SWEETFUEL Project No: FP7-227422

WP 7
Task 7.5: Elaboration of a dissemination and exploitation plan
Task leaders: WIP & CIRAD

Final Plan for Dissemination and Exploitation of Foreground (D7.7)

by WIP & CIRAD

WP7 leader: WIP
Participants:
ICRISAT, CIRAD, EMBRAPA, ARC-GCI, UANL, KWS, IFEU, UNIBO

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Introduction

The **objective of SWEETFUEL** (Sweet Sorghum: An alternative energy crop) is to exploit the advantages of sweet sorghum as potential energy crop creating new varieties of sweet sorghum, better adapted to low temperature for temperate environments, and to drought and/or soil acidity for semi-arid tropics. Results of the project are expected to promote the development of bioethanol production from sweet sorghum in temperate and semi-arid regions.

In order to ensure the best possible benefits from the research results – funded by EC and consortium members - for the stakeholders, to inform policy decision making organizations, to link with the downstreamentrepreneurial initiatives, as well as to inform organizations from civil society, the consortium members develop a plan with their strategic vision for exploitation and further use of the outcomes delivered.

In FP7 there is an obligation to disseminate the foreground swiftly. In this context dissemination refers to the disclosure of project results such as scientific publications, general information on websites or conferences. FP7 SWEETFUEL WP7 activities facilitate these forms of communication.

Plan for Dissemination and Exploitation of Foreground (PUDF)

Stepwise, a Plan for Dissemination and Exploitation of Foreground (PUDF) is updated every year with data made available by the consortium members. External input may be required and presented to the participants. A first **draft PUDF** was presented to the general assembly at the meeting held in Potchefstroom (ZA), February 2011. It was drafted in compliance with the SWEETFUEL Description of Work (DoW), the General Conditions of the Grant Agreement and the Consortium Agreement. The present***FinalPlan***describes achievements with regards to dissemination, the plans and modalities for further research and/or exploitation of results.

According to EC guidelines, the PUDF is composed of two main sections.

Section A provides information about the achievements realized regarding dissemination activities.

Section B defines the foreground of the project which is considered to be potentially exploitable, either commercially or for further research.

Hence, it includes information such as IPR (Intellectual Property Rights) registration, exploitable foreground, its description and sector of application. It also explains plans for the future use of foreground, either in research and/or commercially.

Intellectual Property for Use and Dissemination Committee (IPUDC)

Confidentially issues are important when preparing and writing the PUDF. **Section A** is disclosed publicly by the EC and via the project website, while the information included in **Section B** is also made available to the public, except if clearly marked as confidential. According to the consortium agreement and the DoW, the project beneficiaries agree to avoid disclosures which could be detrimental to future filings.

A specific committee, the **Intellectual Property for Use and Dissemination Committee (IPUDC)** assists the coordinator and the beneficiaries with the dissemination of results and makes suggestions and recommendations for potential exploitation of findings of the project taking into account the legal settings of the agreements and commitment of the beneficiaries. This committee provides assistance to examine the necessity whether information and scientific results need to be kept confidential with regard to those project results for which registration is not planned yet.

Section A - Dissemination

The dissemination activities outlined in Section A are designed to complement demonstration activities and exploitation strategies of the SWEETFUEL project. Communication is an important target of this plan including links with other research projects.

1 SWEETFUEL publications, presentations and press releases

WIP and CIRAD regularly contact partners to promote high-level scientific publications in peer-reviewed international journals. Achievements are listed in Table 1.
Further dissemination activities with respect to oral presentations (Table 2a (international conferences), Table 2b (national conferences)), posters (Table 3), press releases (Table 4), participation in meetings/conferences (Table 5), scientific thesis (Table 6), the organization of workshops (Table 7), as well as technical documents (Table 8) are presented below.

Table 1: Peer-reviewed publications

Walter Zegada-Lizarazu, Andrea Monti. An integrated approach to harvest and storage sweet sorghum at farm scale. Submitted to BioEnergy Research (2014)
Dario Fernando Luna, Walter Zegada-Lizarazu, Andrea Monti. Photosynthetic acclimation of sweet sorghum under progressive water stress. Submitted to European Journal of Agronomy (2014)
Chiranjeevi T., A. Uma, K. Radhika, G. Baby Rani, M. Lakshmi Narasu, R.S. Prakasham, P. Srinivasa Rao, A.V. Umakanth (2014). Enzymatic hydrolysis of market vegetable waste and subsequent ethanol fermentation-Kinetic evaluation. Journal of Biochemical Technology (Accepted)
Luca Pasini, Mauro Bergonti, Alessandra Fracasso, Adriano Marocco, Stefano Amaducci. Microarray analysis of differentially expressed mRNA and miRNAs in young leaves of sorghum under dry-down conditions. 2014, Journal of Plant Physiology, 171 (7): 537-548.
Serge Braconnier -2014- P. Srinivasa Rao and C. Ganesh Kumar (eds.): Characterization of Improved Sweet Sorghum Cultivars. Sugar Tech, 15(3): 345-346.
K. S. Vinutha, Laavanya Rayaprolu, K. Yadagiri, A. V. Umakanth, J. V. Patil, P. Srinivasa Rao. Sweet sorghum research and development in India: status and prospects – 2014- Sugar Tech , 16 (2): 133-143
Tesfamariam, Tsehaye, Yoshinaga H., Deshpande S. P., Srinivasa Rao P., Sahrawat K. L., Ando Y., Nakahara K., Hash C. T., and G. V. Subbarao. (2014). Biological nitrification inhibition in sorghum: the role of sorgoleone production. Plant and Soil 379 (1-2): 325-335
Prakasham, R. S., Nagaiah, D., Vinutha, K. S., Uma, A., Chiranjeevi, T., Umakanth, A. V., Srinivasa Rao, P and Yan, N. (2014). Sorghum biomass: a novel renewable carbon source for industrial bioproducts. Biofuels, 5(2), 159-174
P. Munirathnam, K. Ashok Kumar and P. Srinivasa Rao 2013. Performance of Sweet Sorghum Varieties and Hybrids During Post Rainy Season (maghi) in Vertisols of Scarce Rainfall Zone in Andhra Pradesh. Sugar Tech 15: 271-277
Hilal A. Qazi, Pinnamaneni Srinivasa Rao, Akansha Kashikar, Penna Suprasanna and Sujata Bhargava. Alterations in stem sugar content and metabolism in sorghum genotypes subjected to drought stress -2014- Functional Plant Biology, 41 (9): 954-962.

Table 1: Peer-reviewed publications (cont.)

C. M. B. Damasceno · R. E. Schaffert and I. Dweikat. Mining Genetic Diversity of Sorghum as a Bioenergy Feedstock -2014- In Plants and Bioenergy, Advances in Plant Biology 4., pp81-102. DOI: 10.1007/978-1-4614-9329-7_6, © Springer Science+Business Media New York 2014
Ganesh Kumar, Srinivasa Rao P, Soma Gupta, Jayalakshmi M, and Kamal A. 2013. Enhancing the Shelf Life of Sweet Sorghum [Sorghum bicolor (L.) Moench] Juice Through Pasteurization While Sustaining Fermentation Efficiency Sugar Tech 15: 328-337
S. S. Rao , et al. 2013. Effect of Different Crushing Treatments on Sweet Sorghum Juice Extraction and Sugar Quality Traits in Different Seasons. Sugar Tech 10.1007/s12355-013-0220-2
Srinivasa Rao P and C Ganesh Kumar (Eds) 2013. Characterization of tropical sweet sorghum cultivars. Springer brief (132 Pp,)
Srinivasa Rao P., Belum VS Reddy, AV Umakanth, A Ashok kumar, Ch Ravinder Reddyand JV Patil. (2013) Sweet sorghum: genetics, breeding and commercialization In B. P. Singh (Ed). Biofuel crops: production, physiology and genetics: 172-198
G. Basavaraj, P. Parthasarathy Rao, Lalith Achoth and Ch Ravinder Reddy (2013). Assessing Competitiveness of Sweet Sorghum for Ethanol Production: A Policy Analysis Matrix Approach. Agricultural Economics Research Review. Vol. 26(No.1) January-June 2013
Vander de Souza, Rafael da Costa Parella, FlavioTardin, Marcia Costa, Geraldo de CarvalhoJr,and R. Schaffert: Adaptability and stability of sweet sorghum cultivars – 2013, Crop Breeding and Applied Biotechnology, 13: 144-151
Gutjahr S., Clément-Vidal A., Soutiras A., Sonderegger N., Braconnier S., Dingkuhn M., Luquet. D. -2013 - Grain, sugar and biomass accumulation in photoperiod-sensitive sorghums.II. Biochemical processes at internode level and interaction with phenology. Functional Plant biology, 40: 355-368
G. Basavaraj, Parthasarathy Rao P, Reddy BVS, Ashok Kumar A, BANTILAN MCS, Ravinder Reddy Ch and Srinivasa Rao P. (2013). Policy options for promotion of alternate feedstocks for ethanol production in India: Sweet Sorghum for Ethanol Production. Policy Brief No. 24. RP Markets, institutions and Policy (MIP), ICRISAT, Patancheru, Andhra Pradesh India. 6 pp
Gutjahr S., Vaksmann M., Dingkuhn M., Thera K., Trouche G., Braconnier S., Luquet. D. -2013 - Grain, sugar and biomass accumulation in tropical sorghums. I. Trade-offs and effects of phenological plasticity. Functional Plant biology, 40: 342-354
Rao S., Kumar CG., Malapaka J., Kamal A. and Reddy BVS. 2012. Effect of micronutrient treatments in main and ratoon crops of sweet sorghum cultivar ICSV 93046 under tropical conditions. Sugar Tech.14(4), 370-375
Rao S., Kumar CG., Malapaka J., Kamal A. and Reddy BVS. 2012. Feasibility of Sustaining Sugars in Sweet Sorghum Stalks During Post-Harvest Stage by Exploring Cultivars and Chemicals: A Desk Study. Sugar Tech. 14:21-25
Rao PS, Deshpande S, Blümmel M, Reddy BVS, Hash T. 2012. Characterization of brown midrib mutants of sorghum (Sorghum bicolor (L.) Moench). The European Journal of Plant Science and Biotechnology, 6 (Special issue 1), 71-75.
G. Basavaraj, Parthasarathy Rao, ChRavinder Reddy, A.Ashok Kumar, P. Srinivasa Rao, B.V.S.Reddy (2012). A review of National Biofuel Policy in India: A critique- Need for promotion of alternate feedstocks. J. of Biofuels, Volume 3, Issue 2, Jul-Dec 2012: 65-78.

Table 1: Peer-reviewed publications (cont.)

Zegada-Lizarazu W., Monti A. (2012) Photosynthetic response of sweet sorghum to drought and re-watering at different growth stages. In press in PhysiologiaPlantarumArticle first published online : 28 DEC 2012, DOI: 10.1111/ppl.12016
Zegada-Lizarazu W., Monti A. 2012. Are we ready to cultivate sweet sorghum as a bioenergy feedstock? A review on field management practices. Biomass and Energy, 40: 1-12.
Zegada-Lizarazu W., Zatta Z. Monti A. 2012. Water uptake efficiency and above- and belowground biomass development of sweet sorghum and ethanol maize under different water regimes. Plant and Soil, 351: 47-60.
SrinivasaRao P, Prasad JVNS, Umakanth AV and Belum VS Reddy. 2011. Sweet sorghum (Sorghum bicolor (L.) Moench) – A new generation water use efficient bioenergy crop. Indian Journal of Dryland Agricultural Research and Development, 26: 65-71
Parentoni S. N; de Souza Junior C. L; Alves V. M. C; Gama EEG, Coelho A. M; Oliveira A. C de; Guimarães P. E. O; Guimarães C. T.; Vasconcelos M. J. V; Pacheco C. A. P; Meirelles W. F; Magalhães, J. V. Guimarães L. J. M; Silva A. R, Mendes F. F; Schaffert R. E. 2010. Inheritance and breeding strategies for phosphorus efficiency in tropical maize (Zea Mays L.). Maydica, 55: 1-15

Table 2a: Oral presentations (International Conferences)

Braconnier S. *et al.* (CIRAD) 2014. Sweet and biomass sorghum: a good opportunity for producing energy ? 26th Annual Meeting of AAIC, Athens, Greece, September 13-19, 2014.
Braconnier S. *et al.* (CIRAD) 2014. Sweet sorghum as an alternative energy crop: results from 5 years of research (SWEETFUEL Project), 22nd European Biomass Conference and Exhibition, Hamburg, Germany, June 23-26, 2014.
Zegada-Lizarazu W. (UniBO) 2014. Agronomy of Energy Sorghum in Temperate Climates. Proceedings of the regional stakeholder workshop “Energy sorghum – an alternative energy crop for industrial use” on the occasion of the “22nd European Biomass Conference and Exhibition”, Hamburg, Germany, June 23-26, 2014
P. Srinivasa Rao Keerthi KC, Ramakrishna, Santosh Deshpande, and Stefania Grando (2014). Molecular breeding approaches in sweet sorghum. In 9th Canadian biotechnology Conference, 12-15 May 2014, Montreal, Canada
P. Srinivasa Rao P., Munirathnam, ,Vishwanath, Santosh Deshpande, Francisco Zavala, Nemera Shargie,, Vincent Vadez, Serge Braconnier and Stefania Grando (2014). Improvement of sweet sorghum for drought tolerance. In SSEA meeting, 23 January 2014, Orlando, USA
Luna DF, Zegada-Lizarazu W, Sartoni R, Vecchi A, Zaneti F, Monti A. (UniBO) 2014. Effects of Progressive Drying Up on Photosynthetic Capacity and Sugars Accumulation of Sweet Sorghum during Vegetative and Reproductive Stages. Proceedings of the plant biology Europe FESPB/EPSO 2014, Dublin, Ireland June 22-26, 2014
R. Schaffert and R. Parrella (EMBRAPA) 2014. Minimum Concepts for Ethanol Production from Sweet Sorghum in Brazil, Sweet Sorghum Ethanol Association, Orlando, January 23-24, 2014.

Table 2a: Oral presentations (International Conferences) (cont.)

Monti A. (UniBo) 2013. Sweet Sorghum as an alternative energy crop. AAIC Conference, Washington (Invited speaker) Awarded Best Oral Presentation, 12-16 October, 2013
R. Schaffert and R. Parrella (EMBRAPA) 2013. Overcoming impediments for improving agronomic and industrial traits of sweet sorghum", Sweet Sorghum Ethanol Association, Orlando, Florida, January 24-25, 2013.
Keller and Reinhardt (IFEU) 2013. Environmental impacts of second generation bioethanol: recent LCA results. In: Proceedings of the final NEMO meeting, www.nemo.eu, Nice, France, 15-16 April 2013.
Reinhardt, G (IFEU) 2013. Environmental assessment of 1st and 2nd gen ethanol: an overview. In: Proceedings of the 20th International Symposium on Alcohol Fuels (ISAF) "Alcohol fuels enabling sustainable future development", www.isaf2013.co.za, Stellenbosch, South Africa, 25-27 March 2013
Reinhardt, G (IFEU) 2013. How sustainable are biofuels from Sweet Sorghum? In: Proceedings of the Sweet Sorghum Workshop / Farmers' Day, Potchefstroom, South Africa, 21 February 2013
Reinhardt, G and Hienz (IFEU) 2013. How sustainable are 1st and 2nd generation biofuels for transportation? In: Proceedings of "Fuels - conventional and future energy for automobiles". 9th International Colloquium, 15 – 17 Jan 2013, Esslingen. Bartz (ed): Fuels – Mineral oil based and alternative fuels. pp 37-42, ISBN: 983943563047, 2013
S. Braconnier et al. (CIRAD) 2013. "What kind of competition food vs fuel in sweet sorghum ?" Sweet Sorghum Ethanol Association annual Meeting, Orlando, FL, USA, January 24-25, 2013.
R Schaffert (Embrapa) 2013. "Overcoming impediments for improving agronomic and industrial traits of sweet sorghum" Sweet Sorghum Ethanol Association annual Meeting, Orlando, FL, USA, January 24-25, 2013.
R Schaffert and J Magalhães (Embrapa) 2012. "Population Development and Phenotyping of Important Traits in Sorghum" (International Sorghum Genomics Workshop 15-16/11/2012 in Atlanta, Georgia, USA, November 15-16, 2012.
J.E. Treviño Ramírez *et al.* (UANL) 2012. Response of three population densities on sugar production in 6 sweet sorghum genotypes in Marín, N.L. México. XXIV National and IV International Congress of Plant Genetics, Monterrey, Nuevo Leon, Mexico, 24-26 September 2012.
H. Williams Alanís *et al.* (UANL) 2012. Genetic breeding in sweet sorghum of FAUANL I. A-B Line Formation. XXIV National and IV International Congress of Plant Genetics, Monterrey, Nuevo Leon, Mexico, 24-26 September 2012.
H. Williams Alanís et al. (UANL) 2012. Genetic breeding in sweet sorghum of FAUANL I. Variety formation. XXIV National and IV International Congress of Plant Genetics, Mponterrey, Nuevo Leon, Mexico, 24-28 September 2012.
K.J. Lazarin Padilla *et al*. (UANL) 2012. Estimation of sugar content in sweet sorghum hybrids in different phenological stages. XXIV National and IV International Congress of Plant Genetics, Monterrey, Nuevo Leon, Mexico, 24-26 September 2012.
F. Zavala García *et al.* (UANL) 2012. Physiological responses in sweet sorghum genotypes under soil moisture stress. XXIV National and IV International Congress of Plant Genetics, Mponterrey, Nuevo Leon, Mexico, 24-28 September 2012.

Table 2a: Oral presentations (International Conferences) (cont.)

R Schaffert (EMBRAPA) 2012. "A Changing Scenario and Increased Demand for Sweet Sorghum for Ethanol Production in Brazil" (Biofuel Crops Symposium) in Monterrey, NL, Mexico, September 24-26, 2012.

Braconnier, S (CIRAD) 2012. "Sweet sorghum: a good opportunity to produce bio-ethanol ?". IV International Congress of Phytogenetic/ Biofuel Crops Symposium), Monterrey (Mexico), September 24-28, 2012.

Rao, S (ICRISAT) 2012. SWEETFUEL Presentation participation at the stakeholder meeting of the FP7 project SAHYOG (Strengthening Networking on Biomass Research and Bio-waste Conversion – Biotechnology for Europe India Integration) in New Delhi, India, 7 November 2012.

Reinhardt, G (IFEU) 2012. Environmental implications (LCA) associated with biofuels. Presentation at the international workshop "2G bioethanol production: technological development and agroenvironmental and economic implications". Bologna, Italy, 18 April 2012.

Braconnier, S (CIRAD) 2012.Sweet Sorghum: a smart solution for bioethanol production? 9th international conference "Fuels for the future. Berlin, January 23-24, 2012.

Rettenmaier, N. (IFEU) 2011. Environmental implications associated with sweet sorghum production and use for biofuels. EUROCLIMA Workshop on the agro-environmental impact of biofuels and bioenergy (organised by JRC, UNICAMP & CTBE), Campinas, Brazil, 30 November – 1 December 2011, http://re.jrc.ec.europa.eu/biof/pdf/euroclima_brazil/rettenmaier_lca-biodiesel.pdf, 2011

R. Schaffert (EMBRAPA) 2011. "Breeding Strategies for Sorghum as a Feedstock for First and Second Generation Technologies for Production of Bioenergy in Brazil", oral presentation at the 6th Frontiers in Bioenergy: United States-Brazil Symposium on Sustainable Bioenergy, Purdue University in West Lafayette, Indiana, USA, May 15-18, 2011.

S. Braconnier (CIRAD) 2011. "Development of new sorghum ideotypes to meet the increasing demand of bioethanol". CIMAC (Crop Improvement, Ideotyping, and Modelling for African Cropping Systems under Climate Change) Workshop at University of Hohenheim, Germany, February 7-9, 2011.

S. Köppen, Dahms, T. (IFEU) 2011. Environmental Implications of Sweet Sorghum Bioethanol. Published in: W.J. Bartz [Hrsg.] (2011): Fuels 2011 - Conventional and Future Energy for Automobiles, 8th International Colloquium, January 19 - 20, 2011, TechnischeAkademie Esslingen, p. 335-342, ISBN 9783924813864, 2011.

Monti A. (2010) Ilprogetto SWEETFUEL - Sweet sorghum: an alternative energy crop. "Agroenergie e biocarburanti: le tecnologie e le prospettive di nuovimodellienergeticisostenibili" Green EnergyConference 17-19 Nov., 2010, Milano. Italy. http://www.pvtech.eu/it_esp/conf_2010.asp?conf=BIO

S. Braconnier (CIRAD) 2010. SWEETFUEL presentation at the second annual meeting of the FP7 project "4F Crops", The Netherlands, March 2010

R. Schaffert (EMBRAPA) 2010. Embrapa Energy Sorghum Research and Development Update", Sweet Sorghum Ethanol Association, January 28/29, 2010, Orlando, Florida.

Zegada-Lizarazu W., Zatta A., Matteucci D., Barbanti L., and Monti A. (UniBO) 2010. Rooting characteristics and aboveground biomass development of sweet sorghum and ethanol maize under water deficit. 18th European Biomass Conference and Exhibition, 3-7 May 2010, Lyon, France. 195-199.

R. Janssen and D. Rutz (WIP) 2010. Sweet sorghum: an alternative energy crop. 18th European Biomass Conference and Exhibition in Lyon, France, 3-7 May 2010

Table 2a: Oral presentations (International Conferences) (cont.)

S. Köppen (IFEU) 2010. Sweet Sorghum first and second generation bioethanol – an environmental perspective. 6th International Conference on Biomass for Energy, Kyiv, 14 - 15 September 2010. Conference proceedings published on CD, to be ordered via http://biomass.kiev.ua/en/en/conferences or conference@biomass.kiev.ua.

S. Braconnier (CIRAD) 2010. SWEETFUEL presentation at a round table of the 4th International Exhibition on Renewable Energies at Montpellier, 8-11 December 2010.

R. Janssen (WIP) 2010. “Sweet Sorghum: An Alternative Energy Crop” in Proceedings of the 19. Symposium BIOENERGIE, Bad Staffelstein, Germany, 25-26 November 2010.

S. Braconnier (CIRAD) 2009. Presentation and participation of SWEETFUEL at the EU-India Scientific and Technical Days in New Delhi, India, November 2009

M. Dingkuhn (CIRAD) 2009. SWEETFUEL presentation at the Seminar “Land Resources and land use options”, in Goettingen, Germany, July 2009

S. Braconnier (CIRAD) 2009. SWEETFUEL presentation in the framework of the Twinning programme ”Soil, Plant and Food Research between the EU, Argentina and MERCOSUR”, in Argentina, 7-8 May 2009

S. Braconnier (CIRAD) 2009. SWEETFUEL presentation at the first meeting of the FP7 project “4F Crops” in Madrid, Spain, March 2009

Table 2b: Oral presentations (National Conferences)

R. Schaffert (EMBRAPA) 2013. Situação do Cultivo de Sorgo no Brasil”, Seminário para Subcomissão "Sorgo” CTNBio, 20/03/2013, Brasilia – DF, Brazil.

R. Schaffert (EMBRAPA) 2012. Características desejáveis para uma boa cultivar de sorgo sacarino , Seminário Temático Agroindustrial de Produção de Sorgo Sacarino para Bioetanol, 20-21/09/2012, Riberão Preto – SP, Brazil.

R. Schaffert (EMBRAPA) 2012. Overview of the potential of sweet sorghum to produce ethanol in Brazil”, Embrapa-RDA (South Korea), Project Start-up Workshop,05-09 March 2012, Brasília- Federal District.

Robert E Schaffert (EMBRAPA) 2012. An Update on Sweet Sorghum for Ethanol Production in Brazil”. Embrapa Maize and Sorghum – CERES Meeting, 07/02/2012, Sete Lagoas, MG, Brazil.

R. Schaffert et al.(EMBRAPA) 2012. Overview of the Potential of Sweet Sorghum to Produce Ethanol in Brazil, Embrapa-Nexsteppe – Meeting, 20 March 2012, Sete Lagoas, MG.

R. Schaffert et al. (EMBRAPA) 2012. Overview of the Potential of Sweet Sorghum to Produce Ethanol in Brazil, Embrapa-Chromatin Meeting, 9 Abril 2012, Sete Lagoas, MG.

R Schaffert (EMBRAPA) 2012. “Características desejáveis para um bom cultivar de sorgo sacarino” (Seminário Temático Agroindustrial de Produção de Sorgo Sacarinopara Bioetanol) in Riberão Preto, SP, Brazil, 20 September 2012.

R. Schaffert (EMBRAPA) 2011. Breeding for tolerance to abiotic stress in sorghum – what the plant can do to improve adaptability to abiotic stresses !, 09/11/2011, UFV Vicosa, Minas Gerais.

Table 2b: Oral presentations (National Conferences) (cont.)

R. Schaffert (EMBRAPA) 2011. Sorghum Improvement for Tropical Savannas, Visit of North Korian Deligation Embrapa Maize and Sorghum, September 30, 2011, Sete Lagoas, MG.
R. Schaffert (EMBRAPA) 2011. Potencialidade do Sorgo, como matéria prima para produção de Biocombustíveis, Curso: Resíduos de Biomassa para Produção de Biocombustíveis no Maranhão, 27/09/2011, São Luis, Maranhão.
R. Schaffert (EMBRAPA) 2011. Perspectivas da Embrapa com o Projeto Sistema de Produção em Sorgo Sacarino, Reunião Embrapa/Petrobras - CENPES/PDEDS/BIO, Rio de Janeiro, RJ, 15/09/2011.
R. Schaffert and A. Porcin (EMBRAPA) 2011. Potencial do sorgo sacarino para produção de bioetanol e sua utilização na extensão da safra de cana-de-açúcar – “safrinha”, Reunião Algar, 05/08/2011, Uberlandia, MG.
R. Schaffert (EMBRAPA) 2011. Potencial do sorgo para produção de bioetanol e sua utilização na extensão da safra de produção de bioetanol de cana-de-açúcar, Reunião Embrapa x Ministerio de Minas e Energia, 11/03/2011, Brasilia, DF.
R. Schaffert and Rafael AC Parrella (EMBRAPA) 2011. Estratégias para o melhoramento de sorgo sacarino e desafios futuras, Seminário Temático – Sorgo Sacarino, Embrapa Milho e Sorgo, 20-21/09/2011, Sete Lagoas,-MG.
F. Zavala (UANL) 2010. Biotechnological Crops for Food, Forage and Bioenergy at Biocumbre Monterrey Congress, 16-17 November 2010, Monterrey, Mexico.
R. Schaffert (EMBRAPA) 2010. Pesquisa de Sorgo Como Fonte de Matéria Prima para Produção de Energia na Embrapa Milho e Sorgo, Centro de Tecnologia Canaveira CTC, 04/08/2010, CTC, Piracicaba, SP.
R. Schaffert (EMBRAPA) 2010. A experiência brasileira na produção do etanol a partir de sorgo sacarino, Seminario “Os Gargalos do setor sucroalcooleiro e as contribuições da Embrapa - UDOP”, 18/08/2010, Campo Grande, MS.
R. Schaffert (EMBRAPA) 2010. Potencial do sorgo para produção de bioetanol e sua utilização na extensão da safra de produção de bioetanol de cana-de-açúcar, Reunião Anual do Conselho Assessor Externo da Embrapa, 25/08/2010. Sete Lagoas, MG
R. Schaffert (EMBRAPA) 2010. Sorgo: Potencialidades e limitaçoes para produção de bioenergia, Congresso de Milho e Sorgo, 01/10/2010, Goiania, GO, Brazil
R. Schaffert (EMBRAPA) 2010. Simpósio Estadual de Agroenergia e 3ª Reunião Técnica de Agroenergia, Embrapa Clima Temperado, 11/08/2010. Pelotas, RG, Brazil
F. Zavala (UANL) 2009. SWEETFUEL presentation at the Annual Meeting of the RED MEXICANA DE BIOENERGIA (Mexican Net of Bioenergy) in Mexico, November 2009
W. Snijman (ARC-GCI) 2009. Potential of sorghum for bioethanol production. 13/03/2009, Potchefstroom, South Africa

Table 3: Posters

Reinhardt, G., et al. (IFEU) 2014. Sustainability assessment for sweet and biomass sorghum as energy crops. on the occasion of the “22nd European Biomass Conference and Exhibition”, Hamburg, Germany, June 23-26, 2014
Reinhardt, G., Cornelius, C. (IFEU) 2014. Environmental assessment of energy sorghum. Proceedings of the regional stakeholder workshop “Energy sorghum – an alternative energy crop for industrial use” on the occasion of the “22nd European Biomass Conference and Exhibition”, Hamburg, Germany, June 23-26, 2014
Pereira, G.S. et al. (EMBRAPA) 2013. Quantitative Trait Loci mapping for sugar-related traits in sweet sorghum based on high-density SNP markers. 21th Plant and Animal Genomes Conference, 2013/01/12-16, San Diego, California, USA.
MOURAO, C. S. et al. (EMBRAPA) 2013. Adaptabilidade e estabilidade de híbridos de sorgo granífero em condições de safrinha. In: 7° Congresso Brasileiro de Melhoramento de Plantas, Uberlândia , MG, Brazil, 05-08/08/2013.
SILVA, L. A.et al. R. E. (EMBRAPA) 2013. Análise de trilha em linhagens de Sorghum bicolor L. Moench avaliadas em condições de estresse de fósforo. In: 7° Congresso Brasileiro de Melhoramento de Plantas, Uberlândia , MG, Brazil, 05-08/08/2013.
OLIVEIRA, M. S. et al. (EMBRAPA) 2013.Desempenho de cultivares de sorgo sacarino em dois níveis de saturação por alumínio visando a produção de etanol. In: 7° Congresso Brasileiro de Melhoramento de Plantas, Uberlândia , MG, Brazil, 05-08/08/2013.
PEREIRA, G. S. et al. (EMBRAPA) 2013. Identification of QTLs controlling yield traits in sweet sorghum using genotyping by sequencing. In: 59° Congresso Brasileiro de Genética, Águas de Lindóia. Ribeirão Preto, SBG, Brazil, 16-19/09/2013.
SOUZA, V. F. d et al. (EMBRAPA) 2013. Estimação de parâmetros genéticos em linhagens endogâmicas recombinantes de sorgo sacarino. In: 7° Congresso Brasileiro de Melhoramento de Plantas, Uberlândia , MG, Brazil, 05-08/08/2013.
MOURA, S. M. et al. (EMBRAPA) 2013. Distribuição de açúcares nos entrenós de genótipos comerciais de sorgo sacarino. In: 7° Congresso Brasileiro de Melhoramento de Plantas, Uberlândia , MG, Brazil, 05-08/08/2013.
SENA, F. M. (EMBRAPA) 2013. Distribuição e acumulação de açúcares nos entrenós de dois genótipos de sorgo sacarino sensíveis ao fotoperiodismo. In: 7° Congresso Brasileiro de Melhoramento de Plantas, Uberlândia , MG, Brazil, 05-08/08/2013.
SOARES, E. A. C. et al. (EMBRAPA) 2013. Resposta de genótipos de sorgo à inoculação com microrganismos solubilizadores de fósforo. In: 34° Congresso Brasileiro de Ciencia do Solo, Florianópolis, MG, Brazil, 28/07/2013-02/08/2013.
P.S. Rao and B. VS Reddy (ICRISAT) 2012. Identification of Midseason moisture stress sweet sorghum material. Poster presented to ICRISAT Governingboard April 3, 2012
Zegada-Lizarazu W., Zatta A., Nissen L., Monti A.(UniBO) 2012. Sweet sorghum root and canopy responses to water deficit occurring at different growth stages. Roots to the Future. 8th Symposium of the International Society of Root Research (ISRR), Dundee, Scotland, June 26-29 2012.

Table 3: Posters (Cont.)

Zegada Lizarazu W, Zatta A, Monti A. (UniBO) 2012. Root system characterization in sweet sorghum and maize using two different methodologies. Roots to the Future. 8th Symposium of the International Society of root Research (ISRR), Dundee, Scotland, June 26-29 2012.

Zegada-Lizarazu W, Vecchi A, Zatta A, Luna F, Monti A. (UniBO) 2012. Response of three commercial biomass sorghum hybrids to cold stress in northern Italy. 12th Congress of the European Society for Agronomy, Helsinki, Finland, August 20-24 2012

RIBEIRO, P. B. et al. (EMBRAPA) 2012. Análise de expressão de genes relacionados à biossíntese de lignina em sorgo. In: Encontro da Rede de Pesquisa, Desenvolvimento e Inovaçao em Biocombustiveis em Minas Gerais, Sete Lagoas, Brazil, 2012.

TARDIN, F. D. et al. (EMBRAPA) 2012. Desempenho agronômico de genótipos de sorgo sacarino cultivados em Sinop-MT na safra 2011/12. In: 29° Congresso Nacional de Milho e Sorgo, Águas de Lindóia (SP), Brazil, 26-30/08/2012

PEREIRA, G. de A. et al. (EMBRAPA) 2012. Desempenho agronômico de híbridos de sorgo biomassa. In: 29° Congresso Nacional de Milho e Sorgo, Águas de Lindóia (SP), Brazil, 26-30/08/2012.

SOUZA, V. F. de et al. (EMBRAPA) 2012. Estimativas de correlações fenotípicas e genotípicas entre parâmetros agroindustriais do sorgo sacarino. In: 29° Congresso Nacional de Milho e Sorgo, Águas de Lindóia (SP), Brazil, 26-30/08/2012

TORRES, T. B. C. F.et al. (EMBRAPA) 2012. Caracterização de cultivares de sorgo sacarino no Norte de Minas Gerais visando a produção de etanol. In: 29° Congresso Nacional de Milho e Sorgo, Águas de Lindóia (SP), Brazil, 26-30/08/2012

BERNARDINO, K. da C. et al. (EMBRAPA) 2012. Caracterização de cultivares de sorgo sacarino visando a produção de etanol de primeira e segunda geração In: 29° Congresso Nacional de Milho e Sorgo, Águas de Lindóia (SP), Brazil, 26-30/08/2012

MOURAO, C. S.et al. (EMBRAPA) 2012. Efeito de doenças foliares no desenvolvimento de sorgo sacarino. In: 29° Congresso Nacional de Milho e Sorgo, Águas de Lindóia (SP), Brazil, 26-30/08/2012.

PINTO, M. de O. et al. (EMBRAPA) 2012. Identificação de marcadores moleculares microssatélites associados à restauração da fertilidade em sorgo. In: 29° Congresso Nacional de Milho e Sorgo, Águas de Lindóia (SP), Brazil, 26-30/08/2012

VIANA, A. A. de O. N. et al. (EMBRAPA) 2012. Influência da dose de fósforo na diversidade genética bacteriana na rizosfera de linhagens endogamicas recombinantes de sorgo. In: 29° Congresso Nacional de Milho e Sorgo, Águas de Lindóia (SP), Brazil, 26-30/08/2012

MAY, A. et al. (EMBRAPA) 2012. Influência do arranjo de plantas no desempenho produtivo de sorgo sacarino (Sorghum bicolor (L.) Moench), em Sete Lagoas-MG. In: 29° Congresso Nacional de Milho e Sorgo, Águas de Lindóia (SP), Brazil, 26-30/08/2012

S. Braconnier (CIRAD) 2011. “Definition of new sorghum iodeotypes to meet the increasing demand of bioenergy”. Poster presented at the 19th European Biomass conference and Exhibition, Berlin, Germany, June 6-10 2011.

W. Snijman (ARC-GCI) 2011 SWEETFUEL presentation (flyer) at the NAMPO Agricultural Show, Bothaville, South Africa, May 17-20 2011.

Table 3: Posters (Cont.)

M. Bergonti, L. Pasini, A. Marocco and S. Amaducci (UCSC) 2011. Physiological and molecular analysis of drought response in two sweet sorghum genotypes. XXII EUCARPIA Maize and Sorghum Conference, Opatija, Croatia, June 19-22, 2011.
SOUZA, V. F. de et al. (EMBRAPA) 2012. Desempenho de cultivares de sorgo sacarino em duas épocas de plantio no norte de Minas Gerais visando a produção de etanol. In: 6° Congresso Brasileiro de Melhoramento de Plantas, Búzios, SBMP, Brazil, 01-04/08/2011..
SCHAFFERT, R. E.; DAMASCENO, C. M. B.; PARRELLA, R. A. C. (EMBRAPA) 2011. Breeding strategies for sorghum as a feedstock for first and second generation technologies for production of bioenergy in Brazil. In: 6th Frontiers in Bioenergy: United States-Brazil Symposium on Sustainable Bioenergy, West Lafayette, USA, 15-18/05/2011.
DAMASCENO, C. M. B. et al. (EMBRAPA) 2011. Gene expression and biochemical analysis of a bioenergy sorghum panel for lignin content. In:3° Simposio Brasileiro de Genetica Molecular de Plantas, Ilhéus, Brazil 10-15/04/2011.
S. Rao and B. VS Reddy (ICRISAT) 2010. "Identification of midseason moisture stress tolerant sweet sorghum material" poster presented at National Seminar on Millets "Research and Development in millets-present status and future strategies" 12 November, 2010 in NIRD, Rajendranagar, Hyderabad, India. Poster was awarded certificate of appreciation.
Gutjahr S. et al. (CIRAD) 2010 Functional analysis of sugar accumulation in sorghum stems and its competition with grain filling among contrasted genotypes. In Proceedings of Agro2010: the XIth ESA Congress, August 29th - September 3rd, 2010, Montpellier, France'. Montpellier. (J. Wery, ed. ; I. Shili-Touzi, ed. ; A. Perrin, ed. ; European society for agronomy) pp. 89-90. (Agropolis international)
F. Zavala (UANL) 2010. SWEETFUEL presentation (poster display) at the University of Nuevo Leon, Mexico on the occasion of the university research open days.
PARRELLA, R. A. da C. et al. (EMBRAPA) 2010. Desempenho de cultivares de sorgo sacarino em diferentes ambientes visando a produção de etanol. In: 28° Congresso Nacional de Mihlo e Sorgo, Goiânia, Brazil, 29/08/2010-02/09/2010
BATISTA, K. D.; et al. (EMBRAPA) 2010. Morfologia do sistema radicular de genótipos de sorgo em função da concentração de fósforo na solução nutritiva. In: 28° Congresso Nacional de Mihlo e Sorgo, Goiânia, Brazil, 29/08/2010-02/09/2010.
DAMASCENO, C. M. B.et al. (EMBRAPA) 2010. Biochemical and molecular analysis of bioenergy sorghums for variation in lignin content. In: 2nd Panamerican Congress on Plants and Bioenergy, São Paulo,08-11/09/2010
DAMASCENO, C. M. B. et al. (EMBRAPA) 2010. Caracterização bioquímica de genótipos de sorgo quanto ao teor de lignina e análise molecular de rotas metabólicas visando à produção de etanol de segunda geração. In: 28° Congresso Nacional de Mihlo e Sorgo, Goiânia, Brazil, 29/08/2010-02/09/2010..
MAGALHAES, P. C. et al. (EMBRAPA) 2010. Características morfo-fisiológicas e de produção de seis genótipos de sorgo submetidos ao estresse hídrico. In: CONGRESSO NACIONAL DE MILHO E SORGO, In: 28° Congresso Nacional de Mihlo e Sorgo, Goiânia, Brazil, 29/08/2010-02/09/2010..

Table 3: Posters (Cont.)

NEVES, A. de O.; MARRIEL, I. E.; SCHAFFERT, R. E. (EMBRAPA) 2010. Diversidade funcional e atividade de microrganismos solubilizadores de P na rizosfera de linhagens recombinantes de sorgo. In: 28° Congresso Nacional de Mihlo e Sorgo, Goiânia, Brazil, 29/08/2010-02/09/2010.
SCHAFFERT, R. E. et al. (EMBRAPA) 2010. Validação de método de seleção individual para tolerância ao Alumínio tóxico em plântulas de sorgo avaliadas em solução nutritiva. In: 28° Congresso Nacional de Mihlo e Sorgo, Goiânia, Brazil, 29/08/2010-02/09/2010.
R. Janssen (WIP) 2009. Presentation (poster) of SWEETFUEL at the 17th European Biomass conference and Exhibition in Hamburg, Germany, June 29 – July 03 2009
SILVA, L. A. et al. (EMBRAPA) 2009. Crescimento radicular de híbridos de sorgo isogênicos avaliados quanto a tolerância ao alumínio tóxico. In: 5° Congresso Brasileiro de Melhoramento de Plantas, Vitória, Brazil, 10-13/08/2009
SCHAFFERT, R. E.et al. (EMBRAPA) 2009. Field validation of near isogenic lines and hybrids contrasting of tolerance to aluminum toxicity and comparison of parameters derived from nutrient solution and field evaluation at various levels of aluminum. In: 7th International Symposium on Plant-Soil interactions at low pH, Guangzhou, China, 17-21/05/2009
SCHAFFERT, R. E.et al. (EMBRAPA) 2009. The effect of the AltSB gene on root growth in nutrient solution of isogenic sorghum hybrids. In: 16th International Plant Nutrition Colloquium, Sacramento, California, USA, 26-30/08/2009.
MARRIEL, I. E.et al. (EMBRAPA) 2009. Mycorrhizal diversity of acaulosporaceae and glomaceae families in the sorghum rhizosphere in Brazilian acid soils. In: 7th International Symposium on Plant-Soil interactions at low pH, Guangzhou, China, 17-21/05/2009
LANA, U. G. D. P.et al. (EMBRAPA) 2009. Caracterização molecular de um membro da família Multidrug and Toxic Compound Extrusion (MATE) que confere tolerância ao alumínio em sorgo. In: 55° Congresso Brasileiro de Genética, Águas de Lindóia, SP. Brazil, 30/08/2009-02/09/2009
RODRIGUES, F.et al. (EMBRAPA) 2009. Avaliação precoce de genótipos de sorgo quanto à eficiência e resposta na aquisição de fósforo em solo de cerrado. In: 5° Congresso Brasileiro de Melhoramento de Plantas, Vitória, Brazil, 10-13/08/2009
CANIATO, F. F. et al. (EMBRAPA) 2009. Association mapping for aluminum tolerance in candidate regions of the Altsb locus in sorghum. In: 55° Congresso Brasileiro de Genética, Águas de Lindóia, SP. Ribeirão Preto, Brazil, 30/08/2009-02/09/2009
PARRELLA, R. A. da C. et al. (EMBRAPA) 2009. Seleção de cultivares de sorgo sacarino tolerantes ao alumínio tóxico em solução nutritiva. In: 5° Congresso Brasileiro de Melhoramento de Plantas, Vitória, Brazil, 10-13/08/2009
MAGALHAES, J. et al. (EMBRAPA) 2009. Tailoring superior alleles for abiotic stress genes for deployment into breeding programmes: a case study based on association analysis of Altsb, a major aluminium tolerance gene in sorghum (ALTSORGHUM). In: Generation Challaenge Programme, 2009, Texcoco, Mexico.

Table 4: Press releases

W. Snijman (ARC Grain Crop Institute, Potchefstrom) (2014). The effect of nitrogen application levels on sweet sorghum yield, in Afgriland, Julie/Augustus 2014, Volume 58, Nr. 4
P Srinivasa Rao, ICRISAT presents its take on biomass at European Biomass Conference in Copenhagen, in: ICRISAT Happenings, In-House Newsletter, 28 June 2013 No. 1577
S. Braconnier (CIRAD) 2010. Contribution to the Film “To feed a World” for a regional TV station (in French) available at http://www.capcanal.com/videos.php?rubrique=5&emission=4.

Table 4: Press releases

S. Braconnier (CIRAD) 2010. SWEETFUEL publication in the on-line Magazine Research Media, “Sweet sorghum: a suitable alternative energy crop”, Edition December 2010 ‘Rebuilding trust in the food supply chain’
S. Braconnier (CIRAD) 2009. Radio interview of the coordinator broadcasted in West Africa on 19, May 2009 by The Voice of America Radio
S. Braconnier (CIRAD) 2009. SWEETFUEL presentation in Green Techno N° 14, p3, 24/04/2009
S. Braconnier (CIRAD) 2009. SWEETFUEL presentation at the web portal of European Plant Science Organization (http://www.epsoweb.org/Catalog/projects/FP7projects/FP7-Sweetfuel.htm)

Table 5: Participation in meetings/conferences

R. Janssen (WIP) 2014. SWEETFUEL participation at the Second High Level Meeting of the Africa-EU Energy Partnership on 12-13 February 2014 in Addis Ababa, Ethiopia
D. Rutz (WIP) 2014. SWEETFUEL participation at the meeting of the FP7 project SAHYOG (Strengthening Networking on Biomass Research and Bio-waste Conversion – Biotechnology for Europe India Integration) in New Delhi, India, 4-7 February 2014.
R. Janssen, D. Rutz, C. Khawaja (WIP) 2014. SWEETFUEL participation at the REGIONAL WORKSHOP on Sustainable Biomass Production in Latin America in Bogota, Colombia, 28-29 January 2014
R. Janssen (WIP) 2013. SWEETFUEL participation at the 4th Conference on Biofuels in Ouagadougou, Burkina Faso, 21-23 Nov 2013
D. Rutz and R. Janssen (WIP) 2013. SWEETFUEL participation at the 21st European Biomass Conference and Exhibition in Copenhagen, Denmark, 3-6 June 2013
D. Rutz and R. Janssen (WIP) 2013. SWEETFUEL participation at the final conference of the FP7 project Global-Bio-Pact (Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability) in Brussels, Belgium, 28-30 January 2013.
R. Janssen and D. Rutz (WIP) 2012. SWEETFUEL participation at the meeting of the FP7 project Global-Bio-Pact (Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability) in Buenos Aires, Argentina, 17-20 September 2012.

Table 5: Participation in meetings/conferences (cont.)

R. Janssen and D. Rutz (WIP) 2012. SWEETFUEL participation at the meeting of the FP7 project SAHYOG (Strengthening Networking on Biomass Research and Bio-waste Conversion – Biotechnology for Europe India Integration) in New Delhi, India, 5-7 November 2012.
R. Janssen (WIP) 2011. SWEETFUEL participation at the project meeting of the FP7 project NEMO (Novel High Performance Enzymes and Micro-organisms for Conversion of Lignocellulosic Biomass to Bioethanol), 7-9 November 2011, Frankfurt, Germany.
R. Janssen (WIP) 2011. SWEETFUEL participation at the XIX ISAF (International Symposium on Alcohol Fuels) and 2nd International Conference on Lignocellulosic Ethanol, 10-14 October 2011, Verona, Italy.
R. Janssen and D. Rutz (WIP) 2011. SWEETFUEL participation at the meeting of the FP7 project Global-Bio-Pact (Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability) in Bamako, Mali, 26-30 September 2011.
R. Janssen and D. Rutz (WP) 2011. SWEETFUEL participation at the GTZ/DED/InWEnt conference on decentralised energy solutions for developing countries in Bonn, Germany, 10-12 January 2011.
D. Rutz (WIP) 2011. SWEETFUEL participation at the MitteleuropäischeBiomassekonferenz 2011 in Graz, Austria, 26-29 January 2011.
R. Janssen (WIP) 2011. SWEETFUEL participation at the GIZ Expert discussion "Biofuel feedstock potential in East Africa" in Eschborn, Germany, 8 February 2011.
R. Janssen and D. Rutz (WIP) 2011. SWEETFUEL participation at the meeting of the FP7 project Global-Bio-Pact (Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability) in Medan, Indonesia, 14-17 March 2011.
R. Janssen and D. Rutz (WIP) 2011. SWEETFUEL participation at the EC Workshop International Cooperation Projects in Support to Research and Innovation Policies and Competence Building in Brussels, Belgium, 16-17 June 2011.
D. Rutz (WIP) 2010. SWEETFUEL participation at the Annual Meeting of the RED MEXICANA DE BIOENERGIA (Mexican Net of Bioenergy) in Mexico, October 2010.
R. Janssen (WIP) 2010. SWEETFUEL participation at the First Canada-Europe-Australia-New Zealand Workshop on Biotechnologies for Biorefineries and Biobased Materials, 6-7 October 2010, Saskatoon, Canada.
R. Janssen and D. Rutz (WIP) 2010. SWEETFUEL participation at the meeting of the FP7 project Global-Bio-Pact (Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability) in Turrialba, Costa Rica, 7-10 September 2010.
R. Janssen 2009. SWEETFUEL participation at the conference “Biofuel Markets West Africa” in Accra, Ghana, October 2009
R. Janssen (WIP) 2009. SWEETFUEL participation at the COMPETE Financing Conference in Dakar, Senegal, September 2009

Table 6: Scientific thesis

Dario Fernando Luna, PhD thesis. Evaluation of the photosynthetic efficiency of sweet sorghum under drought and cold conditions. Alma Mater Studiorum – Università di Bologna supervised by Walter Zegada-Lizarazu and Andrea Monti
Boccassi Marco, Laurea Magistrale in Scienze e Tecnologie Agrarie, "Caratterizzazione di genotipi di sorgo in funzione della tolleranza allo stress idrico", Università Cattolica del Sacro Cuore, Piacenza, Italia, Aprile 2013, supervised by Dr. Stefano Amaducci
Gutjahr S. 2012. EcoleDoctoraleSIBAGHE : « Analysis of useful morphogenetic and biochemical traits for the development of dual-purpose "grain-bioethanol" sweet sorghum ». Thèse de doctoratsoutenue le 5/7/2012. 118pp.
Jesus Olivera Vargas. 2012. Production systems basedon fertilization and topological arrangements for bioethanol production with sweet sorghum. Master of Science, UANL, 10/03/2012
Jose Alonso Yerbes Vazquez, Master (UANL) 2011. Thesis on Heterosis en caracteristicasasociadas con la produccion de etanol en sorgo dulce (Sorghumbicolor L. Moench), June 2011, supervised by Dr. Francisco Zavala García (AUNL).
De Souza, Vander Fillipe, Master of Science 'Adaptabilidade e estabilidade de cultivares de sorgo sacarino', UnivsersidadeEstual de Montes Claros, Janaùba, Minas Gerais, Brasil, 2011.

Table 7: Organization of workshops

Schaffert R., Parrela R. and Damasceno C. 2010 – International workshop on "Role of lignin on sorghum biomass quality for energy and animal utilization", Sete Lagoas, Brazil, 19-20 April 2010. 2011 - Regional workshop in Sete Lagoas, Brazil, 20-21 September 2011 2012 - Seminar on the Agro-Industrial Production and Processing of Sweet Sorghum for Ethanol Production" took place in Riberão Preto, São Paulo on 9-10 August 2012
Monti A., and Braconnier S. (Chairs; 2012) 2G Bioethanol production: Technological development and agroenvironmental and economic implications. 18 Aprile 2012 Sala Ulisse - Accademia delle Scienze. Bologna, Italy. www.unibo.it/Ricerca/2GBioethanolProduction
Snijman W. 2012 Regional workshop in South Africa
Zavala Garcia 2012 International workshop in Mexico : « Biofuel Symposium », Monterrey, Nuevo Leon, Mexico, 24-26 September 2012
Rao S. 2014 International workshop and regional workshop in Hyderabad, India
S. Braconnier 2014 SAMARA-sorghum Training workshop in Montpellier 17-21 March 2014-02-19
R. Janssen, D Rutz, S. Braconnier, International workshop on Sweetfuel in Hamburg, Germany, 26 June 2014

Table 8: Technical documents

Melhoramento molecular da tolerância ao alumínio em sorgo. Embrapa Milho e Sorgo, Boletim de Pesquisa e Desenvolvimento n° 90, 25p. Sete Lagoas, 2013.
Cultivo de sorgo sacarino em áreas de reforma de canaviais. - Embrapa Milho e Sorgo. Circular técnica n° 186, 36p. Sete Lagoas, 2013.

Table 8: Technical documents (cont.)

Análise morfoagronômica e bioquímica de um painel de sorgo energia para características relacionadas à qualidade da biomassa. - Embrapa Milho e Sorgo, Circular técnica n° 190. Sete Lagoas, 2013.
Influência do espaçamento entrelinhas e da população de plantas no desempenho produtivo do sorgo sacarino BRS 511. - Embrapa Milho e Sorgo. Boletim de Pesquisa e Desenvolvimento N° 89, 27P. Sete Lagoas, 2013.
Sistema Embrapa de produção agroindustrial de sorgo sacarino para bioetanol: Sistema BRS1G-Tecnologia Qualidade Embrapa. - Embrapa Milho e Sorgo, Documentos n° 139, 118p. Sete Lagoas, 2012.
Mapeamento de QTLs para a tolerância à seca em sorgo com ajustes para características fenológicas. - Embrapa Milho e Sorgo, Circular técnica n° 182, 10p. Sete Lagoas, 2012.
Validação de marcadores moleculares para introgressão da característica nervura marrom (bmr6) em linhagens de sorgo biomassa utilizando retrocruzamento assistido. - Embrapa Milho e Sorgo. Circular técnica n° 184, 7p. Sete Lagoas, 2012.
Efeitos de background genético para a tolerância ao alumínio em sorgo. - Embrapa Milho e Sorgo. Circular técnica n° 180, 7p. Sete Lagoas, 2012.
Desempenho de cultivares de sorgo sacarino para a produção de etanol sob diferentes densidades de plantas Pelotas. - Embrapa Clima Temperado, Boletim de Pesquisa e Desenvolvimento n° 156, 22p. Sete Lagoas, 2011.
Pré-melhoramento para a tolerância ao alumínio em sorgo. Embrapa Milho e Sorgo. - Embrapa Milho e Sorgo. Circular técnica n° 162, Sete Lagoas, 2011.
A influência de características fenológicas na avaliação da tolerância à seca em sorgo. - Embrapa Milho e Sorgo. Circular técnica n° 165. Sete Lagoas, 2011.
Desempenho agronômico de híbridos de sorgo biomassa. Sete Embrapa Milho e Sorgo. - Embrapa Milho e Sorgo. Boletim de Pesquisa e Desenvolvimento n° 41, 19p. Lagoas, 2011.
BRS 508: variedade de sorgo sacarino para produção de etanol. - Embrapa Milho e Sorgo. Comunicado técnico n° 195, 2p. Sete Lagoa, 2011.
BRS 509: variedade de sorgo sacarino para produção de etanol. - Embrapa Milho e Sorgo. Comunicado técnico n° 194, 2p. Sete Lagoa, 2011.
BRS 511: variedade de sorgo sacarino para produção de etanol. - Embrapa Milho e Sorgo. Comunicado técnico n° 196, 2p. Sete Lagoa, 2011.
Metodologia de análise do sistema radicular, em solo, de genótipos de sorgo selecionados

previamente para eficiência no uso de fósforo. - Embrapa Milho e Sorgo, Circular técnica n° 158, 6p. Sete Lagoas, 2010.

Desenvolvimento de híbridos de sorgo sensíveis ao fotoperíodo visando alta produtividade de biomassa. - Embrapa Milho e Sorgo, Boletim de pesquisa e desenvolvimento n° 28, 25p. Sete Lagoas, 2010.

Table 8: Technical documents (cont.)

Desenvolvimento de um ensaio de discriminação alélica para caracterização de fatores regulatórios envolvidos com a expressão do gene de tolerância ao alumínio SbMATE em sorgo. - Embrapa Milho e Sorgo, Circular técnica n° 153, 5p. Sete Lagoas, 2010.

Características morfofisiológicas e de produção de seis genótipos de sorgo submetidos ao estresse hídrico. - Embrapa Milho e Sorgo. Boletim de pesquisa e desenvolvimento n° 22, 16p. Sete Lagoas, 2010.

A importância da lignina para a produção de etanol de Segunda geração. - Embrapa Milho e Sorgo. Documentos n° 108, 35P. Sete Lagoas, 2010.

2 Dissemination achievements beyond the project

2.1 Stakeholder database and Associate Membership

The **SWEETFUEL stakeholder database** is available at the project website (PDF-version) and regular (non-confidential) information emails are sent to all stakeholders related to project activities and evolutions. Requests from new participants to register in the database are important.

In addition, **a specific "SWEETFUEL Associate Membership" database, developed by WIP**provides additional information on end-users, their expectations, questions and needs.Until June 2014, 49 international stakeholders have registered as SWEETFUEL Associate Partners (36 Associate Partners from Africa, 2 from Asia, 3 from Latin America and 10 from Europe).

SWEETFUEL Associate Members are regularly informed about events and activities of the SWEETFUEL project, andare invited to make use of the dissemination platforms established in the framework of the project.

2.2 Regional Workshops

Regional workshops have been organized in India, South Africa, Brazil, Mexico and Europe during 2012-2014. All stakeholders including representatives of National Agriculture Research Systems (NARS) and/or Extension services, seed companies, farmers, farmers' organization, NGOs, entrepreneurs, policy makers have been contacted for their participation.The following regional workshops have been organised:

Europe: The regional workshop in Europe took place on 26 June 2014 in Hamburg, Germany on the occasion of the 22nd European Biomass Conference and Exhibition.

India: The regional workshop in India took place on3-4 March 2014 in Hyderabad on the occasion of the final SWEETFUEL meeting in India.

Brazil:The regional workshop in Brazil "Seminar on the Agro-Industrial Production and Processing of Sweet Sorghum for Ethanol Production" took place in RiberãoPreto, São Paulo on 9-10 August 2012.

Mexico: The regional workshop in Mexico took place on 24-25 September 2012 in Monterrey on the occasion of a scientific meeting organized by UANL.

South Africa: The regional workshop in South Africa took place in Potchefstroom on 21 February 2013 on the occasion of the ARC farmers day.

Detailed information on the five SWEETFUEL regional workshops is presented in dedicated workshop reports available on the project website.

2.3 Sweet Sorghum Handbook

A specific handbook with recommendations for sweet sorghum cultivation for ethanol production was elaborated and disseminated to the target groups during regional workshops and by the project web site.

The target groups of the sweet sorghum handbook have been defined to include policymakers, NGOs, scientists and researchers, entrepreneurs, and farmers. The table of contents for the sweet sorghum handbook was elaborated by WIP and accepted at the meeting in Bologna in April 2012.

The first draft of the **SWEETFUEL handbook**, elaborated by WIP, was presented to all project partners at the meeting in Monterrey in April 2013. The handbook was discussed in detail in a specific session of the project meeting and feedback from all partners was collected by WIP until April 2014.

The final version of the handbook, incorporating comments by project partners, was published in June 2014 and distributes at the EU regional SWEETFUEL workshop in Hamburg.

The handbook was written in English by WIP and it is translated in 3 languages: French, Portuguese, and Spanish. Translation is done by CIRAD, EMBRAPA, and UANL.

The following Portuguese documents are available: “Sistema Agroindustrial do Sorgo Sacarino no Brasil e a Participação Público – Privada: Oportunidades, Perspectivas e Desafios” Documento 138, Agosto, 2012 and “Sistema Embrapa de Produção Agroindustrial para Bioetanol Sistema BRS1G – Tecnologia Qualidade Embrapa. Documento 139, Agosto, 2012.

2.4 Demonstration activities

Sweet sorghum is new to most farmers though they are quite familiar with grain/dual purpose(grain + stover) sorghum cultivation. SWEETFUEL intends to make the farmers familiar with thecrop and demonstrate the economic opportunities of sweet sorghum cultivation using the new hybrids.

Specific demonstration activities have been implemented in India and Brazil.

SWEETFUEL demonstration activities in India

The improved sweet cultivars of SWEETFUEL (i.e. ICSV 93046, ICSV 25299 and ICSV 25306) were evaluated in two sugar mill regions (*i.e.* Sri Datta sugar mill and Jawahar sugar mill in Kolhapur district of Maharashtra) along with national check CSV 24SS in one acre area at each of the locations. Kolhapur region is the sugar bowl of India. The sugar mill staff was trained at ICRISAT on sweet sorghum cultivation practices.

The crop at both the locations is satisfactory and the data is presented in Deliverable D7.8. The varieties ICSV 93046 and ICSV 25299 recorded 3713 L/ha and 2693 L/ha ethanol (96% purity) yield, respectively. As the seed of ICSV 93046 resemble more the traditional M-35 variety the farmers in that area want to go for large scale cultivation in Jawahar sugar mill area.

The sugar mill management is now fully convinced that sweet sorghum could be a viable feedstock for enhancing the operational window of their distilleries for the production of transport grade ethanol for use in the national blending program.

However the oil marketing companies who purchase the ethanol from sugar mills are looking for lower prices than the quoted Rs 40-42.

The system is economically viable as farmers could get benefit from Rs 17018 to Rs 50241/ha by sale of grain and stalk at market prices while the distillery could get benefit excluding processing costs Rs33768 and Rs 64242 (sale price of ethanol: Rs 38/lit).

SWEETFUEL demonstration activities in Brazil

The current (06/2014) energy sorghum scenario in Brazil is to crop sweet sorghum to complement the sugarcane production during the off season, particularly during the two months (March and April) preceding the beginning of sugar cane harvesting.

In 2009 and 2010, several entities of the private seed sector promoted using sorghum hybrids that were not sweet sorghum hybrids, but forage sorghum hybrids with juicy stem but low or intermediate sugar levels in the juice. The seed companies promised ethanol yields of greater than 2500 liters per hectare, but pilote demonstration with the sugarcane sector only produced between 800 (or less) and 1200 liters per hectare. These levels were not sustainable and did not give satisfaction to the sugarcane sector.

This negative experience of low ethanol production of several large distilleries coupled with government policy to maintain the price of gasoline at lower levels has also had the effect to put a cap on ethanol prices near or below production costs which has been a strong factor in reducing the adoption of sweet sorghum for ethanol production.

However in 2011, EMBRAPA developed a partnership with the sugarcane sector to promote sweet sorghum. Improved varieties developed at EMBRAPA were provided to some distilleries and reached in pilot and demonstration areas a production of 2500 liters per ha. The sugarcane sector was a little skeptical before experimenting sweet sorghum, but quickly saw the value of cropping sweet sorghum to complement the sugarcane production. As sweet sorghum is harvested and transformed the same as sugarcane (see photos here under), without investing in equipment and extending his area of production, an industrial can increase the operating window of his plant and of course increase his production (up to 25%). In addition, the bagasse issued from juice extraction has a good caloric value and can be burnt like sugarcane to generate electricity.

Even if there are still significant problems to solve in the production system (geometry of plantation, adaptation of new harvesters etc…), we can reasonably expect a great future for sweet sorghum in Brazil. It has already been able to reach good results with EMBRAPA sweet sorghum varieties reaching 2500 and 3000 liters per hectar in pilot scale demonstration. Embrapa released three Embrapa developed sweet sorghum varieties in 2013. First year experimental hybrids from Embrapa were very promising in 2013/2014 and we expect to release commercial hybrids in 2016.

For more information on harvest and transformation of sweet sorghum stalks to produce ethanol, watch the film produced in 2012 by EMBRAPA at:http://www.sweetfuel-project.eu/sweetfuel_events/complementation_of_sugar_cane_by_sweet_sorghum_in_brazil

Section B– Exploitation

SWEETFUEL aims at producing new varieties of SWEET SORGHUM adapted to various conditions. Access rights and exploitation of the FOREGROUND (or RESULTS) of these new varieties or other project results have been agreed upon between the members of the SWEETFUEL consortium.

During one year after the end of the Project, each beneficiary is granted ACCESS RIGHTS to FOREGROUND for Implementation and for Use (Exploitation) when the Foreground is duly demonstrated to be needed for the implementation and/or for the exploitation of another beneficiaries Foreground.

At contractual level with EC (Annex 1 to G.A., Description of Work), the consortium envisaged collaborative actions and approved some principles:

- The principle to protect their property would allow the control of the marketing development of the new varieties while giving free access to their genetic variability for further research breeding activities.
- The principle of further (direct and/or indirect) exploitation of commercial varieties through licenses with variable levels of royalties based on the economic development level of the considered country.
- The principle to facilitate access to lower developed countries of varieties bred by SWEETFUEL activities at minimum rates.
- The principle of allowing “classical” commercial exploitation of varieties adapted to higher leveled economies.

1. Registration for patents, trademarks, etc.

The following Table B-1 provides an overview on applications for patents, trademarks according to several “types of IP Rights” specified in the on-line scientific reporting via the European Commission Research & Innovation Participant Portal.

Please, insert one of the following “types of IP Rights” in column 1 of Table B-1!

Type of IP Rights

- Patents
- Trademarks
- Registered designs
- Utility models
- Other

TableB-1: List of applications for patents, trademarks, etc. (*: mandatory fields)

Type of IP Rights*	Application reference(s)* (e.g. EP123456)	Intellectual property Organisation*	Subject or title of application*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Applicant (s)* (as on the application)	URL of application (mandatory for patents)
Patent	EXPEDIENTE CNVV 2596 CONTROL DE GESTIÓN 0112	SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS)	38 ANE. Female grain sorghum line. Drought resistance. Good combine ability with sweet sorghum male.	NO		F. Zavala García (50 %), H. Williams Alanís (15 %), G. Alanís Pérez (10 %), J.E. Treviño Ramírez (10 %) M.C. Rodríguez Vázquez (10 %) H. Reyes (5 %)	
Patent	EXPEDIENTE CNVV 2597 CONTROL DE GESTIÓN 0113	SNICS	ROGER. Male sweet sorghum open pollinated variety. Good combining ability with female sorghum lines. High juice production. ºBrix > 15 %	NO		F. Zavala García (50 %), H. Williams Alanís (15 %), G. Alanís Pérez (10 %), J.E. Treviño Ramírez (10 %) M.C. Rodríguez Vázquez (10 %) H. Reyes (5 %)	
Patent	EXPEDIENTE CNVV 2598 CONTROL DE GESTIÓN 0114	SNICS	TEMPLADA. Short female grain sorghum line. Good combining ability with sweet sorghum males.	NO		F. Zavala García (50 %), H. Williams Alanís (15 %), G. Alanís Pérez (10 %), J.E. Treviño Ramírez (10 %) M.C. Rodríguez Vázquez (10 %) H. Reyes (5 %)	
Patent	EXPEDIENTE CNVV 2599 CONTROL DE GESTIÓN 0115	SNICS	7ROGER. Sweet sorghum hybrid. ºBrix > 16 %. Early genotype	NO		F. Zavala García (50 %), H. Williams Alanís (15 %), G. Alanís Pérez (10 %), J.E. Treviño Ramírez (10 %) M.C. Rodríguez Vázquez (10 %) H. Reyes (5 %)	
Patent	EXPEDIENTE CNVV 2600 CONTROL DE GESTIÓN 0116	SNICS	POTRANCA. New female line, using ºBrix as selection criteria. Good combining ability. ºBrix > 20 %	NO		H. Williams Alanís (50 %) F. Zavala García (30 %) G. Arcos Cavazos (18 %) M.C. Rodríguez Vázquez (2 %)	

Type of IP Rights*	**Application reference(s)*** **(e.g. EP123456)**	**Intellectual property Organisation***	**Subject or title of application***	**Confidential * (Yes/No)**	**Foreseen embargo date** **(dd/mm/yyyy)**	**Applicant (s)* (as on the application)**	**URL of application** **(mandatory for patents)**
Patent	EXPEDIENTE CNVV 2601 CONTROL DE GESTIÓN 0117	SNICS	WROGER. High biomass sweet sorghum hybrid. Good juice production and ºBrix > 18 %.	NO		F. Zavala García (50 %), H. Williams Alanís (15 %), G. Alanís Pérez (10 %), J.E. Treviño Ramírez (10 %) M.C. Rodríguez Vázquez (10 %) H. Reyes (5 %)	
Patent	EXPEDIENTE CNVV 2602 CONTROL DE GESTIÓN 0118	SNICS	WYR. B reaction male on Cytoplasm 1. ºBrix > 19 %.	NO		F. Zavala García (50 %), H. Williams Alanís (15 %), G. Alanís Pérez (10 %), J.E. Treviño Ramírez (10 %) M.C. Rodríguez Vázquez (10 %) H. Reyes (5 %)	
Patent	EXPEDIENTE CNVV 2603 CONTROL DE GESTIÓN 0119	SNICS	7KEY. New sweet sorghum hybrid. ºBrix > 18 %. Good juice production.	NO		F. Zavala García (50 %), H. Williams Alanís (15 %), G. Alanís Pérez (10 %), J.E. Treviño Ramírez (10 %) M.C. Rodríguez Vázquez (10 %) H. Reyes (5 %)	
Patent	EXPEDIENTE CNVV 2604 CONTROL DE GESTIÓN 0120	SNICS	MEXINDU. Open pollination variety. ºBrix >20 %. High biomass production.	NO		F. Zavala García (50 %), H. Williams Alanís (15 %), G. Alanís Pérez (10 %), J.E. Treviño Ramírez (10 %) M.C. Rodríguez Vázquez (10 %) H. Reyes (5 %)	

2. Exploitable Foreground - Overview

Specific efforts are placed on the issue of exploitation ("Use") of the SWEETFUEL project results, incl. new hybrids and varieties of sweet-sorghum in the several partner countries: Brazil, Mexico, India (Philippines), Europe, South Africa.

Each country has its own policy with respect to bio-energy and more specifically bio-ethanol production for biofuel purposes. Further, each partner/beneficiary of the Project, within each country and its environing commercial territories develops exploitation strategies whereof some are confidentially and other public-oriented.

In order to provide support for SWEETFUEL exploitation activities, several **Exploitation Flyer**s have been developed which have been widely disseminated among stakeholders and which are available on the project website.

The following Table B-2 provides an overview on **SWEETFUEL Exploitable Foreground** according to several "types of exploitable foreground" specified in the on-line scientific reporting via the European Commission Research & Innovation Participant Portal.

Please, insert one of the following "types of exploitable foreground" in column 2 of Table B-2!

Type of Exploitable Foreground

- Commercial exploitation of R&D results
- General advancement of knowledge
- Exploitation of R&D results via standards
- Exploitation of results through EU policies
- Exploitation of results through (social) innovation

Table B-2: Overview table of exploitable foreground (*: mandatory fields)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
1	New male lines for biomass hybrids	32 S5 lines to be used as male parents for making biomass sorghum hybrids well adapted to European temperate conditions.	No	N/A	New male lines	Agriculture & Forestry, Energy Industrial Biotechnology	2014	No patent application is planned. Plant variety rights (PVR) may be requested in case of registration of one or several hybrids made with these parental lines.	CIRAD, France (WP1)
2	New early A/B female lines for biomass hybrids	24 BC1 and 28 BC4 early A/B lines with adaptive and yield traits to be used as female parents of biomass hybrids for temperate conditions.	No	N/A	New early A/B female lines	Agriculture & Forestry, Energy Industrial Biotechnology	2014	No patent application is planned. Plant variety rights (PVR) may be requested in case of registration of one or several hybrids made with these parental lines.	CIRAD, France (WP1)
3	New A/B female lines with low lignin content	9 BC1 and 6 BC3 early or intermediate A/B lines with low lignin content and other adaptive and yield traits to be used as female parents for biomass hybrids for temperate conditions.	No	N/A	New A/B female lines	Agriculture & Forestry, Energy Industrial Biotechnology	2014	No patent application is planned. Plant variety rights (PVR) may be requested in case of registration of one or several hybrids made with these lines.	CIRAD, France (WP1)
4	New sweet sorghum cultivar for terminal drought stress tolerance - ICSV 25311	Improved sweet sorghum variety tolerant to terminal drought stress, which is common in postrainy season in India. It possesses waxyness, high vigour and shows better survival rate under terminal moisture stress.	No	N/A	New sweet sorghum cultivar for terminal drought stress tolerance	Agriculture & Forestry, Energy Industrial Biotechnology	2014	This SWEETFUEL exploitable result is freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate MTAs.	ICRISAT, India (WP2)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
5	New sweet sorghum cultivar for terminal drought stress tolerance - ICSV 25308	Improved variety of sweet sorghum tolerant to terminal drought stress, which is common in postrainy season in India. It possesses waxyness, high vigour and shows better survival rate under terminal moisture stress.	No	N/A	New sweet sorghum cultivar for terminal drought stress tolerance	Agriculture & Forestry, Energy Industrial Biotechnology	2014	This SWEETFUEL exploitable result is freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate MTAs.	ICRISAT, India (WP2)
6	New sweet sorghum cultivar for mid-season drought stress tolerance - ICSV 25300	Improved sweet sorghum variety tolerant to mid-season moisture stress, which is common during summer season in India. It possesses waxyness, high vigour and shows better survival rate under mid-season moisture stress.	No	N/A	New sweet sorghum cultivar for mid-season drought stress tolerance	Agriculture & Forestry, Energy Industrial Biotechnology	2014	This SWEETFUEL exploitable result is freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate MTAs.	ICRISAT, India (WP2)
7	New sweet sorghum cultivar for mid-season drought stress tolerance - ICSV 12012	Improved sweet sorghum variety tolerant to mid-season moisture stress, which is common during summer season in India. It possesses waxyness, high vigour and shows better survival rate under mid-season moisture stress.	No	N/A	New sweet sorghum cultivar for mid-season drought stress tolerance	Agriculture & Forestry, Energy Industrial Biotechnology	2014	This SWEETFUEL exploitable result is freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate MTAs.	ICRISAT, India (WP2)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
8	New sweet sorghum cultivar for rainy season adaptation - ICSV 25339	Improved sweet sorghum variety flowering in 99 days and growing to a height of 3.05 m. This variety is well suited for rainy adapted condition	No	N/A	New sweet sorghum cultivar for rainy season adaptation	Agriculture & Forestry, Energy Industrial Biotechnology	2014	This SWEETFUEL exploitable result is freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate MTAs.	ICRISAT, India (WP2)
9	New sweet sorghum cultivar – ICSSH 71	Improved sweet sorghum hybrid flowering in 66 days and growing to a height of 2.5 m. This hybrid is tolerant to mid-season moisture stress. This hybrid is expected to suit multiple cropping systems due to early maturity.	No	N/A	New sweet sorghum cultivar	Agriculture & Forestry, Energy Industrial Biotechnology	2014	This SWEETFUEL exploitable result is freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate MTAs.	ICRISAT, India (WP2)
10	New sweet sorghum cultivar – ICSV 12007	Improved sweet sorghum variety flowering in 71 days and growing to a height of 3.4 m. This variety is moderately tolerant to mid-season moisture stress. This variety is expected to suit multiple cropping systems due to early maturity.	No	N/A	New sweet sorghum cultivar	Agriculture & Forestry, Energy Industrial Biotechnology	2014	This SWEETFUEL exploitable result is freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate MTAs.	ICRISAT, India (WP2)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
11	New sweet sorghum cultivar – ICSV 12008	Improved sweet sorghum variety flowering in 77 days and growing to a height of 3.3 m. This variety is moderately tolerant to mid-season moisture stress.	No	N/A	New sweet sorghum cultivar	Agriculture & Forestry, Energy Industrial Biotechnology	2014	This SWEETFUEL exploitable result is freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate MTAs.	ICRISAT, India (WP2)
12	New sweet sorghum cultivar for rainfed growing condition - OPV 007	Open pollinated variety selected from the sweet sorghum germplasm collection	No	N/A	New sweet sorghum cultivar for rainfed growing condition	Agriculture & Forestry, Energy Industrial Biotechnology	2014	The seed material can be accessed by signing a Material Transfer Agreement.	ARC, South Africa (WP2)
13	Top 5 producing cultivars in South Africa regarding biomass yield, syrup yield and sugar content	See chapter 3.13	No	N/A	Sweet sorghum cultivars	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	ARC, South Africa (WP2)
14	Grain Sorghum Female Parent – 38ANE	Grain Sorghum Female Parent in Sweet Sorghum Hybrids for Mexico – 38ANE	No	N/A	Sweet sorghum cultivars	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Patent application initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), Mexico	UANL, Mexico (WP2)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
15	Sweet Sorghum Variety– ROGER	Sweet Sorghum Variety for Sweet Sorghum Hybrids in Mexico – ROGER	No	N/A	Sweet sorghum cultivars	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Patent application initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), Mexico	UANL, Mexico (WP2)
16	Sweet Sorghum Hybrid for Mexico – 7ROGER	The hybrid is suitable for high juice production with more than 16 % of ºBrix.	No	N/A	Sweet sorghum cultivars	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Patent application initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), Mexico	UANL, Mexico (WP2)
17	New Sweet Sorghum Female Line – POTRANCA	See chapter 3.17	No	N/A	Sweet sorghum cultivars	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Patent application initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), Mexico	UANL, Mexico (WP2)
18	Sweet Sorghum Hybrid – WROGER	Sweet Sorghum Hybrid for the Northeastern Part of Mexico – WROGER. It has a Total Fresh Weight near 80 ton ha-1, high juice production (862 ml of juice/5 plants), 16.0 brix.	No	N/A	Sweet sorghum cultivars	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Patent application initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), Mexico	UANL, Mexico (WP2)
19	Sweet Sorghum Variety – WYR	Sweet Sorghum Variety to Produce New Female for Sweet Sorghum Hybrids in Mexico – WYR	No	N/A	Sweet sorghum cultivars	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Patent application initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), Mexico	UANL, Mexico (WP2)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
20	Sweet Sorghum Hybrid for Mexico – 7KEY	This hybrid has been tested at experimental level under different nitrogen and density levels showing ºBrix values > 17 %.	No	N/A	Sweet sorghum cultivars	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Patent application initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), Mexico	UANL, Mexico (WP2)
21	Sweet Sorghum Variety – MEXINDU	Sweet Sorghum Variety for Sweet Sorghum Hybrids in Mexico – MEXINDU	No	N/A	Sweet sorghum cultivars	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Patent application initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), Mexico	UANL, Mexico (WP2)
22	New Sweet Sorghum Cultivar – BRS 508	Variety developed to meet the growing demand for complementary feedstock as an alternative to sugarcane for ethanol production.	No	N/A	New Sweet Sorghum Cultivar	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Freely available; the breeding materials developed and released are available for licensing by the private sector for seed production and commercialization. Partners have access to both experimental and released cultivars with appropriate MTA.	EMBRAPA, Brazil (WP3)
23	New Sweet Sorghum Cultivar – BRS 509	Variety developed to meet the growing demand for complementary feedstock as an alternative to sugarcane for ethanol production.	No	N/A	New Sweet Sorghum Cultivar	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Freely available; the breeding materials developed and released are available for licensing by the private sector for seed production and commercialization. Partners have access to both experimental and released cultivars with appropriate MTA.	EMBRAPA, Brazil (WP3)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
24	New Sweet Sorghum Cultivar – BRS 511	Variety developed to meet the growing demand for complementary feedstock as an alternative to sugarcane for ethanol production.	No	N/A	New Sweet Sorghum Cultivar	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Freely available; the breeding materials developed and released are available for licensing by the private sector for seed production and commercialization. Partners have access to both experimental and released cultivars with appropriate MTA.	EMBRAPA, Brazil (WP3)
25	New Biomass Sorghum Cultivar – CMSXS7015	Biomass photosensitive hybrid to meet the growing demand for complementary feedstock as an alternative to sugarcane for second generation ethanol production and co-generated energy.	No	N/A	New Biomass Sorghum Cultivar	Agriculture & Forestry, Energy Industrial Biotechnology	2014	Freely available; the breeding materials developed and released are available for licensing by the private sector for seed production and commercialization. Partners have access to both experimental and released cultivars with appropriate MTA.	EMBRAPA, Brazil (WP3)
26	Implications of Photoperiod sensitivity for developing multi-purpose food/feed/fuel sweet sorghum varieties	See chapter 3.26	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	CIRAD, France (WP4)
27	Sugar and grain production can be combined in multi-purpose (food/feed/fuel) sorghum varieties	See chapter 3.27	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	CIRAD, France (WP4)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
28	A model enabling to explore the impact of morphological, phenological and physiological trait combination on sugar and grain productions	See chapter 3.28	No	N/A	Computer model	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	CIRAD, France (WP4)
29	Differential gene response to decreasing water soil content during early developmental phases	See chapter 3.29	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	UCSC, Italy (WP4)
30	Physiological characterization of sorghum varieties under dry-down experiment	See chapter 3.30	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	UCSC, Italy (WP4)
31	Sensitivity Analysis	Sensitivity Analysis of Growth Stages to Drought and its Implications on Sweet Sorghum Productivity	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	UANL, Mexico (WP4)
32	Identification of genotypes	Development of SCAR markers for identifying sweet sorghum genotypes with high sugar content in sweet sorghum elite materials of FAUANL	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	UANL, Mexico (WP4)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
33	Adaptability of commercial biomass sorghum hybrids to cold conditions	See chapter 3.33	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	UNIBO. Italy (WP5)
34	Perspectives for farmers to harvest and in-field store sweet sorghum juice and bagasse	See chapter 3.34	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	UNIBO. Italy (WP5)
35	Technological Package for Sweet Sorghum in the Northeastern Part of México	See chapter 3.35	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	UANL, Mexico (WP5)
36	Technological assessment of sweet and biomass sorghum	Definition of sweet and biomass sorghum scenarios and evaluation of differences in the technology of sweet and biomass sorghum cultivation and processing.	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	IFEU, Germany (WP6)
37	Environmental assessment of sweet and biomass sorghum	Analysis of impacts of sweet and biomass sorghum cultivation and use as bioenergy crops.	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	IFEU, Germany (WP6)

No	Type of exploitable foreground*	Exploitable foreground (brief description)*	Confidential * (Yes/No)	Foreseen embargo date (dd/mm/yyyy)	Exploitable product(s) or measure(s)*	Sectors(s) of application*	Timetable for commercial use or any other use*	Patents or other IPR exploitation (licences)*	Owner & Other Beneficiary(s) involved*
38	Economic Assessment	Economic Assessment of Biomass Sorghum to Alternative Products	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	ICRISAT, India (WP6)
39	Economic Assessment	Economic Assessment of Sweet Sorghum to Ethanol	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	ICRISAT, India (WP6)
40	SWOT Analysis – Sweet Sorghum as Energy Crop	Analysis to assess advantages and disadvantages of different sweet sorghum and biomass sorghum value chains.	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	WIP, Germany (WP6)
41	Energy Sorghum Handbook	Up-to-date overview of important facts and figures on energy sorghum	No	N/A	Report	Agriculture & Forestry, Energy Industrial Biotechnology	2014	N/A	WIP, Germany (WP7)
42	SAMARA model	SAMARA model: crop model able to analyze GxE interactions at crop scale for tropical cereals including rice and sorghum	No	N/A	Computrer model	Agriculture & Forestry, Research	2014	N/A	CIRAD, Germany (WP5)

3. Explanation of Exploitable Foreground

3.1 New male lines for biomass hybrids (CIRAD – 1)

This SWEETFUEL exploitable result concerns 32 S5 lines to be used as male parents for making biomass sorghum hybrids well adapted to European temperate conditions.
They are derived from four crosses IS 30441 x IS 29409, IS 30441 x Keller, IS 30441 x IS 30308 and IS 30435 x IS 29407 through pedigree selection alternatively implemented in Germany and France. All parents (progenitors) of these crosses belong to sorghum CIRAD gene bank.
These lines have high early growth vigour, tolerance to low temperatures at seedling stage, adequate earliness, intermediate stem thicknesswith high lodging tolerance and small open panicles. They are B or partial B lines regarding A1 cytoplasm sterility system.

Exploitation strategy

This germplasm belongs to both CIRAD and KWS.
Both organisations are free to use it for research or commercial purposes with other partners.

IPR measures taken or intended

No patent application is planned.
Plant variety rights (PVR) may be requested in case of registration of one or several hybrids made with these parental lines.

Further research necessary

Further research includes further testing in hybrid combination with a small set of females in a broader range of environments in Europe and improvements for stem digestibility.

Potential / expected impact of exploitation

This SWEETFUEL exploitable result constitutes useful germplasm for developing a new generation of biomass sorghum hybrids of short cycle duration (high growth rate per day) relevant for double cropping systems.

3.2 New early A/B female lines for biomass hybrids (CIRAD – 2)

This SWEETFUEL exploitable result concerns 24 BC1 and 28 BC4 early A/B lines with adaptive and yield traits to be used as female parents of biomass hybrids for temperate conditions.
Crosses were made by CIRAD using CIRAD B parents. From the F2 generation, part of the lines was developed through pedigree selection by CIRAD in France and part was selected in Germany by KWS.
The conversion of F4 or F5 new B lines into A1 cytoplasm male sterility was alternately managed by CIRAD and KWS. The last conversion cycle was achieved by CIRAD in Montpellier during the 2013 summer season.

Exploitation strategy

Depending of their respective contribution to the development of the different sets of B lines, this germplasm belongs exclusively to CIRAD or to both CIRAD and KWS

IPR measures taken or intended

No patent application is planned.
Plant variety rights (PVR) may be requested in case of registration of one or several hybrids made with these lines.

Further research necessary

Further research includes further testing in hybrid combination with a small set of male in a broader range of environments in Europe.

Potential / expected impact of exploitation

This SWEETFUEL exploitable result constitutes useful germplasm for developing a new generation of biomass sorghum hybrids of short cycle duration (high growth rate per day) relevant for double cropping systems.

3.3 New A/B female lines with low lignin content (CIRAD – 3)

This SWEETFUEL exploitable result concerns 9 BC1 and 6 BC3 early or intermediate A/B lines with low lignin content and other adaptive and yield traits to be used as female parents for biomass hybrids for temperate conditions.

Crosses made by CIRAD using CIRAD elite B lines as recurrent parents and CIRAD + ICRISAT sources of bmr (low lignin) genes. Lines were created though backcross and pedigree selection implemented at CIRAD. The conversion of promising bmrlines into A1 cytoplasm male sterility was made by CIRAD in France.

These new A/B lines includes bmr6, bmr8 and bmr12 genes, alone or in combination.

Exploitation strategy

This germplasm belongs exclusively to CIRAD which is allowed to use it for research or commercial purposes with other partners.

IPR measures taken or intended

No patent application is planned.
Plant variety rights (PVR) may be requested in case of registration of one or several hybrids made with these lines.

Further research necessary

Further research includes further testing in hybrid combination with a small set of male in a broader range of environments in Europe.

Potential / expected impact of exploitation

This SWEETFUEL exploitable result constitutes useful germplasm for developing a new generation of biomass sorghum hybrids of intermediate cycle duration relevant for dedicated cropping systems.

3.4 New sweet sorghum cultivar for terminal drought stress tolerance - ICSV 25311 (ICRISAT – 1)

This SWEETFUEL exploitable result presents an improved sweet sorghum variety developed at ICRISAT-Patancheru, India by pedigree selection from a cross between DSV 4 x SSV 84. It is tolerant to terminal drought stress, which is common in postrainy season in India. It possesses waxyness, high vigour and shows better survival rate under terminal moisture stress. It flowers in 69 days and grows to a height of 2.7 m. It records 28.8 t ha^{-1} stalk yield, 12 t ha^{-1} juice yield, 16% brix and sugar yield of 1.44 t ha^{-1} along with a grain yield of 3.5 t ha^{-1}. This variety is expected to suit multiple cropping systems due to early maturity.

Exploitation strategy

This variety is well adapted to both rainy and postrainy seasons. Further, it has tolerance to terminal moisture stress. It can be tested in India, Mexico, South Africa, Brazil, USA, Philippines and China for local adaptation.

IPR measures taken or intended

This SWEETFUEL exploitable resultis freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate Material Transfer Agreements.

Further research necessary

Further research includes further testing in hybrid combination with a set of A-lines in a broader range of environments. Its adaptation to other regions can be assessed through multilocation and multi seasonal trials.

Potential / expected impact of exploitation

This variety can be a good source of sugar for biofuel production and it can also be used as fodder, thereby offering opportunities to small farmers for enhancing their income opportunities.

3.5 New sweet sorghum cultivar for terminal drought stress tolerance - ICSV 25308 (ICRISAT – 2)

This SWEETFUEL exploitable result presents an improved variety of sweet sorghum developed at ICRISAT-Patancheru, India by pedigree selection from a cross between DSV 4 x SSV 84. It is tolerant to terminal drought stress, which is common in postrainy season in India. It possesses waxyness, high vigour and shows better survival rate under terminal moisture stress. It flowers in 68 days and grows to height of 2.6 m. It records 24.5 tha^{-1}stalk yield, 11 tha^{-1}juice yield, 16% brix and 1.3 tha^{-1}sugar yield along with grain yield of 3.6 t ha^{-1}.This variety is expected to suit multiple cropping systems due to early maturity.

Exploitation strategy

This variety is well adapted to both rainy and postrainy seasons. Further, it has tolerance to terminal moisture stress. It can be tested in India, Mexico, South Africa, Brazil, USA, Philippines and China for local adaptation.

IPR measures taken or intended

This SWEETFUEL exploitable resultis freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate Material Transfer Agreements.

Further research necessary

Further research includes further testing in hybrid combination with a set of A-lines in a broader range of environments. Its adaptation to other regions can be assessed through multilocation and multi seasonal trials.

Potential / expected impact of exploitation

This variety can be a good source of sugar for biofuel production and it can also be used as fodder, thereby offering opportunities to small farmers for enhancing their income opportunities.

3.6 New sweet sorghum cultivar for mid-season drought stress tolerance -ICSV 25300 (ICRISAT – 3)

This SWEETFUEL exploitable result presents an improved sweet sorghum variety developed at ICRISAT-Patancheru, India by pedigree selection from a cross between DSV 4 x SSV 84.It is tolerant to mid-season moisture stress, which is common during summer season in India. It possesses waxyness, high vigour and shows better survival rate under mid-season moisture stress. It flowers in 69 days and grows to height of 2.7 m. It records 35.02 tha^{-1}stalk yield, 12.5 tha^{-1}juice yield, 17% brix and 1.5 tha^{-1}sugar yield along with grain yield of 2.3 t ha^{-1}.This variety is expected to suit multiple cropping systems due to early maturity.

Exploitation strategy

This variety is well adapted to both rainy and postrainy seasons. Further it has tolerance to mid-season moisture stress. It can be tested in India, Mexico, South Africa, Brazil, USA, Philippines and China for local adaptation.

IPR measures taken or intended

This SWEETFUEL exploitable resultis freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate Material Transfer Agreements.

Further research necessary

Further research includes further testing in hybrid combination with a set of A-lines in a broader range of environments. Its adaptation to other regions can be assessed through multilocation and multi seasonal trials.

Potential / expected impact of exploitation

This variety can be a good source of sugar for biofuel production and it can also be used as fodder, thereby offering opportunities to small farmers for enhancing their income opportunities.

3.7 New sweet sorghum cultivar for mid-season drought stress tolerance -ICSV 12012 (ICRISAT – 4)

This SWEETFUEL exploitable result presents an improved sweet sorghum variety developed at ICRISAT-Patancheru, India by pedigree selection from a cross between Ch-6 x SSV 74. It is tolerant to mid-season moisture stress, which is common during summer season in India. It possesses waxyness, high vigour and shows better survival rate under mid-season moisture stress. It flowers in 91 days and grows to height of 2.8 m, It records 75.5 tha^{-1}stalk yield, 24 tha^{-1}juice yield, 15 % brix and 2.6 tha^{-1} sugar yield along with a grain yield of 1.3 t ha^{-1}.

Exploitation strategy

This variety is well adapted to both rainy and postrainy seasons. Further it has tolerance to mid-season moisture stress. It can be tested in India, Mexico, South Africa, Brazil, USA, Philippines and China for local adaptation.

IPR measures taken or intended

This SWEETFUEL exploitable resultis freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate Material Transfer Agreements.

Further research necessary

Further research includes further testing in hybrid combination with a set of A-lines in a broader range of environments. Its adaptation to other regions can be assessed through multilocation and multi seasonal trials.

Potential / expected impact of exploitation

This variety can be a good source of sugar for biofuel production and it can also be used as fodder, thereby offering opportunities to small farmers for enhancing their income opportunities.

3.8 New sweet sorghum cultivar for rainy season adaptation - ICSV 25339 (ICRISAT – 5)

This SWEETFUEL exploitable result presents an improved sweet sorghum variety developed at ICRISAT-Patancheru, India by pedigree selection from a cross between SSV 74 x AKSV 22. It flowers in 99 days and grows to a height of 3.05 m. It records 115 tha^{-1}stalk yield, 44.5 tha^{-1}juice yield, 18.5 % brix and 5.94 tha^{-1}sugar yield. This variety is well suited for rainy adapted condition.

Exploitation strategy

This variety is well adapted to rainy season. It can be tested in India, Mexico, South Africa, Brazil, USA, Philippines and China for local adaptation.

IPR measures taken or intended

This SWEETFUEL exploitable resultis freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate Material Transfer Agreements.

Further research necessary

Further research includes further testing in hybrid combination with a set of A-lines in a broader range of environments. Its adaptation to other regions can be assessed through multilocation and multi seasonal trials.

Potential / expected impact of exploitation

This variety can be a good source of sugar for biofuel production and it can also be used as fodder, thereby offering opportunities to small farmers for enhancing their income opportunities.

3.9 New sweet sorghum cultivar – ICSSH 71 (ICRISAT – 6)

This SWEETFUEL exploitable result presents an improved sweet sorghum hybrid derived from a cross between ICSA 474 x NTJ-2 at ICRISAT- Patancheru, India. It flowers in 66 days and grows to a height of 2.5 m. It gives 46 t ha^{-1} stalk yield, 23 t ha^{-1} juice yield, 16.5 % brix, 3.2 t ha^{-1} sugar yield and 4.5 t ha^{-1} grain yield. This hybrid is tolerant to mid-season moisture stress.This hybrid is expected to suit multiple cropping systems due to early maturity.

Exploitation strategy

This variety is well adapted to both rainy and postrainy seasons. Further, it has tolerance to mid-season moisture stress. It can be tested in India, Mexico, South Africa, Brazil, USA, Philippines and China for local adaptation.

IPR measures taken or intended

This SWEETFUEL exploitable resultis freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate Material Transfer Agreements.

Further research necessary

Further research includes further testing in hybrid combination with a set of A-lines in a broader range of environments. Its adaptation to other regions can be assessed through multilocation and multi seasonal trials.

Potential / expected impact of exploitation

This variety can be a good source of sugar for biofuel production and it can also be used as fodder, thereby offering opportunities to small farmers for enhancing their income opportunities.

3.10 New sweet sorghum cultivar – ICSV 12007 (ICRISAT – 7)

This SWEETFUEL exploitable result presents an improved sweet sorghum variety derived from a three way cross between (Ch-1 x (DSV 4 x SSV 84) at ICRISAT-Patancheru, India. It flowers in 71 days and grows to a height of 3.4 m. It gives 57 t ha^{-1} stalk yield, 29 t ha^{-1} juice yield, 18.5 % brix, 4.2 t ha^{-1} sugar yield and 4 t ha^{-1} grain yield under better management. This variety is moderately tolerant to mid-season moisture stress.This variety is expected to suit multiple cropping systems due to early maturity.

Exploitation strategy

This variety is well adapted to both rainy and postrainy seasons. Further, it has moderate tolerance to mid-season moisture stress. It can be tested in India, Mexico, South Africa, Brazil, USA, Philippines and China for local adaptation.

IPR measures taken or intended

This SWEETFUEL exploitable resultis freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate Material Transfer Agreements.

Further research necessary

Further research includes further testing in hybrid combination with a set of A-lines in a broader range of environments. Its adaptation to other regions can be assessed through multilocation and multi seasonal trials.

Potential / expected impact of exploitation

This variety can be a good source of sugar for biofuel production and it can also be used as fodder, thereby offering opportunities to small farmers for enhancing their income opportunities.

3.11 New sweet sorghum cultivar – ICSV 12008 (ICRISAT – 8)

This SWEETFUEL exploitable result presents an improved sweet sorghum variety derived from a three way cross between (Ch-1 x (ICSV 93046 x SSV 84) at ICRISAT-Patancheru, India. It flowers in 77 days and grows to a height of 3.3 m. It gives 58 t ha^{-1} stalk yield, 29 t ha^{-1} juice yield, 18.5 % brix, 4.4 t ha^{-1} sugar yield and 4.5 t ha^{-1} grain yield under better management. This variety is moderately tolerant to mid-season moisture stress.

Exploitation strategy

This variety is well adapted to both rainy and postrainy seasons. Further, it has moderate tolerance to mid-season moisture stress. It can be tested in India, Mexico, South Africa, Brazil, USA, Philippines and China for local adaptation.

IPR measures taken or intended

This SWEETFUEL exploitable resultis freely available and the breeding material developed is available freely to SWEETFUEL partners and public sector partners, while private partners can avail the material by becoming members of hybrid parents research consortium and complying of appropriate Material Transfer Agreements.

Further research necessary

Further research includes further testing in hybrid combination with a set of A-lines in a broader range of environments. Its adaptation to other regions can be assessed through multilocation and multi seasonal trials.

Potential / expected impact of exploitation

This variety can be a good source of sugar for biofuel production and it can also be used as fodder, thereby offering opportunities to small farmers for enhancing their income opportunities.

3.12 New sweet sorghum cultivar for rainfed growing condition- OPV 007 (ARC – 1)

This SWEETFUEL exploitable result presents an open pollinated variety selected from the sweet sorghum germplasm collection at the ARC-GCI, South Africa. It flowers in 105 days and grows to 2.5 m height. It records 37 t ha^{-1} stalk yield, 12 t ha^{-1} juice yield, 19% Brix and 1.7 t ha^{-1} sugar yield.

Exploitation strategy

This variety consistently performed top in sugar yield and related traits over the last 3 to 4 seasons under rainfed conditions in South Africa. It has also shown potential in India and Mexico.

IPR measures taken or intended

The seed material can be accessed by signing a Material Transfer Agreement.

Further research necessary

Further research includes testing for adaptation to other regions, and evaluation for hybrid breeding.

Potential / expected impact of exploitation

This variety has shown good potential for biofuel production and high fodder yield.

3.13 Top 5 producing cultivars in South Africa regarding biomass yield, syrup yield and sugar content (ARC – 2)

Cultivar	Biomass t ha^{-1}		Brix %	Syrup t ha^{-1}
s003	76.01	16.24	20.67	
s56	65.94			
s120	47.65	16.68	15.06	
s220	41.19			
s081	38.73			
s007	18.41			
s001			15.73	
s008			15.48	
hg		13.91		
sk12.64				
supa	9.61			

The genotypes s003 and s120 performed the best across 4 localities. Figures are averages across the 4 localities for the 2012/2013 season

Exploitation strategy

These genotypes can be recommended to all stakeholders who want to become involved in Sweetfuel production.

IPR measures taken or intended

None.

Further research necessary

Nitrogen application effects on the syrup yields and TSS composition.

Potential / expected impact of exploitation

Revenue to be collected as soon as biofuel blending come into practice in South Africa.

3.14 Grain Sorghum Female Parent in Sweet Sorghum Hybrids for Mexico – 38ANE (UANL – 1)

This female line was developed at The University of Nebraska and The Facultad de Agronomía, UANL simultaneously. It is a grain sorghum line about 1.10 m tall well adapted to water stress conditions. Due to the lack of female lines selected specifically for sweet sorghum hybrid production, this female line was used to test with sweet sorghum male to produce new hybrids. The female line has a good combining ability and showed good ability to produce good sweet sorghum hybrids.

Exploitation strategy

Due to the good characteristics associated with the response to stress conditions and to produce good sweet sorghum hybrids, the female line has the advantage to facilitate hybrid seed production because it is short and the seed can be harvested using a commercial thrasher machine.

IPR measures taken or intended

Patent application was initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), the Mexican National System for registration and certification of seeds.

Further research necessary

This female line has the disadvantage that the head presents sterility on the bottom part causing a decrease of seed production. Therefore, some research needs to be done to compensate the lack of grain production in this part of the panicle. The female line needs to be tested in crosses with a wide range of maturity male sweet sorghum parents to evaluate sugar and juice production under stress environments in the northern areas of México with high temperature and water stress conditions.

Potential / expected impact of exploitation

This variety can be a good source of sugar for biofuel production and it can also be used as fodder, thereby offering opportunities to small farmers for enhancing their income opportunities.

3.15 Sweet Sorghum Variety for Sweet Sorghum Hybrids in Mexico – ROGER (UANL – 2)

This genotype shows fertility restorer reaction on C1 cytoplasm. This male is a landrace collected by personnel of the Facultad de Agomomía, UANL, in the central part of Tamaulipas in México as part of the SWEETFUEL project. It produces good hybrids with high ºBrix (ºBrix > 16) values and more importantly highjuice production. It has good combine ability with the range of females used. It can also be used as an open pollinated genotype with forage yield above 50 ton ha^{-1}.

Exploitation strategy

This genotype can be used as a male parent. It will restore on C1 cytoplasm. However, it is important to identify the reaction on other types of cytoplasm to find the opportunity to create new females with good characteristics for bioethanol production (high sugar and good juice production). This variety can also be tested with other females to analyze the hybrid produced based on juice and sugar content. This genotype can also be used to cross with other sweet sorghum males using hand emasculation to produce new combinations and make new males with high sugar and juice production.

IPR measures taken or intended

Patent application was initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), the Mexican National System for registration and certification of seeds.

Further research necessary

This male shows some variation due to the open pollinated characteristics. The variety needs to be more uniform through several self-generations. It is important to produce more homogeneous genotypes to produce more uniform sweet sorghum hybrid. This male needs to be tested with a wide range of sweet sorghum female lines to increase the probability to produce better sweet sorghum hybrids.

Potential / expected impact of exploitation

The use of this male variety will produce good forage quality and high yield. This male will increase the probability to find better sweet sorghum hybrids for ethanol production.

3.16 Sweet Sorghum Hybrid for Mexico – 7ROGER (UANL – 3)

This hybrid is a product of the breeding program at Facultad de Agronomía, UANL, México as part of the SWEETFUEL project. The female line is a short grain sorghum line (70 cm tall) well adapted to the northern part of México and it was improved by the sorghum breeding program at UANL. The male parent of the hybrid is FAUANL-39, which is a derivative of a local variety from the central part of Tamaulipas. The hybrid is suitable for high juice production with more than 16 % of ºBrix.

Exploitation strategy

Due to the good characteristics associated with ethanol production and the facility to produce hybrid seeds due to the fact that the A line is a short plant (70 cm tall), it has a lot of potential to produce hybrid seeds. It can also be used as one of the sweet sorghum hybrids in Mexico.

IPR measures taken or intended

Patent application was initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), the Mexican National System for registration and certification of seeds.

Further research necessary

The hybrid needs to be tested under semi-commercial plots using the nitrogen doses and the best plant density to be tested against RB-Cañero,one of the sweet sorghum varieties in México. However, its expression under environments more suitable for commercial sweet sorghum exploitation (near Veracruz, South of Tamaulipas and Sinaloa, México)needs to be evaluated. The male line needs to be selfed for several generations to achieve more uniform male parents and consequently hybrids.

Potential / expected impact of exploitation

The commercial distribution of the seeds of this hybrid will give the advantage to farmers to have good forage production and high juice content to improve feed quality. But, most importantly it gives the opportunity to farmers to produce a fuel crop thereby improvingproductivity of their fields.

3.17 New Sweet Sorghum Female Line – POTRANCA (UANL – 4)

The lack of parental female lines (lines “A”), specifically selected for characteristics such as high juice and ºBrix, has limited the formation of top hybrids that facilitate seed production and increase the raw material base for bioethanol production. After a previous selection in Marín, México, during spring 2009, Rox Orange was used as source of “B” reaction genes, due to the relative high ºBrix values and sterility performance in different environments.

In spring 2009, Rox Orange was crossed with FAUANL-33, grain sorghum “A” line that was used as source of genetic-cytoplasmic sterility. The backcross was using Rox Orange as a recurrent parent. After the RC_6 backcrossing generation, the new “A” line was identified as POTRANCA. Some characteristics of this A-B pair are: 285 and 246 ml for juice; stem weight 1309 and 1211 g; head weight 144 and 112 g, and 20.3 and 20.0 ºBrix, respectively (data on 0.8 m^2).

Exploitation strategy

In México, the opportunity of sweet sorghum to produce bioethanol is high. This is because sorghum is already planted on close to 2 million ha and there are potential areas not being used effectively. On the other hand, sugar cane and corn are not possible to be considered to produce bioethanol because the social aspects involved. Therefore, good sweet sorghum hybrids are important and POTRANCA A/B is an option to produce hybrid seeds, as currently commercial female lines, specifically selected for juice and brix, are not available.

IPR measures taken or intended

Patent application was initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), the Mexican National System for registration and certification of seeds.

Further research necessary

Rox Orange is a variety and the backcrossing process may lead to form lines which are not a hundred percent homozygous. Therefore it may be necessary to evaluate experimental hybrids to measure the variability that may be exist by using different male parents. On the other hand, Rox Orange produces heads that are not big, and the amount of seeds produced is low. Therefore, it is necessary to select large heads from the Rox Orange population and investigate the impact on seed production.

Potential / expected impact of exploitation

The commercial use of this POTRANCA A/B pair to produce sweet sorghum hybrids will increase the probability to produce hybrids with higher expression of the characteristics associated with bioethanol production and improve the opportunities to be more productive in a system focused on bioethanol production.

3.18 Sweet Sorghum Hybrid for the Northeastern Part of Mexico – WROGER (UANL – 5)

This hybrid is a product of the breeding program at Facultad de Agronomía, UANL, México as part of the SWEETFUEL project. The female line is a grain sorghum line derivative of Wheatland in 1994 and the male line (FAUANL-39) is a derivative of a landrace collected in the state of Tamaulipas in 2007.

Both parents were improved by the sorghum breeding program at UANL. The hybrid has been tested at experimental level under different nitrogen and density levels. It has a Total Fresh Weight near 80 ton ha^{-1}, high juice production (862 ml of juice/5 plants),16.0 brix.

Exploitation strategy

Due to the good characteristics associated with ethanol production and the facility to produce hybrid seeds due to the fact that the A line is a short plant (100 cm tall), it has a lot of potential to produce hybrid seeds and to be competitive in México as a dual purpose hybrid (sugar in the juice + forage production).

It can also be used as one of the sweet sorghum hybrids in Mexico, and as a check in the Breeding Project for Sweet Sorghum approved by the Mexican Government in 2012 to produce at least one sweet sorghum hybrid for the main sorghum production areas in Mexico. UANL is part of the Mexican Project due to its recognition of the sorghum breeding work made within the SWEETFUELproject.

IPR measures taken or intended

Patent application was initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), the Mexican National System for registration and certification of seeds.

Further research necessary

The hybrid needs to be tested under semi-commercial plots using the nitrogen doses and the best plant density to be tested against RB-Cañero,the only sweet sorghum variety registered in México so far. However, its expression under environments more suitable for commercial sweet sorghum exploitation (near Veracruz, South of Tamaulipas and Sinaloa, México)needs to be evaluated. The hybrid also needs also to be characterized according to the UPOV for registration and protection.

Potential / expected impact of exploitation

The commercial distribution of the seeds of this hybrid will give the advantage to farmers to have good forage production and high sugar content to improve feed quality. But, most importantly it gives the opportunity to farmers to produce a fuel crop thereby improvingproductivity of their fields.

3.19 Sweet Sorghum Variety to Produce New Female for Sweet Sorghum Hybrids in Mexico – WYR (UANL – 6)

This fertile genotype shows sterility reaction when crossed with females on C1 cytoplasm. This male was selected among other genotypes with the same reactions due to the superiority on ºBrix (ºBrix > 20) and more stable sterility reaction in different environments. It is a derivative of Rox Orange produced at the Facultad de Agomomía, UANL. It was used to produce the first sweet sorghum female line known in Mexico selected specifically for sweetness and juice production.

Exploitation strategy

This genotype can be used as a male parent to produce new sweet sorghum females when crossed with other sweet sorghum males (with B reactions) using hand emasculation to produce new combinations. This approach can be effective using sweetness and juice production as selection criteria. The females being produced can be used to make better hybrids with top values for ºBrix and juice production.

IPR measures taken or intended

Patent application was initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), the Mexican National System for registration and certification of seeds.

Further research necessary

This male shows some variation due to the open pollinated characteristics. The variety needs to be more uniform through several self-generations. It is important to produce more homogeneous genotypes to produce more uniform sweet sorghum females and consequently more uniform hybrids. This male needs to be tested in a wide range of environments to evaluate the fertility reactions.

Potential / expected impact of exploitation

The use of this male variety will produce good forage quality and high yield. This male will increase the probability to find better sweet sorghum hybrids for ethanol production.

3.20 Sweet Sorghum Hybrid for Mexico – 7KEY (UANL – 7)

This hybrid is a product of the breeding program at Facultad de Agronomía, UANL, México as part of the SWEETFUEL project. The female line is a short grain sorghum line (70 cm tall) well adapted to the northern part of México and it was improved by the sorghum breeding program at UANL. The male line of the hybrid is Keller, with the highest ºBrix reading values (>22 %). This hybrid has been tested at experimental level under different nitrogen and density levels showing ºBrix values > 17 %.

Exploitation strategy

Due to the good characteristics associated with ethanol production and the facility to produce hybrid seeds due to the fact that the A line is a short plant (70 cm tall), it has a lot of potential to produce hybrid seeds. It can also be used as one of the sweet sorghum hybrids in Mexico.

IPR measures taken or intended

Patent application was initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), the Mexican National System for registration and certification of seeds.

Further research necessary

The hybrid needs to be tested under semi-commercial plots using the nitrogen doses and the best plant density to be tested against RB-Cañero,one of the sweet sorghum varieties in México. However, its expression under environments more suitable for commercial sweet sorghum exploitation (near Veracruz, South of Tamaulipas and Sinaloa, México)needs to be evaluated.

Potential / expected impact of exploitation

The commercial distribution of the seeds of this hybrid will give the advantage to farmers to have good forage production and high juice content to improve feed quality. But, most importantly it gives the opportunity to farmers to produce a fuel crop thereby improvingproductivity of their fields.

3.21 Sweet Sorghum Variety for Sweet Sorghum Hybrids in Mexico – MEXINDU (UANL – 8)

This genotype shows fertility restorer reaction on C1 cytoplasm. This male is a derivative of Urja. It was selected at the Facultad de Agronomía of the UANL to improved grain production in the panicle. Mass selection was used for three generations. During the SWEETFUEL project it was used with female lines to produce good sweet sorghum hybrids with ºBrix values higher than 18. The experimental hybrids showed good expression on ºBrix and juice production.

Exploitation strategy

Due to the good characteristics associated with ºBrix and juice production, this male needs to be tested on the new female sweet sorghum lines. This genotype can also be used to cross with other sweet sorghum males using hand emasculation to produce new combinations and new males with high sweetness and juice. This male itself can be used in a commercial production systems focused on ethanol production or forage production because of high productivity levels.

IPR measures taken or intended

Patent application was initiated at SERVICIO NACIONAL DE INSPECCION Y CERTIFICACION DE SEMILLAS (SNICS), the Mexican National System for registration and certification of seeds.

Further research necessary

This male shows some variation due to the open pollinated characteristics. The variety needs to be more uniform through several self-generations. It is important to produce more homogeneous genotypes to produce more uniform sweet sorghum hybrid. This male needs to be tested with a wide range of sweet sorghum female lines to increase the probability to produce better sweet sorghum hybrids.

Potential / expected impact of exploitation

The use of this male variety will produce good forage quality and high yield. This male will increase the probability to find better sweet sorghum hybrids for ethanol production.

3.22 New Sweet Sorghum Cultivar – BRS 508 (EMBRAPA – 1)

BRS 508 is a variety developed by Embrapa Maize and Sorghum to meet the growing demand for complementary feedstock as an alternative to sugarcane for ethanol production. This cultivar has high yield potential of stems (average 50-70 t ha^{-1}) and high levels of fermentable sugars in the juice (total sugar 18-20 g L^{-1} at the maturity peak),2.0 t ha-1 grain yield, and resistance to lodging and to major pathogens. Average maturity cycle for the production of ethanol is about 115-125 days after sowing, and with a period of industrial utilization (PUI) of more than30 days.

Sugar profile of juice* extracted from stems of the sweet sorghum variety BRS 508

Trait	g L^{-1}
Sucrose	142.60
Glucose	29.60
Fructose	7.41
Total reduced sugars	179.61
Brix (°B)	22.9

* Values subject to variations according to climatic conditions, crop management and harvest period.

Exploitation strategy

Sweet sorghum can be grown in all areas currently recommended for sugarcane production in Brazil. Sorghum can provide quality feedstock during the period between the months of February and April, before the beginning of sugarcane harvest for ethanol production, extending the total harvest period of distilleries for two additional months.

IPR measures taken or intended

The results of this project from Embrapa are freely available and the breeding materials developed and released herein are available for licensing by the private sector for seed production and commercialization. SWEETFUEL partners have had and continue to have access to both experimental and released cultivars with appropriate Material Transfer Agreements.

Further research necessary

This and other varieties (R-lines) will continue to be evaluated in an evaluation network as male parents of sweet sorghum hybrids as new sweet sorghum female lines (A and B lines) become available. Adaptation to other regions can be assessed through multi location and multi seasonal trials.

Potential / expected impact of exploitation

Research is currently underway to produce sweet sorghum during the period of sugarcane renovation (20% total area recommended annually) during the months of November to May to provide an alternative feedstock to anticipate sugarcane harvest and distillery operation by up to 60 or more days before the beginning of sugarcane harvest in April and May, increasing ethanol output and reducing ethanol production and operational costs.

3.23 New Sweet Sorghum Cultivar – BRS 509 (EMBRAPA – 2)

BRS 509 is a variety developed by Embrapa Maize and Sorghum to meet the growing demand for complementary feedstock as an alternative to sugarcane for ethanol production. This cultivar has high yield potential of stems (average 60-80 t ha^{-1}) and high levels of fermentable sugars in the juice (total sugar 16-20 g L^{-1} at the maturity peak),2.0 t ha-1 grain yield,and resistance to lodging and to major pathogens. Average maturity cycle for the production of ethanol is about 115-125 days after sowing, and with a period of industrial utilization (PUI) more than30 days.

Sugar profile of juice* extracted from stems of the sweet sorghum variety BRS 509

Trait	g L^{-1}
Sucrose	144.5
Glucose	36.3
Fructose	5.2
Total reduced sugars	185.9
Brix (°B)	20.7

* Values subject to variations according to climatic conditions, crop management and harvest period.

Exploitation strategy

Sweet sorghum can be grown in all areas currently recommended for sugarcane production in Brazil. Sorghum can provide quality feedstock during the period between the months of February and April, before the beginning of sugarcane harvest for ethanol production, extending the total harvest period of distilleries for two additional months.

IPR measures taken or intended

The results of this project from Embrapa are freely available and the breeding materials developed and released herein are available for licensing by the private sector for seed production and commercialization. SWEETFUEL partners have had and continue to have access to both experimental and released cultivars with appropriate Material Transfer Agreements.

Further research necessary

This and other varieties (R-lines) will continue to be evaluated in an evaluation network as male parents of sweet sorghum hybrids as new sweet sorghum female lines (A and B lines) become available. Adaptation to other regions can be assessed through multi location and multi seasonal trials.

Potential / expected impact of exploitation

Research is currently underway to produce sweet sorghum during the period of sugarcane renovation (20% total area recommended annually) during the months of November to May to provide an alternative feedstock to anticipate sugarcane harvest and distillery operation by up to 60 or more days before the beginning of sugarcane harvest in April and May, increasing ethanol output and reducing ethanol production and operational costs.

3.24 New Sweet Sorghum Cultivar – BRS 511 (EMBRAPA – 3)

BRS 511 is a variety developed by Embrapa Maize and Sorghum to meet the growing demand for complementary feedstock as an alternative to sugarcane for ethanol production. This cultivar has high yield potential of stems (average 60-80 t ha^{-1}) and high levels of fermentable sugars in the juice (total sugar 18-20 g L^{-1} at the maturity peak), 2.0 t ha-1 grain yield,and resistance to lodging and to major pathogens. Average maturity cycle for the production of ethanol is about 115-125 days after sowing, and with a period of industrial utilization (PUI) more than30 days.

Sugar profile of juice* extracted from stems of the sweet sorghum variety BRS 511

Trait	g L^{-1}
Sucrose	154.8
Glucose	33.3
Fructose	5.9
Total reduced sugars	194.0
Brix (ºB)	21.9

* Values subject to variations according to climatic conditions, crop management and harvest period.

Exploitation strategy

Sweet sorghum can be grown in all areas currently recommended for sugarcane production in Brazil. Sorghum can provide quality feedstock during the period between the months of February and April, before the beginning of sugarcane harvest for ethanol production, extending the total harvest period of distilleries for two additional months.

IPR measures taken or intended

The results of this project from Embrapa are freely available and the breeding materials developed and released herein are available for licensing by the private sector for seed production and commercialization. SWEETFUEL partners have had and continue to have access to both experimental and released cultivars with appropriate Material Transfer Agreements.

Further research necessary

This and other varieties (R-lines) will continue to be evaluated in an evaluation network as male parents of sweet sorghum hybrids as new sweet sorghum female lines (A and B lines) become available. Adaptation to other regions can be assessed through multi location and multi seasonal trials.

Potential / expected impact of exploitation

Research is currently underway to produce sweet sorghum during the period of sugarcane renovation (20% total area recommended annually) during the months of November to May to provide an alternative feedstock to anticipate sugarcane harvest and distillery operation by up to 60 or more days before the beginning of sugarcane harvest in April and May, increasing ethanol output and reducing ethanol production and operational costs.

3.25 New Biomass Sorghum Cultivar – CMSXS7015 (EMBRAPA – 4)

CMSXS 7015 is a biomass photosensitive hybrid developed by Embrapa Maize and Sorghum to meet the growing demand for complementary feedstock as an alternative to sugarcane for second generation (G2) ethanol production and co-generated energy (CO). This cultivar has high yield potential of fresh biomass (150-190 t ha^{-1}), dry biomass (50-60 t ha^{-1}), and high levels of fiber content (22-28%), low moisture in biomass (50-60%), energy content (4000 kcal kg^{-1}), resistance to lodging and to major pathogens. Average maturity cycle for the harvest is about 150-180 days after sowing.

Exploitation strategy

Biomass or Energy sorghum can be grown in all areas currently recommended for sugarcane and maize production in Brazil. This sorghum can provide quality feedstock during the months of March through July for G2 technology to produce ethanol or to burn directly to generate water vapor (CO) that can be used in industrial operations or for generating electricity.

IPR measures taken or intended

The results of this project from Embrapa are freely available and the breeding materials developed and released herein are available for licensing by the private sector for seed production and commercialization. SWEETFUEL partners have had and continue to have access to both experimental and released cultivars with appropriate Material Transfer Agreements.

Further research necessary

Embrapa will continue to develop and release biomass photosensitive hybrids as a feedstock for G2 technologies to produce ethanol or to burn directly to generate water vapor that can be used in industrial operations or for generating electricity. Embrapa is developing biomass hybrids with lower lignin for G2 applications and with higher lignin for CO technologies.

Potential / expected impact of exploitation

This technology can provide energy independence for industries requiring large amounts of energy for industrial processes. The designing of biomass hybrids with low or high lignin content depending upon industrial processing increases energy output and reduces energy costs.

3.26 Implications of Photoperiod sensitivity for developing multi-purpose food/feed/fuel sweet sorghum varieties (CIRAD – WP4 – 1)

Photoperiod sensitivity is a key adaptive behaviour of sorghum enabling to synchronize flowering time with the end of the rainy season. Where sorghum is rain-fed, farmers are used to 'play' with photoperiod sensitivity to adjust sowing date to the increasingly erratic onset of the rainy season. By this way, crop growth is ensured and grain matures under drier conditions, reducing bird and mold damages. Accordingly, vegetative phase duration and thus plant size and biomass production can strongly vary.

With that respect, we could point out that photoperiod sensitivity is of major interest for enhancing sugar production by sweet sorghum: based on field experiments (in Mali) on a panel of 14, variably sweet and photoperiodic, tropical sorghum accessions, it was shown that early sowing improved considerably sugar production, due to a longer vegetative phase and higher biomass accumulation. Sugar concentration per biomass unit and juiciness were not affected by sowing date.

Exploitation strategy

This result provides further insight on the traits and the genetic material to be addressed in sorghum (pre)breeding programmes dedicated to sucrose production. It was already used to define research activities in two companion (subsequent) projects of SWEETFUEL, where the genetic diversity of photoperiodic sorghum panels for traits related to biomass production (organ and plant size) and composition (sucrose, juiciness, but also lignocellulose): the French project "Biomass for the Future" (BFF, 2012-2020) and the French-Italian project "Biosorg" (2014-2016).

IPR measures taken or intended

N/A

Further research necessary

Further researches are needed to unravel the genetic, physiological and environmental control of the complex feedback between whole plant phenology and C allocation to stem (internode) components. This will be performed in BFF and Biosorg projects. It should be reinforced by a common project between CIRAD and Embrapa CNPMS (both partners of SWEETFUEL) dedicated to the valorisation of photoperiod sensitivity for sorghum usage diversification.

Potential / expected impact of exploitation

Accepted projects: French project *Biomass For the Future* (http://www.biomassforthefuture.org) and BioSorg (Franco-Italian project)

Publications: **S. Gutjahr, M. Vaksmann, M. Dingkuhn, K. Thera, G. Trouche, S. Braconnier, D. Luquet**, Grain, sugar and biomass accumulation in tropical sorghums. I. Trade-offs and effects of phenological plasticity, Functional Plant Biology, 40 (2013) 342–354.

3.27 Sugar and grain production can be combined in multi-purpose (food/feed/fuel) sorghum varieties (CIRAD – WP4 – 2)

A set of experiments in subtropical field conditions (Mali) and in a greenhouse in Montpellier (France) on a panel of 14 genotypes expressing diversity in terms of photoperiod sensitivity, juiciness and sweetness, could point out that sugar and grain production were not in competition for carbohydrates along grain filling phase whatever the genotype and the sowing date. Early sowing enabled to increase sugar production for photoperiodic sorghum while it did not affect grain yield.

Combining high sugar and grain productions is physiologically and genetically possible.

Exploitation strategy

This result provides further insight on the role sweet sorghum can play for reducing the competition for land and resource use for food, feed and fuel productions. This will be valorised in a companion project of Sweetfuel by exploring the genetic diversity of photoperiod sensitive sorghum for traits related to biomass composition (including sucrose and ligno-cellulosic components) and production, panicle size and grain quality: French-Italian project Biosorg (2014-2016).

IPR measures taken or intended

N/A

Further research necessary

Further research is needed to understand to which extent a post flowering drought can amplify the level of competition between grain and sugar yield elaborations. A phD is on-going with this respect in collaboration between CIRAD and CERAAS (Senegal).

Genetic bases will be further explored in the abovementioned Biosorg project.

Potential / expected impact of exploitation

Accepted projects: BioSorg (Franco-Italian project)

Publication: **S. Gutjahr, M. Vaksmann, M. Dingkuhn, K. Thera, G. Trouche, S. Braconnier, D. Luquet**, Grain, sugar and biomass accumulation in tropical sorghums. I. Trade-offs and effects of phenological plasticity, Functional Plant Biology, 40 (2013) 342–354.

S. Gutjahr, M. Vaksmann, M. Dingkuhn, K. Thera, G. Trouche, S. Braconnier, D. Luquet, Grain, sugar and biomass accumulation in tropical sorghums. II. Biochemical processes at internode level and interaction with phenology, Functional Plant Biology, 40 (2013) 355–368.

3.28 A model enabling to explore the impact of morphological, phenological and physiological trait combination on sugar and grain productions (CIRAD – WP4 – 3)

A plant growth model initially dedicated to simulate rice and sorghum vegetative morphogenesis, Ecomeristem, was adapted during the SWEETFUEL project in order to account for traits contributing to sugar production, i.e. related to plant phenology vs organ morphogenetic characteristics: internode (sink) and leaf (source) elongation rate, size and number, internode sweetness capacity and panicle initiation.

Accordingly the model is available to explore optimal trait combination and maximize sugar production in targeted environments.

Exploitation strategy

This modelling approach will be used in at least two companion projects of SWEETFUEL in support to (pre)breeding process: French project “Biomass for the Future” (BFF, 2012-2020) and French-Italian project “Biosorg” (2014-2016).
In these projects Ecomeristem will be used to analyse phenotypes within existing genetic diversity (trait quantification: phenotyping) and explore ideotypes for maximizing targeted production(s) in targeted environments.

IPR measures taken or intended

N/A

Further research necessary

The consideration of drought effect as well as the post-flowering competition with grain filling is underway and will provide at the end of the project a relevant tool to analyse and explore dual purpose (grain/sugar) phenotypes and genotype X environment interactions.

Further researches are needed to improve Ecomeristem for appropriately formalizing the genotypic (genetic) and environmental bases of carbon allocation to internode components (sucrose, lignocellulose). This will be performed in BFF and Biosorg projects.

Potential / expected impact of exploitation

Accepted projects: French project *Biomass For the Future* (http://www.biomassforthefuture.org) and BioSorg (Franco-Italian project).

3.29 Differential gene response to decreasing water soil content during early developmental phases (UCSC – 1)

Water availability during early vegetative stage is a major determinant of plant biomass yield, also for a drought resistant species like *Sorghum bicolor* (Moench). Investigations on the gene response to decreasing water availability are needed to advance the knowledge on the mechanisms and processes related to drought stress tolerance.

Genes involved in drought response were identified using a high density microarray containing all available sorghum TC sequences, as well as several rice and maize TC sequences known to be involved in water deficitresponse. The microarray analysis revealed that the response to drought started between 3.65 and 4.14pF, when plant transpiration sharply decreased. Until 3.65 pF value most of the differentially expressed genes where down-regulated, indicating that the early response at the beginning of water stress consists in a reduction of some metabolic functions (sugar and aminoacid metabolism).

Exploitation strategy

These results provide further insight in the complex metabolic pathway triggered by drought stress. The genes that are differentially expressed and located in drought tolerance QTLs (for example stay-green traits) could be used as molecular marker for the drought tolerance trait. Furthermore, the same genes could be important tools to screen different sorghum varieties directly in the laboratories. In this easy and fast way, waste of time and water (required for the field trials) could be avoided.

IPR measures taken or intended

N/A

Further research necessary

The microarray results are a snapshot of the functional status of young sorghum leaves under drought stress. Further research activities are needed to better characterize the differentially expressed genes as real drought tolerance traits and to identify molecular markers for drought tolerance.

For these reasons, additional studies of phenotypization will be performed in different sorghum varieties to better understand the connection between genetics and plant physiology at the beginning of water stress.

Potential / expected impact of exploitation

Publication: **L. Pasini, M. Bergonti, A. Fracasso, A. Marocco, S. Amaducci**. Microarray analysis of differentially expressed mRNAs and miRNAs in young leaves of sorghum under dry-down conditions, Journal of Plant Physiology, in press.

3.30 Physiological characterization of sorghum varieties under dry-down experiment (UCSC – 2)

Physio-phenological characterization is needed to better understand the connection between genetics and plant physiology under water stress conditions. For this purpose, six different sorghum varieties were compared in a dry-down experiment. Physiological parameters, like leaf area, transpiration rate, leaf relative water content, gas exchange measurements and chlorophyll fluorescence were monitored continuously during two dry-down pot experiments. Aboveground biomass production and relative tolerance index, drought susceptibility index and relative growth rate were also measured.

This physiological characterization highlighted some interesting and contrasting behaviour among the genotypes. In particular, the tolerant IS22330 genotype, belonging to the durra race adopts a “conservative strategy” reducing leaf area, leaf expansion rate, closing stomata and interrupting photosynthetic rate when the drought stress occurs. The corresponding IS20351 drought susceptible genotype, on the other hand, keeps high leaf expansion and transpiration rates at increasing water stress levels until it sharply decreases. This kind of “productive strategy” is not suitable to drought prone environments. In our experiment we also combined the physiological characterization to molecular biology. Genes previously identified as potentially drought tolerance markers were used to screening the sorghum genotypes.

Exploitation strategy

Our results represent an important step forward in the knowledge of the underlying mechanism that regulates the gene expression. The strong relationship between the physiological traits and the over-expression of some drought related genes represents a good starting point to deepen our knowledge on sorghum drought tolerance. Using genes drought related, previously identified in a microarray experiment, to screen different sorghum varieties could be a smart solution to know in very quick time which genotypes are more tolerant to drought stress. In the early phase of characterization this method could be also useful to avoid waste of water required for field trials.

IPR measures taken or intended

N/A

Further research necessary

Further research activities will be carried out to understand the daily course of photosynthesis of the two studied genotypes from the onset of water stress and until severe stress. Knowing how the plants respond to water stress and which is their water use efficiency is important to optimise irrigation.

Potential / expected impact of exploitation

These results will be published as part of a PhD thesis.

3.31 Sensitivity Analysis of Growth Stages to Drought and its Implications on Sweet Sorghum Productivity (UANL – WP4 - 1)

Sorghum life cycles are divided in three basic developmental stages. The growth accumulation in each is different and the effect on the final production of sorghum dependson the sensitivity of each to stress factors. Drought and high temperature are the most common stress factors in sorghum production areas in Mexico.

Pre-flowering is divided in two stages: Vegetative stage and Floral organs formation stage. Post-flowering is associated with the stage of grain formation. Pre-flowering is most important in sweet sorghum and other crops because during this phase, the plants differentiate the structure associated with the raw material related to ethanol production. The identification of sweet sorghum hybrids or varieties less affected by drought during this stage will help to increase productivity.

Exploitation strategy

In México, sorghum is mostly grown under dryland conditions. During sowing of the seeds there is good moisture in the soil. However, the moisture level starts to decrease fast without rain or irrigation to supply water in the ground. Therefore, it is important to identify genetic material less affected by the stress during the pre-flowering phase.

IPR measures taken or intended

N/A

Further research necessary

In sorghum there are several examples of compensation effects in the plant, such as seed size compensating seed number. It is important to identify compensation effects during the post-flowering phase compensating the negative effect of a stress during the pre-flowering phase, such as increasing the length of the period between flowering and physiological maturity. This will allow the plant to be active for longer time with better chances to maintain productivity levels.

Potential / expected impact of exploitation

Genotypes with better adaptation to early draught stress, will help to reduce the negative effects under dryland conditions in some parts of México.

3.32 Sensitivity Analysis of Growth Stages to Draught and its Implications on Sweet Sorghum Productivity (UANL – WP4 - 2)

SCAR (Sequence Characterized Amplified Region) is a possible technique to identify markers associated with sugar concentration. In sorghum, previous work done using this technique, has been focused to identify a RAPD (randomly amplified polymorphic DNA) marker closely linked to a gene for resistance to anthracnose *Colletotrichum graminicola* (Ces.) and resistance to blight *Exserohilum turcicum* leaf.

Within SWEETFUEL 54 RAPD markers were identified that had the property of being present in the high genotypes sugar: AN601 x FAUANL-39, FAUANL-35A x FAUANL-39 and FAUANL-33A x FAUANL-5 while they were absent in the lowest genotypes sugar: FAUANL-37A, FAUANL-33A and FAUANL-35A. The sequencing process was not successful for all fragments. However, for fragments aligned with genomic sequences of *Sorghum bicolor* sp. six SCAR primerswere identified.

Exploitation strategy

SCAR markers obtained provide a further biotechnological technique that could be used to define strategies for marker assisted selection in sorghum germplasm for sweetness to improve bioethanol production.

IPR measures taken or intended

N/A

Further research necessary

Specific primers designed (SCAR markers) need to be screened on F2 sorghum populations for early identification of appropriate genotypes for sweet sorghum pre-breeding programs focusing on bioethanol production.

Potential / expected impact of exploitation

Development of SCAR markers will allowan early selection of individual plants as potential candidates to improve the breeding focused on high content of sugar.

3.33 Adaptability of commercial biomass sorghum hybrids to cold conditions (UNIBO – 1)

The adaptability of biomass sorghum to cold conditions and early sowing under temperate climates was evaluated. Seven commercial hybrids (Bulldozer, Tarzan, Zerberus, ICSSH 19, ICSSH 58, ICSSH 31, and Monster) were sown at four sowing times. The sowing dates ranged from early spring to the end of spring. Bulldozer hybrid was better adapted to early sowing times in terms of seedling physiology and biomass productivity thanks to an extended growing season.

Exploitation strategy

The cultivation zones of Bulldozer could be extended to cold temperate climates of central Europe thanks to its adaptability to early sowing.

IPR measures taken or intended

N/A

Further research necessary

Multi location trials should be carried out to evaluate the adaptability of commercial hybrids such as Bulldozer to variable environmental conditions.

Potential / expected impact of exploitation

This commercial hybrid could be used as a reference crop for establishing biomass sorghum as feedstock for 1st and 2nd generation biofuels.

3.34 Perspectives for farmers to harvest and in-field store sweet sorghum juice and bagasse (UNIBO – 2)

The definition of appropriate harvesting methods and storage techniques for maximizing ethanol production directly from sweet sorghum juice or from structural sugars has the potential to ensure economic benefits to sweet sorghum farmers.

Currently, however, the development of such technologies in European temperate climates, where sweet sorghum is a relatively new crop, is limited. Determining low cost and efficient processing systems would allow to harvest and store directly within the farm installations sweet sorghum juice as un-distilled ethanol and the remaining bagasse as ensiled material for further processing.

It was demonstrated that harvesting around the hard dough stage and defoliating the plants before juice extraction result in higher ethanol yields. Moreover, the use of fructophilic yeast types allows maximizing un-distilled ethanol yields and storing it for about one year without spoilage damages. Finally,the energetic conservation properties of ensiled bagasse can be improved by inoculation with a mixture of lactobacillus bacteria.

Exploitation strategy

The extrapolation of these results to real farmers' conditions could further increase the potential expansion of sweet sorghum cultivation into non-traditional areas.

IPR measures taken or intended

N/A

Further research necessary

Further research is needed on more efficient ways of extracting the juice, on triggering the yeast fermentation of sugars without any process control into ethanol immediately after the harvest, and on storing the remaining bagasse.

Potential / expected impact of exploitation

Small/medium scale farmers could easilyapply these simplified harvest and storage methods without the need of specialized knowledge and/or costly equipment.

3.35 Technological Package for Sweet Sorghum in the Northeastern Part of México (UANL – WP5 -1)

The best agronomic practices will allow expressing the yield potential in the varieties and hybrids of sweet sorghum genotypes.

Plant density, fertilization and planting dates are the most important aspects to consider in sorghum productivity. According to the results the best plant density was 125 mil plants/ha for grain yield. However, there was no difference in juice and ºBrix per plant with 250,000 plants ha^{-1}. Therefore high potential for juice production can be present under high plant densities.

The fertilization depends on the soil type, and the fertilization doses will depend of the natural fertility of the soil, the right moment of application and the source of the fertilization elements. Organic fertilization is also possible.

Exploitation strategy

To create a pamphlet with information that allows farmers to know the right agricultural practices to increase productivity in the fields and also to promote advantages of sweet sorghum.

IPR measures taken or intended

N/A

Further research necessary

Further research will focus on the identification of sustainable sources of N fertilization suitable for environments under stress and to work with farms to better represent the variability in existing production systems in Mexico.

Potential / expected impact of exploitation

Improved agricultural practices may reduce the amount of N used to grow a crop in sweet sorghum production systems, and thus decrease the cost of the production in fields with sweet sorghum crop.

3.36 Technological assessmentof sweet and biomass sorghum (CIRAD – 1)

The technological assessment defines all sweet and biomass sorghum scenarios investigated in the SWEETFUEL project, and evaluates differences in the technology of sweet and biomass sorghum cultivation and processing. The assessment focuses mainly on cultivation aspects since those differ greatly due to different growing regions coupled with various production practices, environmental conditions and economic resources.Several indicators such as cultivation experience, breeding potential and harvest technology were defined and evaluated. The purpose of this assessment was to identifytechnological potentials, challenges and bottlenecks which might occur if sweet and biomass sorghum are used as bioenergy crops.

Exploitation strategy

The technological assessment was published in a detailed report, which is available on the SWEETFUEL homepage.

IPR measures taken or intended

N/A

Further research necessary

Results of the technological assessment show that there is a great potential to further improve technological conditions of bioenergy production from sweet and biomass sorghum. In the case of sweet sorghum cultivation, for example, further research is especially needed to enhance the harvest technology in order to harvest the entire plant and make leaves and grains accessible to bioenergy production.

Potential / expected impact of exploitation

Information and facts of the technological assessment may help stakeholders (politicians, scientists and researchers, industry, NGOs) to recognize and overcome technological challenges and to identify technological potentials as aims to be pursued in further projects.

3.37 Environmental assessmentof sweet and biomass sorghum (IFEU – 2)

The environmental assessment analysedthe impacts of sweet and biomass sorghum cultivation and use as bioenergy crops. It covers the entire production chains of all considered SWEETFUEL scenarios in various settings. Sweet sorghum is mainly processed into ethanol. In the case of biomass sorghum, primarily biogas and biomethane production was considered but alsoalternative use options of the biomass, such as2nd gen. ethanol, gasification or direct combustion. The assessment uses life cycle assessment (LCA) methodology (for implications e.g. on climate, acidification etc.) supplemented by a novel life cycle environmental impact assessment (LC-EIA), which covers local impacts. The objective was to identify the most promising pathways in environmental terms, to determine optimisation potentials and to compare the SWEETFUEL concept to conventional production chains.

Exploitation strategy

The results were and will be presented on several national and international conferences and are going to be published in a detailed report on the SWEETFUEL homepage (Reinhardt et al.: Report on environmental assessment, 2014, www.sweetfuel-project.eu). Furthermore, the results strongly contribute to the integrated sustainability assessment of this project and to several other projects regarding the production of bioenergy from crops.

IPR measures taken or intended

N/A

Further research necessary

Since there is a potential for optimising the production of bioenergy from sweet and biomass sorghum, further research is needed, amongst others, on breeding improved crop cultivars that aim at higher yields and a lower nutrient content in the harvested biomass to reduce the applied amount of mineral fertiliser per hectare.

Potential / expected impact of exploitation

Results of the environmental assessment may help stakeholders (politicians, scientists and researchers, industry, NGOs) to better understand the environmental implications of sweet and biomass sorghum cultivation and use, to realise potentials and to avoid associated risks.

Selected publications:

Köppen, S.: Sweet Sorghum first and second generation bioethanol – an environmental perspective. 6th International Conference on Biomass for Energy, Kyiv, 14 - 15 September 2010. Conference proceedings published on CD, to be ordered via http://biomass.kiev.ua/en/en/conferences, 2010

Rettenmaier, N.: Environmental implications associated with sweet sorghum production and use for biofuels. EUROCLIMA Workshop on the agro-environmental impact of biofuels and bioenergy (organised by JRC, UNICAMP & CTBE), Campinas, Brazil, 30 Nov –1 Dec 2011, http://re.jrc.ec.europa.eu/biof/pdf/ euroclima_brazil/rettenmaier_sweet_sorghum.pdf, 2011

Reinhardt, G.: Environmental implications (LCA) associated with biofuels. Presentation at the international workshop "2G bioethanol production: technological development and agroenvironmental and economic implications". 18 April 2012, Bologna, Italy.

Reinhardt, G.: Environmental assessment of 1st and 2nd gen ethanol: an overview. In: Proceedings of the 20th International Symposium on Alcohol Fuels (ISAF) "Alcohol fuels enabling sustainable future development", www.isaf2013.co.za, 25-27 March 2013, Stellenbosch, South Africa, 2013

Reinhardt, G., Cornelius C.: Environmental assessment of energy sorghum. Proceedings of "22nd European Biomass Conference and Exhibition", Hamburg, Germany, 23-26 June 2014

3.38 Economic Assessment of Biomass Sorghum to Alternative Products (ICRISAT – 9)

The economic feasibility of alternative products from sorghum biomass is analysed for different scenarios, namely for biomass sorghum to biogas, 2nd generation ethanol, and FT (Fischer-Tropsch) diesel. For the assessment “low”, “typical” and “high” cases are defined by varying the key production and processing parameters like feedstock yield, conversion efficiency and per unit processing cost.

Comparison of calculated total variable cost of biogas and biomethane generated from sorghum biomass shows that it has a competitive edge over conventional energy. A fifteen year cash flow analysis shows that for biomass sorghum to biogas the return on investment is positive with IRR (Internal Rate of Return)of 24%, 44% and 57% under the three cases “low”, “typical” and “high”, respectively.

Variable cost analysis indicates that 2nd generation ethanol is competitive at the lower end of the price of enzyme used for processing biomass to ethanol, but is not competitive at the higher end of enzyme price.

There is a need for considerable improvement in the production technology of FT diesel through Fischer-Tropsch synthesis of gas since presently the end product is not economical given the current global price of diesel.

Exploitation strategy

Economic feasibility analysis of producing 2nd generation ethanol from sorghum biomass indicates that processing cost determines its profitability which in turn depends on the enzyme price. Bringing down enzyme price holds the key for the economic viability of 2nd generation ethanol.

IPR measures taken or intended

N/A

Further research necessary

Further analysis will be carried out in future by varying the key parameters related to production, processing and capital cost based on developments in the field.

Potential / expected impact of exploitation

N/A

3.39 Economic Assessment of Sweet Sorghum to Ethanol (ICRISAT – 10)

In order to promote the use of biofuels several countries have mandated blending of biofuels with gasoline/diesel. Brazil has the highest blending target of 20%in 2013. Most other countries have 10-15% targets by 2020.The major feedstock presently utilized such as sugarcane, corn, wheat and sugarcane molasses are not sufficient to meet the mandatory requirement for bioethanol blending programs. Sweet sorghum (*Sorghum* bicolor L. Moench) is a potential complementary feedstock since it can achieve fuel production along with food security and lower environmental pollution.

Under this project the economic feasibility of ethanol from sweet sorghum was analysed for different scenarios, namely “sweet sorghum stalk”, “stalk + grain”, “grain to food” and “syrup at village level to ethanol at distillery”. For the assessment “low”, “typical” and “high” cases are defined by varying the key production and processing parameters such as feedstock yield, ethanol recovery and per unit processing cost.

The economic assessment of the sweet sorghum to ethanol scenarios, though generally positive, show mixed results. “Stalk+grain to ethanol” (“cane fallow 2020”) and “grain to food” scenarios are economically most viable compared to the“stalk only to ethanol” scenario. A fifteen year cash flow analysis shows that the NPV (Net Present Value) of investment under the “stalk + grain” scenario under “typical” and “high” cases is positive with IRR(Internal Rate of Return) ranging from 70% to 148%. Under the “grain to food” scenario the NPVs are positive with IRR ranging from 67% in the “typical” case to 120% in the “high” case. In the case of “syrup to ethanol” scenario the NPVs are negative in all cases.

Exploitation strategy

For the use pathways of bagasse the IRRs are higher when surplus bagasse is used for electricity generation compared to its use as feed. However, the use pathway should be determined based on local requirements. Feedstock and processing costs form the bulk of the cost of ethanol production and hence any reduction in cost should aim to bring down these costs.

IPR measures taken or intended

N/A

Further research necessary

Further analysis will be carried out in future by varying the key parameters related to production, processing and capital cost based on developments in the field.

Potential / expected impact of exploitation

N/A

3.40 SWOT Analysis – Sweet Sorghum as Energy Crop (WIP – 1)

In the framework of the SWEETFUEL project a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis was conducted in order to assess advantages and disadvantages of different sweet sorghum and biomass sorghum value chains.
The analysis investigated several energy sorghum value chains under different framework conditions: subtropical, tropical and temperate climate. The value chains included the cultivation of energy sorghum, conversion to different products and end use of the products.
The SWOT analysis addressed land use, social (e.g. smallholder benefits, health, food security), environmental (e.g. emissions, soil and water), and economic aspects (e.g. efficiency, competitiveness) in order to help identify promising pathways to produce and use sweet sorghum as energy crop.

Core focus was placed on the competition between the biomass uses for food, feed, fibres, and biofuels and on different scales of energy sorghum production and use. Finally, policy aspects such as different policy framework conditions in target countries as well as issues of social acceptance and public perception were taken into account.

Exploitation strategy

The SWEETFUEL SWOT Analysis was published as public deliverable of the project and is available for download at: www.sweetfuel-project.eu/publications/swot_analysis_deliverable_6_5.

IPR measures taken or intended

N/A

Further research necessary

Further research is needed on social, environmental, and economic aspects of energy sorghum value chains, especially with respect to dual purpose applications (food and energy production) in tropical climates (e.g. India, Mexico, Philippines) and energy sorghum for industrial applications (e.g. biogas and lignocellulosic ethanol production) in temperate climates.

Potential / expected impact of exploitation

Results of the SWEETFUEL SWOT Analysis may provide international stakeholders (e.g. seed and feedstock suppliers, entrepreneurs, NGO's, policymakers, and agricultural research institutions) with valuable information to identify promising pathways to produce and use sweet sorghum as energy crop and to assist in decision making processes for improved energy sorghum value chains in different climates and framework conditions to:

- ensure competitiveness/complementary with other energy (bioethanol) crops
- ensure competitivenesswith fossil based energy/products
- guarantee environmental, social and economic sustainability

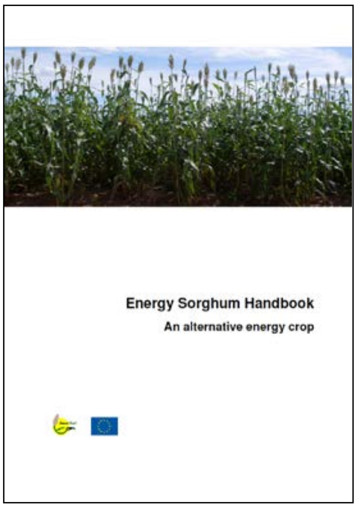
3.41 Energy Sorghum Handbook (WIP – 2)

In the framework of the SWEETFUEL project an Energy Sorghum Handbook is produced with the aim to provide interested stakeholders, namely policymakers, NGOs, scientists and researchers, entrepreneurs, and farmers with an up-to-date overview of important facts and figures on energy sorghum.

The handbook includes information on energy sorghum characteristics (botanical classification, morphology, growth stages, specific properties), cultivation (soil preparation, sowing, fertilisation, plant pest and control), harvesting and logistics, promising applications (food and fuel production, syrup production, advanced biofuels and biogas production), as well as social (e.g. smallholder benefits, health, food security), environmental (e.g. emissions, soil and water), and economic sustainability aspects (e.g. efficiency, competitiveness).

Exploitation strategy

The SWEETFUEL Energy Sorghum Handbook is published as public deliverable of the project and will be available for download at: www.sweetfuel-project.eu/publications/.
Furthermore, printed hardcopies of the SWEETFUEL handbook will be available for interested stakeholders.
The SWEETFUEL handbook will be available in English, French, Portuguese and Spanish.



IPR measures taken or intended

N/A

Further research necessary

N/A

Potential / expected impact of exploitation

The facts and figures presented in the SWEETFUEL Energy Sorghum Handbook may provide international stakeholders (policymakers, NGOs, scientists and researchers, entrepreneurs, and farmers) with valuable information to identify promising pathways to produce and use sweet sorghum as energy crop and to assist in decision making processes for improved energy sorghum value chains in different climates and framework conditions.

3.41 SAMARA Model (CIRAD – 2)

Samara is a crop model designed as a tool able to analyze GxE interactions at crop scale for tropical cereals including rice and sorghum. The plant growth and development is simulated and regulated by a carbohydrate "source to sink" depending on varietal traits. This model can be used to define new Ideotypes according to climatic changes, study the competition between grain, biomass and sugar accumulation in sweet sorghum, study the effect of photoperiod sensitivity on crop (suar and grain) performance as well as characterize the target population of environments (TPE) for a breeding programme.

Exploitation strategy

The objective is to develop the community of Samara users for improving model capacity to simulate cereals in different environments.

IPR measures taken or intended

Samara is free (no IPR), it works on the platform ECOTROP, developed by Cirad. This model can be shared, but it requires at least a short training to understand the concepts and use it. Such training is usually organized once a year at Montpellier by Cirad.

Further research necessary

N/A