) - Arbeitskreise Mykologie und Wirt-Parasit-Beziehungen", [German Phytomedicine Society (DPG) – Working group Mycology and host-parasite interactions], 26th to 27th March 2009, Technischen Universität Kaiserslautern, **Germany** [avialable from: http://www.phytomedizin.org/wirt_parasit_bez.html).
10. **Elzein, A.** J. Kroschel, P. Marley, B. Fen, A. Avocanh & G. Cadisch **(2008):** Progress on *Striga* Mycoherbicide Research: A Time for Scaling-up?. In: Book of Abstracts of the Deutscher Tropentag 2008 "Competition for Resources in a Changing World: New Drive for Rural Development", October 7 - 9, 2008, Hohenheim, **Germany**. Pp. 118
11. Ndambi, B., A. Heller, **A. Elzein** and G. Cadisch **(2008):** Action of the mycoherbicide *Fusarium oxysporum* f. sp. strigae 'Foxy 2' on *Striga hermonthica*: an anatomical study. In: Book of Abstracts of the Deutscher Tropentag 2008 "Competition for Resources in a Changing World: New Drive for Rural Development", October 7 - 9, 2008, Hohenheim, **Germany**. Pp. 286
12. **Elzein, A.,** J. Kroschel, F. Beed, A. Avocanh, P. Marley and G. Cadisch **(2008):** Co-delivering of *Striga*-Mycoherbicides with Fungicides Using Seed Treatment Technology: Compatibility, Field efficacy and Implication. In: CD-Rom, Abstracts of the 5th International Weed Science Congress "Weeds – local problems/global challenge", 23 - 27 June 2008. Vancouver, **Canada**. Pp. 232.
13. **Elzein, A.**, J. Kroschel, P. Marley, & G. Cadisch **(2008):** Does vacuum-packaging atmosphere enhance shelf-life of *Striga*- mycoherbicidal products containing *Fusarium oxysporum* f.sp. s*trigae* during

storage?. In: CD-Rom, Abstracts of the 5th International Weed Science Congress "Weeds – local problems/global challenge", 23 - 27 June 2008. Vancouver, **Canada**. Pp. 65.

14. **Elzein, A.,** J. Kroschel, P. Marley & G. Cadisch **(2008):** Advances in *Striga* mycoherbicide research and development: Implications and future perspective for Africa. In: *Proceedings of the XII international Symposium on Biological Control of Weeds*, (eds. Julien, M.H., Sforza, R., Bon, M.C., Evans, H.C., Hatcher, P.E., Hinz, H.L., and Rector), 22-27 April 2007, Montpellier, **France.** CAB International Wallingford, UK. Pp. 705.
15. **Elzein, A.,** M. Thines, F. Brändle, J. Kroschel, P. Marley & G. Cadisch **(2008):** Molecular Characterization of Potential *Striga* Mycoherbicides "*Fusarium oxysporum* strains": An Evidence for a New *forma specialis*. In: *Proceedings of the XII international Symposium on Biological Control of Weeds*, (eds. Julien, M.H., Sforza, R., Bon, M.C., Evans, H.C., Hatcher, P.E., Hinz, H.L., and Rector). Presented at the VII International Bioherbicide Group Workshop (VII IBGW), held as a pre-syposium workshop on 22 April 2007, Montpellier, **France.** CAB International Wallingford, UK. Pp. 643.
16. **Elzein, A.,** F. Beed, A. Avocanh, J. Kroschel, P. Marley and G. Cadisch **(2007):** Synergy Between *Striga*- Mycoherbicides *Fusarium oxysporum f.sp. strigae* and Resistant Cultivars Under Field Conditions: Step Towards Integrated Striga Control in Africa". In: CD-Rom, Abstracts of the "9th World Congress on Parasitic Plants", June 3-7, 2007. Omni Hotel, Charlottesville, Virginia, **USA.** Available from: http://www.cpe.vt.edu/wcopp/Abstracts_Final.pdf. Pp. 76.
17. Heller A, **A. Elzein,** M. De Mol, J. Kroschel and G. Cadisch **(2007):** Colonization of *F. oxysporum f.sp. strigae* (Foxy 2) on roots of Sorghum plants and its implication for *Striga* control using a seed treatment delivery system: an anatomical study". In: CD-Rom, Abstracts of the "9th World Congress on Parasitic Plants", June 3-7, 2007. Omni Hotel, Charlottesville, Virginia, **USA**. Available from: http://www.cpe.vt.edu/wcopp/Abstracts_Final.pdf. Pp. 75.
18. **Elzein, A**., J. Kroschel & P. Marley (2006): Mycoherbicide research and development for integrated *Striga* control in Africa: achievements, constraints and future perspective. In: *Proceedings of the Deutscher Tropentag 2006 'Prosperity and Poverty in a Globalized World _ Challenges for Agricultural Research'*, eds. F. Asch and M. Becker. Hausdruckerei der Universität Bonn, Germany. 205 p. 11 - 13 October 2006.. Pp. 63.
19. **Elzein**, A., J. Kroschel G. Cadisch & P. Marley (2006): Enhancing *Striga* management using Pesta granular mycoherbicidal formulations: Synergy between *Striga*-mycoherbicides and nitrogen fertilizer. In: *Proceedings of the Deutscher Tropentag 2006 'Prosperity and Poverty in a Globalized World _ Challenges for Agricultural Research'*, eds. F. Asch and M. Becker. Hausdruckerei der Universität Bonn, **Germany**. 205 p. 11 - 13 October 2006. Pp. 205.
20. **Elzein, A.** and J. Kroschel **(2004):** Pesta formulation and seed treatment technology: attractive delivery systems for *Striga* mycoherbicides - step towards practical field application. 4th International Weeds Science Conference, 20-25 June 2004, Durban, **South Africa**. Pp. 14.
21. **Elzein, A.**, J. Kroschel and V. Leth **(2004):** Seed treatment technology: a novel approach for controlling the parasitic weed *Striga* with *Fusarium oxysporum* "Foxy 2". In: *Proceeding of the XI International Symposium on Biological Control of Weeds*, (eds. Cullen, J.M., Kriticos, D.T, Lonsdate, W.M., Morin, L., and Scott, J.K.). CSIRO Entomology, Canberra, **Australia**. Pp. 472-473.
22. **Elzein, A.E.M**., J. Kroschel **(2002):** *Fusarium oxysporum* isolate "Foxy 2" also controls *Striga asiatica*: a novel emerging advantage for *Striga* control in Africa. In: *Proceedinggs of the 12th European Weed Research Society Symposium*, (ed. van Lair, H.H.), Wageningen – **The Netherlands** -24-27 June 2002, pp. 242-243.
23. **Elzein, A.**, J. Kroschel, D. Mueller-Stoever, and J. Sauerborn **(2001):** Different inocula of *Fusarium oxysporum* (Foxy 2) prepared as a granular mycoherbicides, and their efficacy on *Striga hermonthica*. In Book of Abstract, The practice of biological control: importation and management of natural enemies and agents, August 2-5, 2001, Bozeman, Montana, **USA**, pp. 43-44.
24. **Elzein, A.E.M**., J. Kroschel and J. Sauerborn **(2001):** Host specificity assessments of *Fusarium oxysporum* (Foxy 2), a potential antagonist of *Striga hermonthica*: Implications for its use as an acceptable mycoherbicide. In A. Fer, P. Thalouarn, D.M. Joel, L.J. Musselman, C. Parker and J.A.C. Verkleij (Eds.) Proceedings of the 7th International Symposium on Parasitic Weeds, 3-8 June, 2001, Nantes, **France**, pp. 301.

25. Kroschel, J., D. Mueller-Stoever, **A. Elzein,** and J. Sauerborn **(2000):** Efficacy and Shelf-life of Mycoherbicides for the Management of Parasitic Weeds of the Genus *Striga* and *Orabanche*. In: Proceedings on CD-Rom „Deutscher Tropentag 2000“ International Agricultural Research: A contribution to Crisis Prevention, Oct. 2000, University of Hohenheim, **Germany**. Pp. 279.
26. **Elzein, A.E.M**., J. Sauerborn, D. Mueller-Stoever, and J. Kroschel **(2000):** Effect of storage temperature, granule size, and inoculum type on the viability of *Fusarium oxysporum*, a pathogen of *Striga hermonthica*, encapsulated in wheat-kaolin (Pesta) granules. In Book of Abstracts, III International Weed Science Congress, June 2000, Foz Do Iguacu, **Brazil,** pp. 179.
27. **Elzein, A.E.M**., J. Kroschel, D. Mueller-Stoever, and J. Sauerborn **(2000):** Efficacy of Chlamydospore-rich biomass of *Fusarium oxysporum* encapsulated into a granular formulation ‘Pesta‘ for *Striga hermonthica* control. In Book of Abstracts, V International Bioherbicide Group Workshop, 5 –6 June 2000, Foz Do Iguacu, **Brazil**, pp. 24.
28. **Elzein, A.E.M**., J. Kroschel, A. Admassu, M. Fetene and D. Mueller-Stoever **(2000):** Fungi isolated from *Orobanche* spp. in Ethiopia, and their potential use for biological control. In: Proceedings of the X International Symposium on Biological Control of Weeds, N. R. Spencer (Ed.), 4-14 July 1999, Bozeman, Montana, **USA**. 136 pp.
29. Kroschel, J., D. Mueller-Stoever, **A. Elzein** and J. Sauerborn **(2000):** The Development of Mycoherbicides for the Management of Parasitic Weeds of the Genus *Striga* and *Orobanche*- a Review and Recent Results. In: Proceedings of the X International Symposium on Biological Control of Weeds, N. R. Spencer (Ed.), 4-14 July 1999, Bozeman, **USA**. 139 pp.
30. **Elzein, A.E.M. (1996):** An investigation on the possibilities of biological control of *Orobanche* spp. in Ethiopia. Master’s thesis, Biology Department, Addis Ababa University, **Ethiopia**, 88pp.

II. PRESENTED PAPERS IN CONFERENCES/MEETINGS WITH UNPUBLISHED PROCEEEDINGS

31. **Elzein, A**., A. Zarafi and F. Beed (2014). Progress on Biocontrol Technology in Nigeria. Presented at the Annual Review and Planning Meeting of the Integrated Striga Management in Africa (ISMA), held May 21-23, 2014, in Hotel DeBently, Abuja, Nigeria.
32. **Elzein, A**., A. Zarafi and F. Beed (2013). Biological control Technology Nigerian component. Presented at the Annual Review and Planning Meeting of the Integrated Striga Management in Africa (ISMA), held 4-7 June, 2013, in Kisumu, Kenya.
33. **Elzein, A**., F. Beed and A. Zarafi (2012). Update on Striga Biocontrol Technology in Nigeria. Presented at the mini workshop that organised by Dr Wainwright at The Real IPM Company in Thika, Kenya on Dec 19th, 2012.
34. **Elzein, A.,** F. Beed and Partners (2012). Biological control a component of ISMA. Presented during the meetings with Dr. Yilma Kebede, ISMA Senior Program Officer of Bill & Melinda Gates Foundation. The meeting was, held 4-7 Dec, 2012, in IITA HQ in Ibadan, Nigeria.
35. **Elzein, A**., A. Zarafi and F. Beed (2012). Progess on Striga Biocontrol Technology. Presented at the Annual Review and Planning Meeting of the Integrated Striga Management in Africa (ISMA), held 21-24 May, 2012, in IITA Ibadan, Nigeria.
36. **Elzein** J. Kroschel, & G. Cadisch **(2008):** Progress in *Striga*-Mycoherbicides Research and Development: A Future Prospective for Africa. Presented as invited lecture at the closing workshop of the German Ministry for Economic Cooperation and Development (**BMZ**)-funded project “*Arresting the Scourge of Striga on Sorghum in Africa by Combining the Strengths of Marker-Assisted Backcrossing and Farmer-Participatory Selection*”. The meeting was held in Stuttgart, **Germany**, July 21st-25th 2008
37. **Elzein, A**., J. Kroschel, P. Marley & G. Cadisch **(2006):** Progress on Mycoherbicide Research and Development Technology for integrated *Striga* control in Africa. Presented at the *International Symposium on Integrating New Technology for Striga Control: Towards Ending the Wicht-hunt.* November 5-11, 2006, Addis Ababa, **Ehtiopia**.
38. **Elzein, A. (2006):** Biological control of *Striga*: progress and implication for practical field appication in Africa. Invited key-note address. FAO regional technical meeting within FAO *Striga* project TCP/RAF/3008 for West African Countries (*Atelier sous-régional sur la gestion intégrée durable en*

agriculture des espèces du genre Striga) on *Striga* control, 25-27 April 2006, **Cotonou** "Le Chant d'Oiseau", **Benin.**

39. **Elzein, A. (2005):** Development of efficient delivery systems for *Striga* mycoherbicides: step towards practical *Striga* control in Africa. Presented at the Introducing Meeting of Alexander von Humboldt Foundation Fellows "Einführungstagung der Alexander von Humboldt Stiftung", 13-15 October 2005, Mainz, **Germany**.
40. **Elzein, A.**, J. Kroschel, V. Leth and P. Marley **(2004):** Enhancing *Striga*-mycoherbicide's efficacy through seed treatment delivery system: a step towards practical field application. In Biological Control Working Group (WG2) Meeting "Synergistic use of biocontrol agents for parasitic plant management", a working group of COST 849 action "Parasitic plant management in sustainable agriculture", 27-29 February 2004 Rome, **Italy**. (http://cost849.ba.cnr.it/meetings.HTM).
41. **Elzein, A.**, J. Kroschel, D. Mueller-Stoever, and J. Sauerborn **(2001):** Safety "host specificity" and efficacy of *Fusarium oxysporum* (Foxy 2), a potential antagonist of *Striga hermonthica*: Implications for its use as an acceptable mycoherbicide. Presented "as a contribution of introducing participant" at NATO Advanced Research Workshop: Enhancing biocontrol agents and handling risks, June 9-15, 2001, Hotel Villa Pitiana, Donnini, Florence, **Italy**.

E) PATENTS:

42. **Elzein, A.** and J. Kroschel **(2005).** An efficient delivery system for the Bioherbicide *Fusarium oxysporum* "Foxy 2" for controlling the parasitic weed *Striga* using seed treatment technology. Sudan Patent Number 1191.

F) TECHNICAL REPORTS

I have significantly contributed with aflasafe and Striga teams, in the preparation of a number of technical progress reports on various aflatoxin and Striga biocontrol projects, submitted to different donors, including:

1. **Elzein A**, Agbetiameh D, Ortega-Beltran A, Bandyopadhyay R (2016). A Technical Quarterly Progress Report (1 Jan–31 March 2016) on biological control of aflatoxins in maize and groundnut in Ghana of IITA-MERIDIAN/PACA-PJ1476, submitted to MERIDIAN, April 30, 2016.
2. Ortega-Beltran A, **Elzein A**, Bandyopadhyay R (2016). Potential use of cassava peels, an agricultural by-product, as a delivery carrier of the biopesticide aflasafe™, presented to the AgResults Steering Committee that comprised of the World Bank financial trustee, BMGF, the governments of Australia, Canada, the United Kingdom and the United States, in Washington DC, March, 2016
3. Bandyopadhyay R, **Elzein A**, Agbetiameh D, et al. (2016). A summary report on of activities conducted by IITA and partners on mycotoxin-related activities in Africa with reference to Ghana, September 2015 to February 2016, for the 8th Meeting of the PACA Steering Committee, 2-3 March 2016, Addis Ababa, February 28, 2016.
4. **Elzein A**, Agbetiameh D, Bandyopadhyay R (2016). A Technical Quarterly Progress Report (1 Oct –31 Dec 2015) on biological control of aflatoxins in maize and groundnut in Ghana of IITA-MERIDIAN/PACA-PJ1476, submitted to MERIDIAN, Jan 31, 2016.
5. **Elzein A**, Bandyopadhyay R (2015). A summary technical report (1 April–30 Sep 2015) on Aflatoxin Biological Control activities in Northern regions of Ghana for Feed the Future Africa RISING project funded by USAID), November 7, 2015.
6. Agbetiameh D, **Elzein A**, Bandyopadhyay R (2015). A Technical Quarterly Progress Report (1 Jul –30 Sep 2015) on biological control of aflatoxins in maize and groundnut in Ghana of IITA-MERIDIAN/PACA-PJ1476, submitted to MERIDIAN, Oct 31, 2016.
7. **Elzein, A,** (2015). Technical annual research report on Striga biocontrol technology in maize in Nigeria. Submitted to CIMMYT through IITA Maize CRP coordinator Dr. Menkir, Jan 30, 2015. 7pp.
8. **Elzein, A,** Zarafi, F. Beed (2014). Annual research report on Striga biocontrol activities and achievements in Nigeria, a component of Integrated Striga Management in Africa (ISMA – project). Submitted to BMG Foundation through ISMA project manager Dr. Oluoch. May 2014. 34pp.

9. **Elzein, A,** F. Beed (2014). Technical annual research report on Striga biocontrol technology in maize in Nigeria. Submitted to CIMMYT through IITA Maize CRP coordinator Dr. Menkir, Feb 7th, 2014. 7pp.
10. **Elzein, A,** Zarafi, F. Beed (2013). Annual research report on Striga biocontrol activities and achievements in Nigeria, a component of Integrated Striga Management in Africa (ISMA – project). Submitted to BMG Foundation through ISMA project manager Dr. Oluoch. May, 2013. ISMA Technical Report IITA-BMGF, pp. 55-144.
11. **Elzein, A,** F. Beed (2013). Technical annual research report on Striga biocontrol technology in maize in Nigeria. Submitted to CIMMYT through IITA Maize CRP coordinator Dr. Menkir, Feb 7th, 2013. 6pp.
12. **Elzein, A,** Zarafi, F. Beed (2012). Annual research report on Striga biocontrol activities and achievements in Nigeria, a component of Integrated Striga Management in Africa (ISMA – project). Submitted to BMG Foundation through ISMA project manager Dr. Oluoch. May, 2012, 72pp.
13. **Elzein, A. (2007).** Research report on project entitled "Field evaluation of an integrated *Striga hermontica* management in Sub-Saharan Africa: Synergy between *Striga*- mycoherbicides (*Fusarium oxysporum*: Foxy2 and PSM197) and sorghum and maize resistant varieties". Submitted to the Eiselen Foundation, Ulm, Germany. 22p.
14. **Elzein, A. (2006).** Research progress report of the project "*Seed treatment technology and Pesta formulation: Efficient delivery systems for* Striga *mycoherbicides – a step towards practical* Striga *control in Africa*". Submitted to the Alexander von Humboldt Foundation (**AvH**), Bonn, Germany. 43p.
15. **Elzein, A. (2005).** Report of the training course on biological control of parasitic weed *Orobanche*, Rabat, Morocco, 27-29 September 2005. The course was organised and sponsored by the **FAO** Plant Protection Service (AGPP) within the framework of the regional technical corporation project for control of *Orobanche* in leguminous crops (TCP/INT/2004). 20p.

G) CONTRIBUTION IN MASSMEDIA (NEWSPAPERS/Media interviews):

A series of media interviews and newspapers articles were conducted/published about Striga biocontrol technology and other ISMA control technologies, including:

1. **Elzein A.** On Nov, 5th, 2014, interview by FM Community Radio Toro in Bauchi in Nigeria, that broadcasted on 5th Nov 2014, and re-broadcasted for several times.
2. Beed, F., A. **Elzein,** H. Wainwright (2013). Biocontrol of Striga – A Progress report. Haustroium, 64, pp. 7-8, December 2013.
3. **Elzein A.** On 18th Oct. 2012, interview by Community Radio Bauchi, broadcasted by Community Radio Community Radio in Hausa language on 2th Nov. 2012 (30 min. at 2:00 pm), and re-broadcasted successively on 4th , 9th, 11th and 18th Nov. (30 min. at 11:00 am)..
4. **Elzein A.** On 7th Oct. 2012, interview by Daily Trust newspaper (www.daillytrust.com), published successively in the Daily Trust newspaper on (Sunday Trust, Oct. 7th, 2012, Vol. 7 No.15, page 56), (Oct, 10th, 2012, Vol.30 No. 58, Kano chronicle Page VI), and on (Oct, 19th,2012, Vol.30 No. 64, Feature Page 42). Daily Trust is national newspaper widely distributed across Nigeria.
5. **Elzein A.** On 6th Oct. 2012, interview by Freedom Radio Kano (www.freedomradio.com), broadcasted on 6th Oct. 2012 at 7:00 pm (English version) and rebroadcasted at 7:30 pm in Hausa version).
6. **Elzein A.** & F. Beed (2011). Validation of a Striga mycoherbicide technology in Kenya and Nigeria: A new project funded by the Bill and Melinda Gates Foundation to enhance food security in Sub Saharan Africa. International Bioherbicide Group IBG Newsletter. December 2011. http://ibg.ba.cnr.it/Latest_issue.htm.
7. **Elzein, A.** (2004). Development of a granular mycoherbicidal formulation of *Fusarium oxysporum* "Foxy 2" for the biological control of *Striga hermonthica*. Haustroium, Vol. 45, pp. 10-11, August 2004.

PARTICIPATION IN CONFERENCES

1. Second Annual Conference of Ethiopian Weeds Science Society (EWSS), 15-16 December **1994**, Addis Ababa, **Ethiopia.**

2. Pflanzenschutz in den Tropen und Subtropen: Arbeitskreistreffen, 7-8 July **1998**, Hattersheim/Frankfurt, **Germany**. The Conference was organized by the Deutsche Phytomedizinische Gesellschaft, Institut fuer Pflanzenkrankheiten, Bonn.
3. Plant Production and Agroecology: Thoughts about the Future, A symposium in honour of Prof. Dr. Werner Koch, 24 July **1998**, University of Hohenheim, Stuttgart**, Germany.**
4. The Fourth International Workshop on *Orobanche* Research, 23 September **1998**, in **Albena, Bulgaria**.
5. Parasietendag (Parasitic day) on 2 November **1998**, at the Royal Tropical Institute, Amsterdam**, The Netherlands.**
6. Tropentag 98, "Stabilisierung und nachhaltige Entwicklung land- und forstwirtschaftlicher Systeme in den Tropen, 3-4 Dezember **1998**", Tropenzentrum, Georg-August-Universität, Göttingen, **Germany.**
7. X International Symposium on Biological Control of Weeds, 4-14 July **1999**, Bozeman, Montana, **USA**.
8. „Fusarien – Symposium" , 02.12.**1999**, Universität Hohenheim, Stuttgart, **Germany.**
9. „ V International Bioherbicide Group Workshop", 5 – 6 June **2000**, Foz Do Iguacu, **BARAZIL**.
10. Third International Weed Science Congress – IWSC", 6 – 11 June **2000**, Foz Do Iguacu, **BARAZIL**.
11. „Symposium 2000, Adapted Farming in West Africa: 15 Years of Research Results Offering New Perspectives for the Future", 5 – 7 July **2000**, Universität Hohenheim, Stuttgart, **Germany.**
12. „Deutscher Tropentag 2000" International Agricultural Research: A Contribution to Crisis Prevention, 11 – 12 October **2000**, Universität Hohenheim, Stuttgart, **Germany.**
13. Workshop: Host-Parasite Interactions in Parasitic Flowering Plants, 7. February **2001**, University of Hohenheim, Stuttgart, **Germany.**
14. Arbeitskreis Mykologie / Wirt-Parasit-Beziehungen, 15-16 March **2001**, University of Hohenheim, Stuttgart, **Germany.**
15. 7th International Symposium on Parasitic Weeds, 3-8 June, **2001**, Nantes, **France**.
16. NATO Advanced Research Workshop: Enhancing biocontrol agents and handling risks, June 9-15, **2001**, Hotel Villa Pitiana, Donnini, Florence, **Italy**.
17. The practice of biological control: importation and management of natural enemies and agents, August 2-5, **2001**, Montana State University, Bozeman, Montana, **USA.**
18. 12th European Weed Research Society Symposium, June, **2002**, Wageningen, **The Netherlands.**
19. 2nd joint meeting of working groups 2 and 4 of COST Action 849, Parasitic plant management in sustainable agriculture, June, **2002,** Obermarchtal, **Germany**.
20. XI International Symposium on Biological Control of Weeds, 27 April- 02 May **2003**, Canberra, **Australia**.
21. VI International Bioherbicide Group Workshop", 27 April **2003**, Canberra, **Australia**.
22. Biological control working group (WG2) of COST 849 action meeting entitled "Synergistic use of biocontrol agents for parasitic plant management", 27-29 February **2004**, Rome, **Italy**.
23. SAFE Consortium "European Excellence in Food Safety" Seminar Series 5 entitled "Contaminants and influence of agricultural practices - mycotoxins; chemical contaminants; microorganisms" March, 18-19, **2004**, Brussels, **Belgium**.
24. 4th International Weed Science Congress – IWSC - 20-24 June **2004**, Durban, **South Africa**.
25. 1st International Parasitic Plants Society (IPPS) Workshop, 25 June **2004**, Durban, **South Africa.**
26. Jahrestagung 2005 der Alexander von Humboldt Stiftung, 30 June- 02 July **2005,** Berlin, **Germany.**
27. „Deutscher Tropentag 2005" The Global Food & Product Chain – Dynamics, Innovations, Conflicts, Strategies, 11 – 13 October **2005**, Universität Hohenheim, Stuttgart, **Germany.**
28. Einführungstagung der Alexander von Humboldt Foundation, 13-15 October **2005,** Mainz, **Germany.**
29. 23rd German Conference on Weed Biology and Weed Control, March 7th – 9th, **2006**, Universität Hohenheim, Stuttgart, **Germany**.
30. FAO regional technical meeting within FAO *Striga* project TCP/RAF/3008 for West African Countries (*Atelier sous-régional sur la gestion intégrée durable en agriculture des espèces du genre Striga)* on *Striga* control, 25-27 April **2006, Cotonou** "Le Chant d'Oiseau", **Benin.**
31. Deutscher Tropentag 2006 "Prosperity and Poverty in a Globalized World – Challenges for Agricultural Research", University of Bonn, **Germany**, 11 - 13 October 2006.
32. International Symposium on Integrating New Technology for Striga Control: Towards Ending the Wicht-hunt. November 5-11, 2006, Addis Ababa, **Ethiopia**.
33. XII international Symposium on Biological Control of Weeds, 22-27 April **2007**, Montpellier, **France**.
34. VII International Bioherbicide Group Workshop (VII IBGW), 22 April **2007**. Montpellier, **France**.
35. "9th World Congress on Parasitic Plants", June 3-7, **2007**. Omni Hotel, Charlottesville, Virginia, **USA**.

36. Deutscher Tropentag 2007 “Utilisation of diversity in land use systems: Sustainable and organic approaches to meet human needs”, Witzenhausen, **Germany**, October 9-11, **2007**.
37. 5th International Weed Science Congress “Weeds – local problems/global challenge” Vancouver, **Canada,** 23 - 27 June **2008**.
38. Deutscher Tropentag 2008 “Competition for Resources in a Changing World: New Drive for Rural Development”, University of Hohenheim, **Germany,** October 7 - 9, **2008**.
39. "10th World Congress on Parasitic Plants", 8 to 12 June, **2009** Kusadasi, **Turkey.**
40. 2nd International Conference on Applied Biotechnology "Biotechnology for Sustainable Human Society", October 25-27, **2010**, Khartoum, **Sudan**. African City of Technology, Sudan.

FELLOWSHIPS, HONORS AND OTHER AWARDS

Period	Name, type and location of the award	Value
Nov 13,2007–Dec. 14, 2008	Approved candidate on "Inventory List" to be offered a Visiting Fellowship in Canadian Government Laboratory (**VF**), provided by the Natural Sciences and Engineering Research Council of Canada (**NSERC**), **Canada**, to promote excellence and intellectual creativity in both generation and use of new knowledge by awarding scholarships and research grants, for promising young qualified scientists.	
May 2005- May 2007	Postdoc Research Fellowship: Georg Forster Research Fellowship of the Alexander von Humboldt-Foundation **(AvH)**, Bonn, **Germany**. Within this program**, AvH** awards only 50 research scholarships per year in all discplines to highly qualified scientists from the developing countires to carry out research projects designed to promote the transfer of knowledge and new methods, and to contribute to the further development. The research project is being carried out at the University of Hohenheim, Stuttgart, **Germany.**	
Oct.97- Feb.02	Ph.D. full scholarship from German Academic Exchange Services **(DAAD)** at the University of Hohenheim, **Germany.**	
Nov. 93–June 96	M.Sc. full scholarship under German Academic Exchange Services – Natural Products Research Network for Eastern and Central Africa scholarship programme **(DAAD-NAPRECA),** Addis Ababa University, **Ethiopia.** Eight months of which at the Uni. of Hohenheim, **Germany**	
10-21 June 96	Full scholarschip from Detusche Gesellschaft für Technische Zusammenarbeit (**GTZ)** and the International Maize and Wheat Improvement Center (**CIMMYT)** to participate in the 4th International Training Course on: Biology and control of parasitic weeds, at Kenyan Agricultural Research Institute (KARI), **Kenya**	
May-June 89	Particial financial award from International Association for Exchange of Students for Technical Experience **(IAESTE),** to obtain a four weeks technical experience at the Department of Agricultural Botany, Queen's University of Belfast, Northern Ireland, **United Kingdom**.	
Other awards		
June 2004	Full financial support from **CTA'S** Seminar Support Programme, Technical Centre for Agricultural and Rural Co-operation (**CTA**), **ACP-EU** (Africa, Caribbean and Pacific), to participate in the 4th International Weed Science Congress (IWSC) and Special Symposium on Basic and Applied Aspects of Parasitic Weeds, Durban, **South Africa**	
18-19 March 04	Full financial award provided by the SAFE (Science for Safe Food in Europe) Consortium "European Excellence in Food Safety" to participate in the Seminar Series 5 entitled "Contaminants and influence of agricultural practices - mycotoxins; chemical contaminants; microorganisms" which was held in Brussels, **Belguim.** The	

	seminar aimed at evaluating the effects of changes in agricultural practices on the occurrence and accumulation of natural contaminants such as mycotoxins (pathogenic and beneficial microorganisms), organic pollutants, pesticides residues, GMOs and GMO products in foods and feeds, as well as evaluating the risks of their presence.	
April - May 03	Full financial award provided by the organizing committee (funds that designated for delegates from developing countries) and from Institute of plant production and agroecology in the tropics and subtropics (Institute 380), University of Hohenheim to particpate in the XI International Symposium on Biological Control of Weeds, **Australia.**	
24-27 June 02	Full financial award from the European Weed Research Society (**EWRS**) to participate in the 12th EWRS Symposium,**The Netherlands**	
2001 and 2002	Reserach grant from Saat-und Erntetechnik "SUET" GmbH, Eschwege, **Germany**.	
2-5.08.2001	Full financial support from **CTA'S** to participate in the International Symposium "The Practice of Biological Control: Importation and Management of Natural Enemies and Agents", Bozeman, **USA.**	
9-15 June 2001	Full financial support from NATO Science Program, Institute (380), and Universitaetsbund**,** University of Hohenheim, to participate in NATO Advanced Research Workshop: Enhancing biocontrol agents and handling risks, Florence, **Italy**.	
Aug -Sept. 2000	Research period at Danish Governmental Institute of Seed pathology for Developing Countries (DGISP), Copenhagen, **Denmark**, sponsored by **DAAD** and **DGISP**.	
6 – 11 June 00	Full financial award from the International Weed Science Society to participate in the III International Weed Science Congress, **Brazil.**	
4-14 July 99	Full financial support from the Organizing Committee of the X International Symposium on Biological Control of Weeds (XISBCW) & the Universitaetsbund**,** Hohenheim, Germany, the to participate in XISBCW, Bozeman, **USA**	
23-26 Sept. 98	Full financial award from **GTZ** and **DAAD** to participate in The Fourth International Workshop on *Orobanche* Research, **Bulgaria**	

PROFESSIONAL AND OTHER RELEVANT EXPERIENCES

Section 1: Other academic experiences

July 2017 - present: Managing Editor of the University of Khartoum Jouranal of Agricultural Sciences. Published by the faculty of Agriculture, University of Khartoum, Sudan.

April 2017 – Present: Member of the Higher Committe of the Faculty of Agriculture Forum. The Forum is initiated by the Faculty of Agriculture of the University of Khartoum, as a premier event where sustainable agriculture and environmental challenges in Sudan are debated. Every month, experts, professionals and luminaries from various leading agricultural national institutions, their partners, the food/farming chain, and businesses from every agricultural sector present their diverse views to a packed auditorium.

Section 2: Organization and moderation of international training courses experience on biological control

Under the technical supervision of Plant Protection Service (AGPP) of Food and Agriclure Orgnazation of United nation (FAO) and in close collaboration with ICARDA, I have been selected as an international expert to conduct an international training course on biological control of parasitic weed *Orobanche* within the framework of the FAO regional project TCP/INT/3004, held in Rabat, Morocco, September 2005. I acted as moderator and facilitator of the course responsible for organizing, planning and preparing the content and the program for the training course, giving lectures and practical work, and presenting a technical report at the end of the mission. The project TCP/INT/3004 was designed and based on Training of Trainers (TOT) and Farmer Field Schools or similar experimenting farmers groups (FFS) established for an effective implementation of Integrated *Orobanche* Management Practices. A total of 16 participants (reserachers and high level extension staff at least MSc level) from 7 countries belonging mainly to North and East Africa but also few to West Asia were trained. The participants were shortly introduced to biology and ecology of parasitic weed *Orobanche*, and trained mainly in the biological control methods including: i) Inoculative and inundative approach with insects, biology and natural efficacy of *Phytomyza orobanchias* a successful example, its limiting factors, its mass rearing and storage techniques, procedure and practical aspects of inundative release of *P. orobanchia*; ii) biological control of *Orobanche* with pathogens, mycoherbicidal approach, protocol for use of pathogens as *Orobanche* biocontrol agents, formulation and delivery of mycoherbicides: the case of *Fusarium* isolates; iii) seed treatment as anovel delivery system for *Orobanche* mycoherbicides: demonstration of the protocol; and iv) biological control research methodologies for enhancing the comprehension of scientific information presented, and participatory technology development. The output of this training course is developing and strengthening capacity building and innovative learning program in knowledge dissemination and implementation.

Section 3: Research experience

In this section, I briefly describe my research experience:

a. Recent research activities: Biological control of aflatoxins, Pathology unit/Aflasafe projects, International Institute of Tropical Agriculture (IITA), Headquarters, Ibadan, Nigeria

i. **Providing stewardship and technical backstopping for AgResults Aflasafe™ Project in Nigeria** including: supervising and monitoring with the team, proper sample collection, handling and processing of aflasafe-treated maize grains from different regions and aggregations (implementers) where aflasafe product is applied; supervising aflatoxin analysis (aflatoxion extraction and quantification) and microbial analysis (strain isolation, mutant development, complementation, aflasafe strain recovery) of collected maize grain samples; training and sensitizing the AgResults implementers on the use of Aflasafe products,; and monitoring the training and follow-up of the know-how messages delivery to farmers by implementers on the use of Aflasafe technology.

ii. **Providing stewardship and technical backstopping for aflatoxin biocontrol projects in** Ghana (co-funded by Feed the Future Africa RISING USAID project, and Meridian/PACA/BMGF). These project activities are carried by a PhD student (Daniel Agbetiameh) as part of his PhD research. My responsibilities include, preparing with the team the workplan including deliverables and budget for the activities of biological control of aflatoxins in maize and groundnut with Aflasafe GH01 and GH02 in Northern regions of Ghana under Africa Rising project; contributing in supervising and guiding the PhD student to develop and prepare all standard

protocols for establishment of field efficacy and carry-over trials and implement standard protocols for lab analyses [microbiology (strain isolation, mutant development, complementation) and chemical (aflatoxin extraction and quantification)]; supervising and monitoring production of Aflasafe products (Aflasafe GH01 and GH02) including quality control assurance, by IITA Aflasafe Manufacturing Plant, in Ibadan, for the large-scale field efficacy validation and scaling-up with complementary projects (GIZ and SPRING/Ghana) in Ghana.

iii. **Increasing awareness** and promoting the potential benefit of flatoxin biocontrol technology with different stakeholders in the maize and groundnut value chains in Nigeria (AgResults) and Ghana including regulators, researchers, extension agencies, farmers, farmer organizations, policy makers, seed companies and input suppliers through organization of training and sensitization workshops on the prevalence of aflatoxin contamination in crops; its health and economic importance to the citizenry; management and the use of Aflasafe as a mitigation strategy and possible market linkages for these crops.

iv. **Registration of aflasafe** biocontrol technology in Ghana and Burkina Faso**:** Building strategic partnership with regulatory authorities such as the EPA, PPRSD (Ghana) and INERA (Burkina Faso), and guiding the inspection of Aflasafe efficacy trials in farmer's fields and strengthening national advocacy coalitions for supporting the process of aflasafe products registration in Ghana and Burkina Faso.

v. **Evaluation of the potential use of the agricultural by-product cassava peel pellets as a delivery-carrier for aflasafe™** to replace sorghum grains, and the use of Arabic Gum (AG) as coating material (binder) for the commercial delivery of the biopesticide aflasafe™. The main focus of this investigation are i) development and optimization of seed coating protocols for coating cassava peel pellets with atoxgenic starins of *A. flavus*, through screening for suitable seed coating materials and fungal inoculums dose that support excellent colonization increase the sporulation rates and spore yield of atoxgenic starins of *A. flavus*; and ii) preparation of bocontrol formulations using cassava peel pellets and laboratory-scale procedures of aflasafe™ production. The goal is to use an agricultural by-product that is available in Nigeria and other African countries as a potential carrier of the biopesticide aflasafe™ to replace sorghum grains. This will i) allow utilization of an agricultural waste, ii) avoid competing with both food and feed chains of sorghum, and iii) ensure sustainable production of aflasafe™ at the lowest possible cost. These activities are carried with strong support of aflasafe team from lab and manufacturing plant as joint effort, and I am providing technical guidance for the team.

vi. **Scaling out of Aflasafe technology (products and know-how) in partnership with the complementary development organisations and project**: Scaling out of Aflasafe technology (products and know-how) in partnership with the GIC [Green Innovation Centre: a Ghanaian-German program assisted by the Deutsche Geselischaft für Internationale Zusammenarbeit (GIZ)] project in maize value chain and SPRING/Ghana (a USAID funded nutrition project) in groundnut in Ghana. This activity is the result of the established linkages that led by aflasafe team leader, Dr. Ranajit Bandyopadhyay, and common interest between IITA and GIZ and SPRING Ghana to promote the use of Aflasafe Ghana products to reduce aflatoxin contamination in the maize and groundnut value chains in GIZ and SPRING project areas.

b. Research activities: Biocontrol technology of Striga of ISMA project, International Institute of Tropical Agriculture (IITA), HQ, Ibadan, Nigeria

i. **Assessing biosafety** of *Striga* biocontrol agents (including their host-specificity to the genus *Striga*, impact on cereal hosts or any other associated crops and plants, production of mycotoxicin) in collaboration with the Nigerian regulatory authorities, national (IAR-ABU) and international partners (Univ. Stellenbosch), and increasing awareness and confidence of regulatory authorities and stakeholders (researchers, extension agencies, farmers, input suppliers, etc) that this technology do not cause disease on any plant other than *Striga* and does not produce any known mycotoxic compounds that threaten humans, crops or the environment., and thus safe to use.

ii. **Validating the field efficacy** and potential of biocontrol technology for the control of the root parasitic weeds Striga in Sub-Saharan Africa, and evaluating the benefit and additive value of integrating biocontrol with resistant varieties in crop rotation with legumes or imazapyr resistant (IR) maize varieties combined with seed treatment with imazapayr and other crop management practices, on *Striga* suppression and yield increase.

iii. **Studding the compatibility** of Striga- biocontrol (BC) agents *Fusarium oxysporum* f.sp. *strigae* (Foxy 2 & PSM197) with commonly used pesticides (herbicides, fungicides, insecticides, containing a wide-range of active ingredients) in the farming system of Nigeria**,** to ensure that the seed-treatment herbicides (imazapyr & metsulfuron methyl, MSM) and fungicides can be co-treated with BC agents onto maize seeds without adverse effects on BC agents and vice versa, for integrated Striga control. This study is aiming at providing a triple action seed coating package for direct control of Striga and fungal diseases of maize in Sub-Saharan Africa, and hence to contribute in improving food security and income generation.

iv. **Increasing awareness** and promoting the safety and potential benefit of biocontrol technology with different stakeholders including regulators, researchers, extension agencies, farmers, farmer organizations, policy makers,

seed companies and input suppliers through organization of framer field days, field visits to experimental sites, media interviews and production of publicity documents, including press and radio broadcasts etc.

v. **Undertaking of socio-economic and cost benefit analysis** of biocontrol technology in collaboration with our socio-economist partners (IITA, IAR-ABU). Our roles as biocontrol team are to provide socio-economist with the relevant data and information from all biocontrol trials in Nigeria including field data [field trials material (cost of maize seeds); supplies and operational costs (land preapartion, planting, weeding, fertilizers, fertilizers application, harvesting, threshing, bagging, transportation etc.); yield data, cost of biocontrol productd; and on surveys and interviews with farmers, and on current market information], *to* determine the cost-benefit and profitibility of BC technology and understanding farmer's preferences and perceptions on the Striga biocontrol.

vi. **Developing, promoting and scaling-up of Integrated control package** containing biocontrol technology and other complementary control technologies, delivered using the same input pathway and transaction and application costs, for effective and sustainable *Striga* control with active participation of researchers, farmers, community based organizations and extension agents.

vii. **Establishment of biocontrol inoculum production** and seed coating technology unit at IITA HQ in Ibadan, and optimization of cost effective mass production methods and seed coating protocols, to transfer and domesticate these technologies in Nigeria, to facilitate and strengthen Striga biocontrol and other relevant research, and to build capacity in this innovative technology. Our strategy for scaling-up the developed Striga biocontrol innovations is based on using technology appropriate to Africa in order to ensure the feasibility of sustained production of the mycoherbicide at a cost affordable to African small-scale farmers. The Striga-bioherbicide *F. oxysporum* f. sp. *strigae* is being delivered as a film-coat on maize seeds using seed treatment technology and Arabic gum as adhesive The advantage of using seed treatment technology is that it requires significantly less inoculum, establishes the antagonist at the infection sites of *Striga*, which are host roots, and provides a simple, economic and easy delivery system for subsistence farmers in SSA.

viii. **Registration of** biocontrol technology in Nigeri**a:** Promote benefit of biocontrol technology with regulators (Nigerian Agency for Food and Drug Administration and Control, NAFDAC) towards registration in Nigeria, including i) preparing and sharing the BC field efficacy trials protocol with NAFDAC; ii) guiding and demonstrating the inspection of the efficacy of biocontrol technology in farmers field trials by NAFDAC; iii) preparing and submitting to NAFDAC field validation and biosafety data and reports; and iv) preparing and submitting to NAFDAC registration dossiers with complete toxicology data and all required documents, to facilitate the the registration process of BC in Nigeria.

ix. **Monitoring the survival and persistence of biocontrol agent** (*F. oxysporum* f. sp. *strigae*; Foxy2) in rhizosphere soil of treated maize in Nigeria: collaborating with our German project partner university of Hohenheim who developed molecular detection and monitoring tools that shown high specificity to Striga biocontrol agent Foxy2, to use the developed detection tools to monitor survival and proliferation of the biocontrol agent Foxy2 in the soil of Northern Nigeria, by providing rhizosphere soil samples from different treatments of field efficacy trials of Foxy2 and different agroecological zones (AEZ) as well as all necessary information (maize variety, biocontol product used, GPS data, AEZ, collection date, location) of each individual sample. The developed molecular detection tools is also utmost important to certify inoculum quality, and validate environmental biosafety of BC agents by allowing its unequivocal differentiation from other crop-pathogenic and mycotoxin-producing *F. oxysporum formae speciales*.

x. **Evaluation of the pathogenicity and** virulence of the newly isolated indigenous *F. oxysporum* f.sp. *strigae* strains collected from Striga plants and different Agro-ecological zones in Nigeria, against Striga. The main objective of this pathogenicity study is to screen for more promising, highly virulent and aggressive Fos strains for their future promotion as bioherbicides for Striga control.

xi. **Evaluating the influence of the coating material** and herbicide dose on the efficacy of metsulfuron methyl (MSM) and imazapyr herbicides – treated seeds of the IR-Maize Hybrids in controlling *S. hermonthica*, and improving of maize performance.

xii. **Understanding the genetic diversity** in *Striga hermonthica* and the physiobiochemical relationship with host-parasite specificity for developing maize cultivars with durable resistance and adapted to different agro-ecologies where Striga is a major problem in Nigeria and Kenya. I am sharing my experience in Striga biology and actively working with Dr. Gedil (Bioscience) and Dr. Menkir (Maize unit) to achieve these research objectives.

c. Research activities: Department of Botany and Agricultural Biotechnology, Faculty of Agriculture, University of Khartoum, Shambat, Sudan

My research activities focus mainly on ecological weed management, that include:-

i. **Conducting intensive surveys in crop and vegetable production areas in Khartoum Staste for microorganisms pathogenic to noxious weeds mesquite *(Prosopis* spp.*),* siddig "nut grass" (*Cyperus***

***rotundus*), *Striga* spp. and *Orobanche* spp. for the purpose of their isolation, identification and exploration of their potential as biological control agents:** Purification, identification and classification of the isolated pathogens, maintenance of their culture collections and inoculum mass production were done. Pathogenicity tests (laboratory and greenhouse experiments) to screen for promising fungal pathogens were carried out.

ii. **Scaling-up and promoting of mycoherbicide innovations (biopesticide) for the control of the Parasitic Weed, *Striga hermonthica*, in East Africa:** an Industrial approach for transferring, and scaling-up of innovative technologies (bioherbicides products) into practical field application for research optimization and commercialization in collaboration with relevant international industry and companies in the field of bio-pesticides in Kenya (Real IMP) to adapat the innovative technologies for *Striga* control in Africa.

d. Postdoctoral research activities: Institute of Plant Production and Agroecology in the Tropics and Subtropics, University of Hohenheim, Germany

My postdoctortal research, which focued mainly on ecological weed management, delt with the development of easy, effective and inexpensive formulations and delivery systems of biocontrol agents for *Striga* for large-scale application in Africa. In addition, extensive basic relevant research aiming at facilitating and enhancing the field application of the developed *Striga*-mycoherbicides products (*F. oxysporum* f.sp. *strigae*) were carried out as well. My research activities during my employment period at Hohenheim University and my stay as an Alexander von Humboldt Foundation (AvH) Research Fellow (Postdoc), can be summarized as follows:-

I **Enhancing and optimizing the efficacy of *Striga* mycoherbicides:** Virulence of a mycoherbicidal fungus is related to the rate of germination, penetration and extracellular degrading enzyme production, degradation of induced and pre-formed plant defences, and/or toxin production. Understanding the mechansims involved in these processes should facilitate more effective ways and means as additive and/or synergy for improving virulence and efficacy of *Striga* mycoherbicides. Therefore, for optimising the conditions that increase the efficacy of both seed treatment and Pesta formulation, the following options were studied: i) Synergy between *Striga*-mycoherbicides and nitrogen fertilizer (urea); ii) Synergy and compatibility between *Striga*-mycoherbicides and Resistant Cultivars and iii) Effect of different seed coating material.

II **Inoculum mass production:** Optimising the fermentation conditions that enhance the mass-production of the fungal inoculum using agricultural by-products as liquid and/or solid substrates and industrialized fermenter for economical large scale application such as effect of various substrates, synergistic effect of the fungal isolates combination etc.

III Optimization of storage conditions for long-term viability (shelf-life) of *Striga*-mycoherbicidal products: i) Studying the effect of the fungal inoculum, concentration of urea, vacuum-packaging system and storage temperature on viability and shelf life of the formulated *Striga*-mycoherbicides into Pesta granules during storage; and ii) Determining the combined effect of fungal inoculum, concentration of fungicides, vacuum-packaging system, storage temperature and coating material on the survival (shelf-life) of *Striga*-mycoherbicides on film-coated sorghum seeds during storage.

IV Histological/Anotomical studies using light, scanning and transmission electron microscopy: Are essential for in-depth understanding of the pattern of infection and penetration process of fungal isolates into the tissue of its target weed, *Striga*. This may provide basis and clues for enhancing the efficacy of the formulated mycoherbicides by adding some additives that facilitate the penetration processes and/or minimizing any future resistance that might occur. Also the histological studies are important for better understanding of the interaction and association between the fungal isolates and the roots of sorghum and maize when delivered as seed treatments. A large number of samples collected from different experiments (*in vitro*, root chamber and pot trial) was prepared for microscopic examinations including fixation, embedding, sectioning, staining, mounting coverslips and sputtering. Thereafter, the following investigations were carried out: i) Studying the ability of Foxy 2 hyphae to penetrate and survive in the sorghum root tissues using light-microscopical methods, scanning and transmission electron microscopy; ii) Following the infection and penetration process of Foxy 2 into the tissue of its target weed, *S. hermonthica*; and iii) Describing the pattern of sorghum root penetration "colonization" by Foxy 2 as non-pathogenic strain in comparison with its pattern of infection as a host-specific pathogenic strain on *S. hermonthica* tissues.

V Molecular characterization of *Striga*-mycoherbicides: Characterizing of *Striga*-mycoherbicides "fungal pathogens" using molecular biology tools such as (DNA extraction, purification, fingerprinting and phylogentic trees) and their application and usage for facilitating biological control research especially for scanning for the persistence of the bioagents in the soil as well as for determining of their concentration on coated seeds and per gram of granular formulation (quality control). The regulatory approvals required for each strain is the primary reasons for the underemployment of pest and plant disease biocontrol. Therefore, molecular markers can also verify the environmental biosafety of the mycoherbicdes and that will facilitate the acceptance and introduction of *Striga*-mycoherbicides a cross-countries for practical field testing and application by regulatory authorities and farmers.

VI Compatibility between *Striga*-mycoherbicides and fungicides delivered using seed treatment technology for controlling *Striga* and some cereals fungal diseases: With the aim of improving sorghum and maize performance

and yield, an investigation on the possibility of delivering both *Striga*-mycoherbicides and some selected fungicides using seed treatment technology to control simultaneously *Striga* and some sorghum and maize fungal diseases was made for the first time. The fungicides were chosen according to their target organisms, their seed treatment delivery system, and their frequency in application on fields where biocontrol with *F. oxysporum* is applied. Hene, the following investigations were carried out: i) Determing the effect of fungicides on mycelial growth and sporulation of Foxy2 and PSM197 applied as seed treatment; ii) The effect of fungicides on sorghum seed germination and seedling vigour; iii) Studing the efficay of different seed treatments made with fungal mycoherbicides Foxy 2 and PSM197 in combination with different concentration of fungicides in controlling *Striga* in pot trials.

VI **Integration with other technologies "*Striga* control methods" under filed conditions:** Integrating *Striga* mycoherbicidal formulations (Pesta & seed treatment) with existing *Striga* control measures such as sorghum and maize resistant varieties as well as with some selected fungicides using seed treatment technology to control simultaneously *Striga* and sorghum and maize fungal diseases under field conditions of West Africa was undertaken in collaboration with the International Institute of Tropical Agriculture (IITA).

VII **Scaling-up and commercialization of mycoherbicide innovations for the Parasitic Weed, *Striga hermonthica*, to enhance food security in Sub-Saharan Africa:** an Industrial approach for transferring, and scaling-up of innovative technologies (bioherbicides products) into practical field application for research optimization and commercialization in collaboration with relevant bio-pesticides companies (SUET, Prophyta) in Germany and other countries to adapat the innovative technologies for *Striga* control in Africa.

e. Research period at the Danish Governmental Institute of Seed pathology for Developing Countries (DGISP), Copenhagen, Denmark, and thereafter at the University of Hohenheim, Germany: Seed treatment technology

Investigation on the possibility of using seed treatment technology as a novel approach for delivering *F. oxysporum* "Foxy2" to control *Striga* was carried out. By coating the sorghum seeds with *F. oxysporum* Foxy2 the fungal pathogen could be introduced to the infection sites of *Striga*. In this way, the pathogen has an opportunity of being the first colonizer of the host roots, and protecting the germinated seedlings from *Striga* attack. Therefore, the research investigated the following i) development and optimization of seed coating protocols for Foxy2 through screening for suitable seed coating materials (adhesives) and fungal inoculum; ii) importance of inoculum type on the survival of Foxy2 during seed coating process as well as during storage of coated seeds as affected by the storage temperature; (iii) ability of Foxy2 to colonize the root system of the host plant; and (iv) the efficacy of coated sorghum seed with Foxy 2 for the reduction of *S. hermonthica* infestation in pot and root chamber trails.

These investigations resulted in the selection of appropriate seed coating materials and a suitable type and form of fungal inoculum. In addition the technique provides an optimized coating protocol for liquid application of dry and fresh microbial preparation (inoculum) of *F. oxysporum* Foxy2 to sorghum seeds. This technique includes several steps starting by formation of the microbial inoculum, coating the seeds with a mixture of the microbial inoculum and adhesives effective for enhancing survival of the microorganisms and drying the coated seeds. The fungal antagonist *F. oxysporum* Foxy2, was used as the microbial agent, the coating materials tested were gum arabic, carboxymethylcellulose (CMC1%, 2%) and pectin (LS 440, LM-5 CS 1%), while the fungal inoculum included fresh and dried chlamydospores produced using different substrates (agricultural byproducts: maize straw and wheat-based stillage) and microconidia. Coated seeds made according to this process maintained a high rate of germination, fungal survival and shelf life and high ability for colonizing all roots even root tips and hairs of the host (sorghum), thereby meeting the criteria of being a promising candidate for controlling *Striga* when applied as a seed treatment. This efficient delivery system will contribute to a more practical application of various antagonistic microorganisms (bacteria & fungi) to control different root parasitic weeds, seed- and soil-borne diseases and nematodes within an integrated control approach adoptable and acceptable to subsistence farmers.

f. PhD research: Institute of Plant Production and Agroecology in the Tropics and Subtropics, University of Hohenheim, Germany

Developing a formulation for microbial weed control agents is very essential for their storage, application and protection against environmental constraints. My PhD research focused on the development of an effective, economically feasible and environmentally friendly bioherbicidal formulation for the control of the parasitic weed *Striga*. During this research period, numerous laboratory and greenhouse experiments were conducted. As a prerequisite, an attempt was made to assess the host specificity of the potential biocontrol agent, *Fusarium oxysporum* "Foxy2" by quantifying its ability to attack non-target species, i.e. other closely related species to the target weed *S. hermonthica*, some selected Poaceous crops, crop species reported to be highly susceptible to *Fusarium* diseases in tropical and subtropical regions, as well as economically important cultivated crops. Since a critical requirement for the development of a mycoherbicide is

inoculum mass production, different substrates (agricultural by-products and synthetic) and the conditions that influence the production of spores, especially chlamydospores, of Foxy2 were investigated and optimized. The substrates tested were maize straw; cotton seed cake, wheat and triticale stillage as well as Czapek (Cz) broth. The efficacy of different granular formulations of Foxy2 including sodium alginate pellets; vermiculite; and ''Pesta'' granules in comparison to the fungal inoculum propagated on wheat grains, on *S. hermonthica* was intensively investigated also. Furthermore, the effect of the propagule type, inoculum concentration and application dose on the efficacy of wheat flour-kaolin ''Pesta'' granules for the control of *S. hermonthica* was studied. The propagules tested included dried and freshly prepared chlamydospore-rich biomass, microconidia and a mixture of mycelia and microconidia. Maximizing the shelf-life of the "Pesta" products containing Foxy2 is very essential for commercialization, therefore, the effect of inoculum type and concentration, temperature, granule size and water activity on the viability of Foxy2 encapsulated in "Pesta" granules during storage was investigated as well.

g. MSc research: Faculty of Science, Addis Ababa University, Ethiopia and Hohenheim University, Germany within the research program of the Supra-regional -GTZ- project

My MSc research entitled "An investigation on the possibilities of biological control of *Orobanche* spp. in Ethiopia" was conducted in Ethiopia (field survey) and in Germany, University of Hohenheim, (lab. and greenhouse experiments). In the course of my study, intensive surveys were conducted in tomato production areas for microorganisms pathogenic to *Orobanche* spp. for the purpose of their isolation, identification and exploration of their potential as biological control agents. Thereafter, isolation, purification, identification and classification of the pathogens associated with diseased *Orobanche* plants were carried out. Maintenance of their culture collections was done, single spore isolates and inoculum mass production were also prepared. Pathogenicity tests (laboratory and greenhouse experiments) were performed to screen for promising fungal pathogens.

Section 4: Most significant contributions to research and development

Most of my research findings were published in well recognized international scientific journals and/or presented in international conferences (see publication list). Here I describe in brief some of the most significant contribution to research and development.

1. **Elzein, A.E.M. (2003).** Development of a granular mycoherbicidal formulation of *Fusarium oxysporum* "Foxy 2" for the biological control of *Striga hermonthica*. *In* "Tropical Agriculture 12 – Advances in Crop Research (2)" (J Kroschel, ed.). Margraf Verlag, Weikersheim, Germany. 190 pp., ISBN 3-8236-1405-3.

Importance: This book presents a strategy of developing inoculum mass production techniques using inexpensive locally available agricultural by-products and a simple concept and technology for a biodegradable granular formulation of *Fusarium oxysporum* "Foxy2". Foxy2 is a fungal antagonist of *Striga hermonthica*, a root parasite of cereal crops that constitutes a major biotic constraint to food production in the Sahelian and the Savannah zones of Africa, where the livelihood of 300 millions of people is adversely affected. By adopting "Pesta" formulation technology for the first time for parasitic weeds, a dramatic reduction in the required end-use dosage of fungal inoculum could be achieved, offering a significant economical practical possibility for large scale application. Storage conditions for long shelf-life of Foxy2 "Pesta" products were optimized as well. Valuable suggestions are also made for research to further enhance the efficacy of the products, as well as to improve the delivery of the mycoherbicide using seed treatment technology. The book intends to contribute to a more practical application of Foxy2 as potential mycoherbicide against *Striga* within an integrated control approach adoptable and acceptable by subsistence farmers.
Role in research: My original Ph.D. research project.
Contribution to writing of the book: Author

2. **Elzein, A.,** J. Kroschel and V. Leth **(2006):** Seed treatment technology: an attractive delivery system for controlling root parasitic weed *Striga* with mycoherbicide. **Biocontrol Science and Technology,** 16 (1) 3-26.

Importance: Coating sorghum/maize seeds with bioherbicidal antagonists for the control of the root parasitic weed *Striga*, appears to be an attractive option for minimizing the inoculum amount, establishing the biocontrol agent in the potential infection zone of the host plants, and offering a simple, easy and economical delivery system. This paper represents the first detailed investigations dealing with the possibility of delivering antagonistic agents for root parasitic weeds using seed treatment technology, which resulted in the selection of appropriate seed coating materials and a suitable type and form of fungal inoculum. Since appropriate formulations and delivery system are the key elements in performance of mycoherbicides in the field, this delivery system intends to contribute to a more practical field application, a key obstacle, for the use of mycoherbicidal antagonist for biocontrol. This innovation of delivering bioherbicides by seed technologies has many advantages: non-toxic; relatively cost effective; can be produced on a large scale; convenient to store; and simple to use. In addition, the pre-coated seeds are more appropriate to be sown using the existing agricultural machinaries, and can be easily integrated with existing control methods e.g. cultural, mechanical

and use of resistant varieties. With the help of this innovation an integrated control approach adoptable and acceptable to subsistence farmers could be realized, and it is hoped, it will be the key to successful use of antagonistic microorganisms (bacteria & fungi) to control different root parasitic weeds, seed- and soil-borne diseases, and nematodes.
Role in research: all experimental work were carried out by first author.
Contribution to writing of the manuscript: First author. The constructive criticims and fruitful discussion of the 2nd and 3rd authors improved the paper significantly.

3. **Elzein, A.EM.** and J. Kroschel **(2006)**. Host range studies of *Fusarium oxysporum* "Foxy 2": an evidence for a new *forma specialis* and its implications for *Striga* control. **Journal of Plant Diseases and Protection** 20, 875-887.

Importance: The acceptance and implementation of inundative biological control by regulatory authorities are based on the safety issues which include avoidance of any non-target adverse effects associated with the use of biological control agents. Therefore, in this paper, we attempted to assess the host specificity of *F. oxysporum* "Foxy2" by quantifying its ability to attack non-target species including two *Striga* species. The ability of Foxy2 to control more than one *Striga* species (*S. hermonthica* and *S. asiatica*, the latter was reported to be susceptible for the first time) together with the non-susceptibility of a wide range of non-target test plant species to the fungus, which was also proved, provides an opportunity to control both parasites simultaneously in those regions where they are co-existing. This advantage may encourage the regulatory authorities to accept and introduce the antagonist for field testing.
Role in research: all experimental work were carried out by first author.
Contribution to writing of the maunscript: First author. The constructive criticims and corrections of the 2nd author improved the paper quality significantly.

4. **Elzein, A.E.M** and J. Kroschel **(2003)**. Progress On Management Of Parasitic Weeds. In: *Addendum To Weed Management For Developing Countries***. FAO Publication**, pp. 109-144.

Importance: Parasitic weeds of the genus *Orobanche* and *Striga* are considered among the most serious agricultural pests of economic importance in many parts of the world. Over the last decade and with help of innovative technologies, basic and applied research have generated a wealth of scientific knowledge for better understanding and improving sustainable integrated parasitic weed management. The significant progresses achieved in the various individual parasitic weed control measures was summarized and discussed in this contribution, and may be of high relevance to contribute to the success of any proposed and/or applied integrated control approach through the accommodation of newly adaptive and applicable components. Accordinglly, valuable suggestions and strategies about how to utilize these progresses to formulate successful integrated control methods economically accessible and acceptable to the subsistence farmer's cropping systems, local needs and preferences, were proposed.
Role in research: review manuscript.
Contribution to writing of the book chapter: As a first author, I prepared appoximately 80% of the manuscript. The addition and corrections of the 2nd author compled the quality chapter.

Section 5: Academic and teaching activities at different Universities in Sudan and Germany

Since graduation, I worked at different universities in the Sudan as teaching assistant, and thereafter as lecturer, assistant and associate professor. I have also worked at the University of Hohenheim, Germany as a scientist. This working experience can be summarized as follows: i) Conception, updating and teaching biological control, agricultural biotechnology, crop protection and botany courses, plant ecology, weed science, weed control, ii) conducting research, supervising graduate students and organizing other activities e.g. seminars, workshops and field days etc., iii) prepar ation and writing up of research projects, scientific manuscripts including papers, poster and oral presentations, and iv) preparing and demonstrating laboratory and greenhouse materials for practical courses. I have also contributed to the teaching activities of the Department of Agronomy of the Institute of Plant Production and Agrarecology in the Tropics und Subtropics (380) for three successive academic years (2005/2006/2007/2008). I taught the part dealing with *pest and weed biological control* of the Module 5104 **"***Advanced Crop Production Methods"*. Module 5104 is one of the compulsory modules of the international English M.Sc. Program entitled "*Agricultural Sciences, Food Security and Natural Resource Management in the Tropics and Subtropics*" offered by the Centre for Agriculture in the Tropics and Subtropics (790), Faculty of Agricultural Sciences, University of Hohenheim, Stuttgart, Germnay.

Section 6: Capacity building (training of postgraduates)

I am sharing my technical experience in the field of biological control and Striga research to contribute in enhancing capacity development of a number of postgraduate students through supervision and co-supervision of PhD, MSc & BSc research projects:

1. PhD research: Agbetiameh Daniel (2014 – present).Topic: Development and evaluation of a biocontrol product (the Ghanaian aflasafe GH01) for the mitigation of aflatoxins in maize and groundnuts in Ghana. Kwame Nkrumah

University of Science & Technology (KNUST–Kumasi), Ghana. Supervisors Dr. R Bandyopadhyay, Prof. RT Awuah.

2. PhD research: Unachukwu, Nnanna (01/02/2013 – 31/01/2017). Topic: Assessment of genetic diversity in striga hermonthica and the physiobiochemical relationship between observed ecotypes in Nigeria and Kenya and resistant maize lines. University of Ibadan, Nigeria. Supervisors Dr. M. Gedil, Dr. A. Menkir & Dr. A. Elzein.
3. MSc thesis: Azeez, Moriam Iyabo (01/07/2014 - 31/12/2015). Topic: Influence of seed coating material on the efficacy of methyl sulphuron methyl and imazaphyr herbicides in controlling Striga in IR maize, University of Ibadan, Nigeria. Supervisors Dr. A. Elzein & Dr. A. Menkir (IITA).
4. PhD research: Ndambi, B. (2008-2011). Topic: Investigating the mode of action of the mycoherbicide *Fusarium oxysporum* f.sp *strigae* on *Striga* parasitizing sorghum and its implication for *Striga* control in Africa. The student was co-supervised by Prof. G. Cadisch, Prof. O. Spring, Dr. A. Heller and Dr. A. Elzein. University of Hohenheim, Stuttgart, Germany. The PhD thesis link is: http://opus.ub.uni-hohenheim.de/volltexte/2011/665/pdf/NdambiBeni_PhD_Thesis_Final_2.pdf
5. MSc thesis: Ndambi, B. (2007): Topic: An anatomical study on the colonization of *Fusarium oxysporumm* f.s. *strigae* (Foxy 2) on Sorghum root and its penetration into the shoot of *Striga hermonthica* using seed treatment technology. The student was co-supervised by Dr. A. Elzein, Dr. A. Heller and Prof. G. Cadisch, University of Hohenheim, Stuttgart, Germany.
6. BSc dissertations: Supervised the following BSc dissertations: i) Evaluation of local sorghum varieties for resistance to Striga, by Awad Ali & Issa Omar. Department of Botany and Agricultural Biotechnology, Faculty of Agriculture, University of Khartoum, Shambat, Sudan. July 2009: ii), Isolation and exploration of potential antagonists as biological control agents for Striga in Sudan, by Safa A. Department of Botany and Agricultural Biotechnology, Faculty of Agriculture, University of Khartoum, Sudan. 2009-2010.

I am sharing my technical experience, protocols, data, etc. in the field of Striga biocontrol technology to contribute to the training/capacity building of the following trainees:

7. PhD research: Bello Hassan (2012 – present). Topic: undertaking of socio-economic analysis, to understand farmer's preferences and perceptions on the Striga control technologies being disseminated including biocontrol technology. University of Natal, South Africa.
8. MSc thesis. Madelein du Plessis (Dec 2012 – Feb 2015). Topic: Studying the genetic diversity and pathogenicity of indegious Fusarium oxysporum f. sp. strigae (Fos) strains collected from diseased striga plants from Nigeria and Kenya. Stellenbosch University, South Africa: The student is supervised by Prof. Altus Viljoen, Department of Plant Pathology.
9. Azeez, Moriam (Feb 2012 -Feb. 2013). Trained in mechanism (s) of resistance in maize to Striga at IITA HQ in Ibadan, Nigeria, within the National Youth Service Corps (NYSC). Co-supervised with Dr. Menkir.
10. Kellechi, Ugwu (Feb 2012 -Feb. 2013).Trained in Striga biocontrol technology and field efficacy evaluation in Nigeria at IITA Kano, within the National Youth Service Corps (NYSC). Co-supervised with Dr. Oluoch.

Examiner:

1. Internal examiner for MSc thesis: Evaluation of the efficacy of four products of Pendimithalin herbicide on weed control on transplanted Onion, by Iman Mohammed Abdo Elrahim Mohammed. Graduate College, University of Khartoum, Khartoum, Sudan. 25 Janouary 2010.

Section 7: Communication skills and experinces:

During the last 16 years I had the opportunities to participate and present research results in international conferences and symposia on biological control of weeds, phytopathology, weed science and relevant disciplines in many countries including USA, Australia, Germany, Canada, France, Italy, Brazil, the Netherlands, South Africa, etc. I attanded and participated in 38 international conferences and symposia and presented 38 conference papers. My contributions to these conferences were oral presentations, posters and active participation in the disscusion groups. At these conferences, I gained a lot of new information and ideas from the excellent presentations and fruitful discussions with the experts in the field of weed science, biological control, plant pathology, mycoherbicide development and integrated pest management. I had the opportunities to meet and to start a strong linkage with many international professional agriculturists, that enabled me to collaborate with many international institutions. My activities in the scientific arena are not limited to journal and conferences. I am a member of 8 scientific societies. Through their newsletters and electronic discussion boards, I communicate and exchange ideas, research news and findings, discussion etc. with all groups.

Additional communication experiences include: i) organization of a number of framer field days, field visits; ii) hosting professional visitors (Directors, Scientists, EAs, etc.) and guiding of field tours; iii) contributing to a series of media interviews including press and radio broadcasts etc.; and iv) participating and hosting meetings with scientists, regulatory

authorities, seed and biopesticide companies, donors to share progress, discuss challenges, initiate and strengthen collaboration for promotion of the of Striga biocontrol technology.

I have also worked with the IITA Communication Office in developing a Communication Advisory Brief, introducing the new Striga biocontrol product, to name a brand and trademark for the Striga biocontrol product for its registration by the Federal Ministry of Commerce and Industry, Nigeria, to facilitate full registration.

Section 8: Resource mobilization:

I have contributed to different proposal/concept notes development.

- I have represented IITA aflasafe team, and actively contributed to the proposal development of the emerging Phase II proposal for the Africa RISING project in West Africa during the meeting held in Accra in Ghana, 15-19 Feb 2016. Aflasafe technology is considered for Phase II of the Africa RISING program for the next coming 5 years, and thereby the scaling-out of the technology in Ghana will be given a major boost. The meeting was organized by the Feed the Future-Africa RISING program in West Africa that led by IITA and funded by USAID. The proposal will be submitted to USAID. The total funding expected for Phase II of the Africa RISING project is US$ 15 million for 5 years.
- I developed with aflasafe team (A Elzein A, Ortega-Beltran & R Bandyopadhyay) a Concept Note on Scaling out of Aflasafe technology (products and know-how) in the maize value chain in Ghana in partnership with the Green Innovation Centre. The CN was submitted to Green Innovation Centre-Ghana, a Ghanaian-German program assisted by the German Government via the Deutsche Geselischaft für Internationale Zusammenarbeit (GIZ) in March 2016. The total funding requested is US$ 60,000.
- I contributed with aflasafe team (A Elzein & R Bandyopadhyay) and prepared Project Brief on Aflatoxin management in DRC and Burundi for safer crops, better health and higher incomes, that submitted to the World bank in November 2015. The total funding requested is US$ 4 million for DRC and US$ 2.5 million for Burundi.
- I contributed with aflasafe team and other colleagues in the preparation of project proposal on Introduction and use of Aflasafe™ for the biological control of aflatoxins in main staple food crops value chains in the Democratic Republic of Congo The total funding requested is US$ 4.923 million.
- I contributed with our team members, and prepared the biocontrol component of the proposal entitled "*Scaling up Sustainable Striga Control for poor farmers in Africa*" that submitted recently to donor USAID DIV in April 2015. The total funding requested is US$ 6,000,000 for 48 months.
- I led the preparation of CN on biocontrol Component for phase 2 of ISMA project *"Achieving Sustainable Striga control for poor farmers in Africa through Integrated Striga Management in Africa"* that submitted to BMG Foundation end of July 2014. The ISMA phase 2 was not funded due to some changes and new funding priorities at the Foundation, but discussion and negotiation with BMGF is ongoing for reconsidering it for the next year 2016 funding opportunities.
- I took the initiation and lead of preparing two different CNs with our team members *on Striga biocontrol and on characterization of resistance mechanism against Striga hermonthica in maize* for BMZ Project Funding for CGIAR centers - Call 2015, submitted for IITA internal review and selection. Unfortunately our CNs were not selected by IITA PDO internal selection committee for further development into a proposal for BMZ 2015 Call. The amount of fund targeted for each CN was 1.2 million Euro.
- I developed with our team members a CN on characterization of resistance mechanism against *Striga hermonthica* in maize for the development of maize varieties and hybrids with durable resistance that submitted to BMG Foundation. The Foundation split this initiative from ISMA phase 2 and considered it as breeding component for possible additional funding and continuation in combination with DTMA phase 3.
- Small funds obtained: Euro 6.628, awarded by our DG Dr. Sanginga to buy small seed coating machine for Striga Laboratory; $7,000 support fund awarded from the common CRP3.2-Maize fund.

Section 9: Relevant Activities

Chairing Committees: Acting Coordinator of WG2 (Parasitic plant-pathogen and pest interaction working group) on behalf of Prof. Dr. J. Kroschel during the 1st Executive Board Meeting of the COST Action 849 "Parasitic Plant Management in Sustainable Agriculture" which was held in **Nantes, France**, on 8-9 June 2001. The agenda of the meeting was the presentation and approval of the tentative programs of all working groups. The project is a European cooperation in the field of Scientific and Technical research (COST) projects. COST Action 849 is divided into four working groups (WG): WG1: Biology and ecology of parasitic plants, WG2: Parasitic plant-pathogen and pest

interaction, WG3: Genetic resistance, and WG4: Integrated control. The main objective of this COST Action is to increase the understanding of the interactions between plants/hosts in order to implement sustainable means of control.

Meetings: I participated in the biological control working group (WG2) meeting entitled "Synergistic use of biocontrol agents for parasitic plant management" which was held in **Rome (Italy)**, 27-29 February 2004. WG2 is one of the working groups of COST 849 action "Parasitic plant management in sustainable agriculture". The aim of the working group meeting was to: discuss about the synergistic use of different biological agents; plan the exchange of biocontrol material; and set up common protocols to evaluate their efficacy to also achieve a synergy among the workers by starting collaborations.

Seminars: I participated in the SAFE Consortium "European Excellence in Food Safety" Seminar Series 5 entitled "Contaminants and influence of agricultural practices - mycotoxins; chemical contaminants; microorganisms" which was held in **Brussels, Belguim**, 18-19 March 2004. The seminar aimed at evaluating the effects of changes in agricultural practices on the occurrence and accumulation of natural contaminants such as mycotoxins (pathogenic and beneficial microorganisms), organic pollutants, pesticides residues, GMOs and GMO products in foods and feeds, as well as evaluating the risks of their presence. The principle objective of SAFE (Science for Safe Food in Europe) Consortium are ensuring safe food; anticipation and prevention of risk- from food poisoning bacteria, from chemical contaminants or from new technologies.

Invited lectures:

1. I have been invited by FAO as a key-note speaker to participate in FAO regional technical meeting for West African Countries (*Atelier sous-régional sur la gestion intégrée durable en agriculture des espèces du genre Striga)* on *Striga* control by given lecture on biological control of *Striga* and moderating a session on biological control. The meeting was held in **Cotonou** "Le Chant d'Oiseau", **Benin,** 25-27 April 2006, within FAO *Striga* regional project TCP/RAF/3008. My lecture entitled *"Biological control of Striga: progress and implication for practical field appication in Africa)*.
2. I have been invited by the Institute of Plant Breeding Seed Science and Population Genetics (350), University of Hohenheim, as key-note speaker to give a lecture entitled (*Progress in Striga-Mycoherbicides Research and Development: Implications and Future Prospective for Africa*) in the closing workshop of the German Ministry for Economic Cooperation and Development (**BMZ**)-funded project "*Arresting the Scourge of Striga on Sorghum in Africa by Combining the Strengths of Marker-Assisted Backcrossing and Farmer-Participatory Selection*". The meeting was held in Stuttgart, **Germany**, July 21st-25th 2008.

Section 10: Personal skills

My wide range of activities and expertise at universities, or in collaboration with research centers and development organizations, enabled me to acquirea good experience on:

- Conception and conduction of research as well as managing research findings, analysing and disseminating data and innovative research findings.
- Successful development of relevant project proposals and joined research work with other scientists in different disciplines and various development and research organizations.
- Ability to work collegially and collaboratively in a multidisciplinary and multi-cultural environment.
- Proven record in project development, management and fund raising.
- Constructing and moderating training, capacity building and innovative learing programs.
- Supervising and providing guidance to scientists, graduate students and organizing other activities e.g. seminars, workshops etc.
- Very good experienced with Windows and associated programs and statistical and data processing.
- Analysis, interpretation, and discussion of research results, presentation and discussion of research findings with both national and international audiences, as well as publishing in scientific journals and writing scientific, and administrative reports.
- Strong interpersonal relationships and communication skills. Working experience and successful communication with targeted populations in simple, understandable, persuading and acceptable manner.
- Excellent leadership and team building skills.