Marginal lands for Growing Industrial Crops

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Type			**Dissemination Level**		
R	Document, report	☒	**PU**	Public	☒
DEM	Demonstrator, pilot, prototype	☐	**CO**	Confidential, only for members of the consortium (including the Commission Services)	☐
DEC	Websites, patent fillings, videos, etc.	☐			
OTHER		☐			

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Abbreviations

COGECA: General Confederation of Agricultural Cooperatives
COPA: Committee of Professional Agricultural Organisations
EIP-AGRI: European Innovation Partnership for Agricultural productivity and Sustainability
DBH: Diameter at Breast Height
DSS: Decision Support System
EC: European Commission
ET: Evapotranspiration
EU: European Union
GCV: Gross Calorific Value
GHG: Greenhouse Gas
JRC: Joint Research Centre
MAGIC: Marginal lands for Growing Industrial Crops
P: Precipitation
PA: Practice Abstract
REA: Research Executive Agency
SRC: Short Rotation Coppices

Partners short names

3B: BioWarmia Bioenergy and Bioresources Michal Krzyzaniak
ARKEMA: Arkema France
AUA: Agricultural University of Athens
BTG: B.T.G. Biomass Technology Group BV
CIEMAT: Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
CREA: Consiglio Per La Ricerca In Agricoltura E L'analisi Dell'economia Agraria
CRES: Centre for Renewable Energy Sources and Saving
FCT/UNL: Faculdade De Ciencias E Tecnologiada Universidade Nova De Lisboa
IBCSB NAASU: Institute of Bioenergy Crops and Sugar Beet National Academy of Agrarian Sciences of Ukraine
Imperial: Imperial College of Science Technology and Medicine
INRAE: Institut National De La Recherche Agronomique
IWNiRZ: Instytut Wlokien Naturalnych I Roslin Zielarskich
LSFRI SILAVA: Latvijas Valsts Mezinatnes Instituts Silava
nova: nova-Institut für Politische und Ökologische Innovation GmbH
SAS NOVABIOM: Nova Biomedical
Spanish Co-ops: Cooperativas Agro-alimentarias de España
UHOH: Universität Hohenheim
UNICT: Università Degli Studi di Catania
WR: Stichting Wageningen Research

Executive summary

The MAGIC project aims to promote the sustainable development of efficient and beneficial industrial crops on marginal lands. A database and a crop support system has been developed, including detailed agricultural information to be of great use to farmers.

In addition, marginal lands in Europe have also been analysed and several optimal crops have been proposed with the aim of developing sustainable best practice options for industrial crops. The impact of MAGIC has been maximised by integrating the sustainability aspects (encompassing environment, society, and economy) of value chains.

Work Package 8 - Dissemination and link establishment with EIP AGRI, seeks to propagate the project results, database, maps and DSS tool in order to enhance farmers' knowledge, plus creating strong links with EIP AGRI.

One of the MAGIC Project targets is to maximise stakeholders mobilization and enhance the impact of the project activities and outcomes for promoting the cultivation of industrial crops on marginal land. In this line, practice abstracts (PAs) are short summaries that describe main information that can serve end users in their daily practice. Following the guidelines of the EIP-AGRI and their common format, MAGIC has produced a set of PAs for dissemination over the entire duration of the project. During the project life, PAs have fed the webpage of EIP-AGRI with easily understandable practical knowledge that is expected to reach a broader public.

This document presents forty-nine practice abstracts that summarize some of the main results at the end of the project. This report has been updated several times as project progressed and results were available.

1 Introduction

The European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI) was launched by the European Commission in 2012. This initiative aimed to help all EU countries to provide their citizens with a more competitive economy, better jobs and life standards, fostering a competitive and sustainable agriculture and forestry sector that "achieves more from less".

The EIP-Agri adheres to the "interactive innovation model" which brings together specific actors (e.g., farmers, advisors, researchers, businesses, etc.) to work together in multi-actor projects to find a solution for a specific issue or developing a concrete opportunity. In this sense, communicating about projects activities and results is much easier through the use of a common format (see *Figure 2*). Such common format facilitates the knowledge flow and enables contacting farmers, researchers and all the other actors involved in innovation projects. The EIP common format consists of a set of basic elements characterising the project, including practice abstracts (PAs). The format is developed with the aim of enable the contact with partners, incentivise efficient knowledge exchange and to disseminate the results of the project in a concise and easy understandable way to practitioners.

All the PAs generated during the period of the MAGIC project are uploaded to the EIP-AGRI website (see *Figure 1*), where the information is shared at EU level, via the EIP- AGRI project database, a unique repository which supports the dissemination of results of all interactive innovation projects. In addition, these PAs were a useful dissemination tool to share the updates and outcomes of MAGIC both with the EIP-AGRI subgroup of innovation and the COPA-COGECA Sectoral Boards of European farmers.

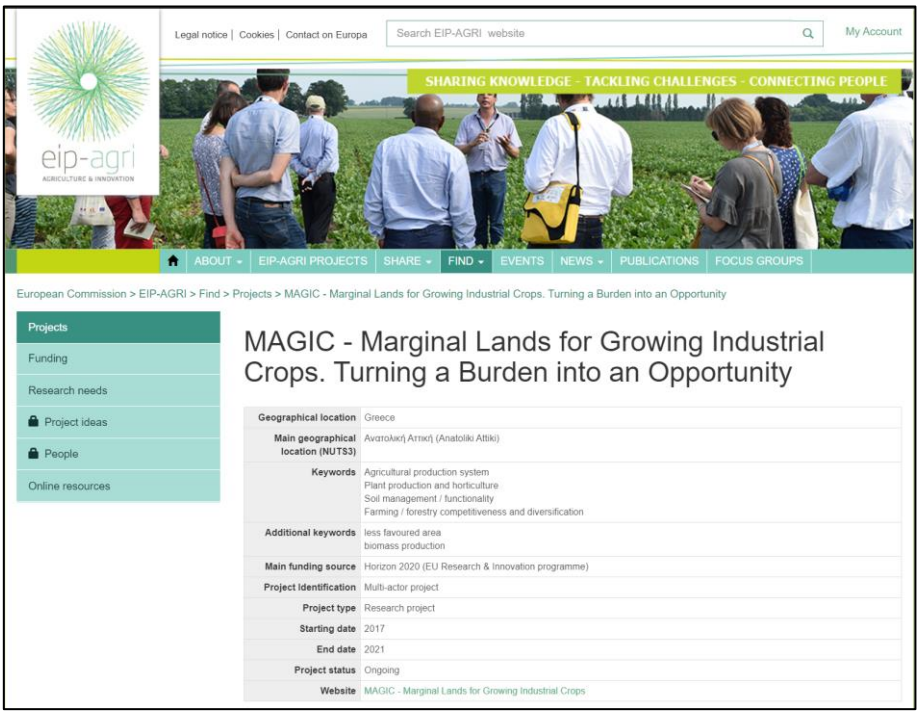


Figure 1. MAGIC at EIP-Agri website. *Source: EIP-Agri*

This document presents forty-nine PAs that have been developed based on the deliverables submitted so far and the outcomes provided by the long-term field trials, small-scale trials, long-scale trials, and additional papers related with MAGIC.

2 Methodology

Practice abstracts (PAs) are short summaries of around 1000 - 1500 characters (word count – no spaces) which describe main information/recommendations and serve end users in their daily practice. Every PA must be accompanied by a short title of no more than 150 characters. All PAs have been prepared following the guidance and Common Format of EIP-AGRI (see *Figure 2*) in the shape of an excel template. The information shown in this template (see Annex B) is accumulative.

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR AGRICULTURE AND RURAL DEVELOPMENT

Directorate H. Sustainability and Quality of Agriculture and Rural Development
H.5. Research and Innovation

EIP-AGRI Common format for interactive innovation projects

The interactive innovation approach under the European Innovation Partnership Agricultural Productivity and Sustainability (EIP-AGRI)[1] fosters the development of demand-driven innovation, turning creative new ideas into practical applications thanks to interactions between partners, the sharing of knowledge and effective intermediation and dissemination.

The EIP **common format** consists of a set of basic elements characterising the project and **includes one (or more) "practice abstract"(s)**. The format was developed with two main objectives:
(1) to enable contacting partners and incentivise efficient knowledge exchange, and
(2) to disseminate the results of the project in a concise and easy understandable way to practitioners.
The common format allows providing information all along the life-cycle of the project. The **content of the common format can be updated at any moment** when useful, for instance in an intermediate phase of the project. Project information should at least be available at the beginning (describing the situation at the start of the project, including project title and objectives) and at the end of the project (describing the results/recommendations resulting from the project, including a final project report and one or more practice abstracts).

EIP-AGRI Common format | INSTRUCTIONS | PROJECT INFORMATION | PARTNERS | KEYWORDS | AUD

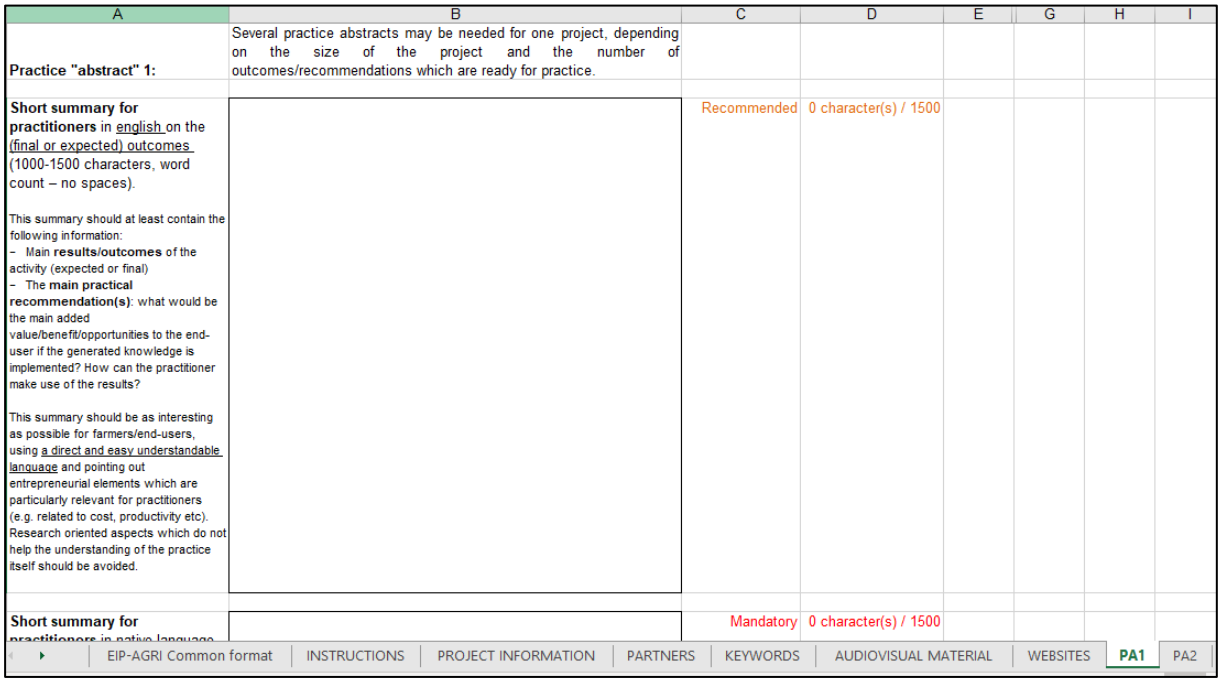
Figure 2. EIP-AGRI Common format. *Source: EIP-Agri*.

Summaries (see *Figure 3*) contain the following information:

- Main results/outcomes of the activity (expected or final).
- Main practical recommendations such as the main added value/benefit/opportunities to the end user.
- How the generated knowledge is implemented and how the practitioner can make use of the project results.

Both the summary and the title may be also provided in the native language of the coordinator or one of the partners. However, an English version of PAs must always be available. In addition to the PAs, the excel template contains some general information about the project, including keywords, list of partners and contacts, website and audio-visual material (see Annex B).

Finally, the PAs are delivered to agri-eip-practice-abstracts@ec.europa.eu with copy to the Project Officer (REA) and Policy Officer (DG AGRI).



A	B	C	D	E	G	H	I
Practice "abstract" 1:	Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.						
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: – Main **results/outcomes** of the activity (expected or final) – The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.		Recommended	0 character(s) / 1500				
Short summary for practitioners in native language		Mandatory	0 character(s) / 1500				

EIP-AGRI Common format | INSTRUCTIONS | PROJECT INFORMATION | PARTNERS | KEYWORDS | AUDIOVISUAL MATERIAL | WEBSITES | PA1 | PA2

Figure 3. EIP-AGRI template for PA. *Source: EIP-Agri*.

3 Practice abstracts

3.1 PA1: About MAGIC Project

Author: nova

Title (English): Marginal lands for growing industrial crops

Summary (English): Marginal lands for Growing Industrial Crops (MAGIC) is a 4-year project and gets funding by the European Commission. The project aims to promote the sustainable development of resource-efficient and economically profitable industrial crops grown on marginal lands.

Industrial crops can provide abundant renewable biomass feedstocks for the production of high added-value bio-based commodities (such as bio-plastics, bio-lubricants, bio-chemicals, pharmaceuticals, bio-composites, etc.) and bioenergy. Most of these crops are multi-purpose and offer the opportunity to follow a cascade biorefinery concept to produce a number of high-quality bio-products and bioenergy, to strengthen the bio-based economy.

To achieve the project objectives, an up-to-date database of existing resource-efficient industrial crops will be developed with information on their agronomic characteristics, input requirements, yield performance and quality traits for end use applications. In parallel, current and future marginal lands in Europe facing natural constraints will be mapped, characterised and analysed to provide a spatially explicit classification that will serve as a basis for developing sustainable best-practice options for industrial crops. A Decision Support System (DSS) based on both MAGIC-CROPS and MAGIC-MAPS will be developed and validated with the active involvement of farmers and end users in order to choose the most promising industrial crop at any geo-location in Europe.

In the long term, this strategy will foster the sustainable development of the EU bio-based economy and will contribute to achieving EU energy and climate targets.

3.2 PA2: About definition and classification of marginal lands

Author: Spanish Co-ops (based on D2.1, prepared by WR)

Title (English): Definition and classification of marginal lands suitable for industrial crops in Europe

Summary (English): Industrial crops will provide feedstocks for bio-based applications, thereby, will foster the bioeconomy and provide diversification opportunities to farmers. MAGIC project has identified and mapped those marginal lands across Europe where industrial crops (oil, lignocellulosic, carbohydrate and specialty crops) could be grown in a sustainable way.

This mapping was based on a previous classification of marginal lands according to features such as:

-Biophysical constraints, considering adverse climate due to low temperature, dryness, or excessive wetness; analysing soil problems such as adverse chemical composition, low fertility, or limitations in rooting; and paying attention to adverse terrain due to steep slope.

-Socio-economic constraints regarding limited access to markets, difficult accessibility and bad infrastructure.

-Sustainability, since the impact of growing industrial crops depend very much on whether other land uses are replaced by the industrial crops (leading to potential competition with food production); on whether biodiversity and other ecosystem services will be affected; and on what industrial crops and what management systems are to be used.

Moreover, to determine whether a land is suitable for growing industrial crops or not, four key main features of the terrains classified as marginal lands must be pointed out: land can be marginal for agricultural use, but not for forestry use; marginality refers to the mentioned biophysical and socio-economic constraints; there are synonymous uses of “marginal lands” (abandoned farmland, low productivity, etc.); and that “marginality” is a dynamic feature which can change in time.

3.3 PA3: About spatially explicit map database of MAGIC

Author: Spanish Co-ops (based on D2.6, prepared by WR)

Title (English): Mapping marginal lands for growing industrial crops

Summary (English): The purpose of the MAGIC mapping is to characterize and analyse projections for current and future marginal lands in Europe facing natural constraints.

Identified MAGIC marginal lands are defined as: “Lands having limitations which in aggregate are severe for sustained application of a given use and/or are sensitive to land degradation, as a result of inappropriate human use, and/or have lost already part or all of their productive capacity as a result of inappropriate human use”. The elements that were considered in building the classification include biophysical limitations clustered in six main groups. In addition, the resulting marginal land map was further classified according to, land use management, socio-economic limitations, ecosystem services and drives and pressures influencing the ecosystem functions.

As a result, in total 29% of the agricultural land (i.e. land classified as agricultural by Corine Land Cover since 1992) in the European Union are classified as marginal. The most common limitations are rooting limitations, with 12% of the agricultural area. This is followed by adverse climate and excessive soil moisture occurring in respectively 11% and 8% of the agricultural land.

The spatial explicit classification created by MAGIC will serve as a basis for developing sustainable best-practice options for industrial crops in Europe. In addition, the spatially explicit map database is accessible via the project website and will be maintained and further improved during the project’s lifetime and at least five years beyond the project completion. Visitors to the public website can access the map to inform themselves about the marginal land status in their region but can also help to evaluate the quality of the map.

3.4 PA4: About MAGIC tools

Author: Spanish Co-ops

Title (English): MAGIC Tools

Summary (English): MAGIC project has developed four databases' tools. MAGIC MAPS is an online service that features and presents the European marginal lands. It allows to consult at local administration level (LAU1) not only the overall percentage of agricultural lands facing marginal conditions over the selected area, but also the extension of area affected by specific constraints such as chemicals, climate, fertility, rooting, terrain and wetness. This information is shown over an ArcGIS Web App where those LAU with higher marginality rates are represented in darker colours.

Alternatively, MAGIC-CROPS is an Excel database that offers detailed description of 37 industrial crops. Crop performance is provided according to different parameters such as dryness, soil moisture, drainage, texture, rooting depth, salinity, acidity, pollutants etc. It also includes agronomical information such as the fertilization needs, adequate temperature, cycle, harvesting period, harvesting method, possible applications use they may have, etc. This tool is excellent to increase farmers' knowledge and encourage them to cultivate a crop that suits most under their land and market conditions.

MAGIC DSS shows practical information on (i) average rate of marginal lands, (ii) marginal land types (climate, moisture, soil, rooting, fertility and chemicals) (iii) marginal area in km^2 and (iv) types of potential crops suitable for cultivation in these marginal areas. All the information is automatically recalculated depending on the chosen area, it is also possible to filter by country (resolution provided at a LAU2 level).

Bio2Match was created in S2Biom-project and it has been expanded in MAGIC project. There is a practice abstract which explains in detail how it works.

3.5 PA5: About Bio2Match tool

Author: Spanish Co-ops (based on D 5.4, prepared by BTG)

Title (English): Bio2Match tool

Summary (English): Bio2Match is an internet tool created to guide the user for matching industrial crops with their associated conversion technologies. This is done by combining two databases, biomass information and conversion technologies. The biomass properties can be affected by the plant and wood species, the soil, the harvesting time and climate, the part of the plant or wood considered and the type of fertilization.

Firstly, the tool checks if the biomass is suitable for the conversion, taking into account the post-harvesting biomass properties that are inalterable. For instance, ash, cellulose, hemicellulose, nitrogen, and chlorine content. Secondly, a match is generated when the technology criteria are met by the biomass properties. Subsequently, a second match can be made by checking the physical biomass properties, such as dimensions or humidity content.

If there is no match, the device will suggest the physical properties needed to alter, to make the conversion possible. This tool also provides biomass pre-treatment recommendation.

Bio2Match was created in S2Biom-project, which incorporated lignocellulosic crops and their associated conversion technologies. However, it has been expanded in MAGIC project, including the industrial MAGIC crop database and the corresponding technologies.

The tool is available on the MAGIC-website: http://magic-h2020.eu/bio2match-tool/. The biomass database and technology database can be downloaded on the website. Additionally, there is a guide and a tutorial video available for the users, in order to get them familiarized with the tool.

3.6 PA6: About factsheets of the existing resource-efficient industrial crops

Author: Spanish Co-ops (based on D1.5, prepared by CRES)

Title (English): Handbook with factsheets of the existing resource-efficient industrial crops

Summary (English): MAGIC consortium has gained an extensive knowledge on industrial crops by coordinating and participating in several relevant national & EU projects. This experience has allowed to create a handbook with fact sheets of the existing resource-efficient industrial crops. In them, useful agronomic information is presented in a synthetic way.

Although not all aspects were available for each crop, most factsheets present information on crop features such as varieties, soil and climate preferences, soil preparation and sowing, water and fertilization needs, yields, uses, qualitative traits, harvesting, handling, storing, environmental impacts and risks associated with cultivation (diseases, insects and weed control). All this information was supported by a thoroughly research work on literature, position papers, project reports, etc. In total, twenty factsheets are available for the following crops:

- Amaranth
- Calendula
- Camelina
- Caper spurge
- Castor bean
- Crambe
- Ethiopian mustard
- Flax
- Industrial hemp
- Kenaf
- Nettle
- Pennycress
- Poplar
- Safflower
- Sorghum
- Spartium
- Sunflower
- Sunn hemp
- Switchgrass
- Wild tobacco

All the factsheets can be found at MAGIC website over the Reports&Deliverables tab (D1.5 – Handbook with fact sheets of the existing resources-efficient). In addition, MAGIC has created MAGIC-CROPS, a database that provides a description of 37 industrial crops suitable for growing on marginal land in Europe where more information can be found. You can also access MAGIC-CROPS through the main page of MAGIC website.

3.7 PA7: About factsheets of the inventory on available harvesting technology

Author: Spanish Co-ops (based on D5.1, prepared by CREA)

Title (English): Inventory on available harvesting technology for industrial crops on marginal lands

Summary (English): The apparent lack of appropriate machinery significantly affects farmers' perception of the possibility to cultivate industrial crops. Thus, the development of a comprehensive inventory on currently available harvesting systems of industrial crops on marginal land has been considered as a need in the MAGIC project. This inventory gathers information obtained from direct data collection in previous projects, scientific literature review and market analysis on the current existing technologies used to harvest non-food crops in marginal lands and included in the MAGIC CROPS database.

The inventory document is organized in fact-sheets representing an “easy-to-find” and “easy-to-use” instrument for final users, providing a rapid identification of the principal mechanized harvesting solutions for a specific crop, according to the final use of the biomass. For each crop a traffic light is included to provide indications about the status of knowledge on harvest technologies. In total, twenty factsheets are available for the following crops:

- *Sorghum bicolor L.*
- *Camelina sativa L.*
- *Crambe abyssinica L.*
- *Ricinus communis L.*
- *Panicum virgatum L.*
- *Miscanthus x giganteus*
- *Arundo donax L.*
- *Agropyron elongatum (Host)*
- *Brassica carinata L.*
- *Cannabis sativa L.*
- *Phalaris arundinaceae L.*
- *Carthamus dictorius L.*
- *Cynara cardunculus L.*
- *Thlaspi arvense L.*
- *Salix spp*
- *Populus spp*
- *Robinia pseudoacacia L.*
- *Ulmus pumila L.*
- *Saccharum spontaneum L.*
- *Lupinus mutabilis Sweet*

Factsheets can be found at MAGIC website over the Reports&Deliverables tab (D5.1 – Inventory on available harvesting technology for industrial crops on marginal lands).

3.8 PA8: About MAGIC long-term field trials

Author: UHOH

Title (English): Long-term field trials with industrial crops on marginal land

Summary (English): One of the expected results of the MAGIC Project will be a comprehensive overview of the long-term performance potential of industrial crop cultivation on marginal land in Europe. For this purpose, the results of several long-term field trials with important industrial plants such as Miscanthus, Giant Reed, Reed Canary Grass, Camelina, Hemp and Poplar, which are carried out Europe-wide under the most important marginal growth conditions such as adverse rooting conditions, adverse climatic conditions and unfavourable terrain, will be compiled and evaluated. Many of these field trials are still on-going. In particular, the best low-input agricultural cultivation strategies for the crop categories 'tillage', 'nitrogen fertilization', 'weed control' and 'irrigation' will be identified.

Practitioners should benefit from the results by implementing low-input agricultural practices for industrial crop cultivation, which are adapted to both the marginality conditions of their locations and to the market requirements in their region. It is assumed that this will increase both the overall income of the farms and the net profit due to higher biomass yields (and qualities) and higher production efficiencies. In addition, to these direct benefits, it is expected to bring indirect benefits through improved legal frameworks resulting from the policy recommendations.

3.9 PA9: About Miscanthus long-term field trial in Germany

Author: UHOH

Title (English): Miscanthus cultivation on marginal land in southwest Germany

Summary (English): In 2012 and 2014, several field trials with Miscanthus (a perennial C4 grass for combustion and other conversion routes) were carried out at various marginal sites in southwest Germany. The most severe marginality conditions at one of these sites ('OLI') are a combination of adverse root conditions (shallow soil (26 cm) and stoniness (20%)) and low temperatures (frost and short vegetation period). At OLI, six genotypes of Miscanthus were established in 2014 (~1 plantlet/m²). Weeding was performed by hand in 2014 and 2015. The harvest was carried out each year in spring starting from 2016. No fertilization was applied. The previous crop was grassland. The estimated accumulated dry matter yields of the first three growing seasons (2015, 2016 and 2017) range between 12.4 t/ha (GNT 4) and 30.9 t/ha (*Miscanthus* × *giganteus*). These preliminary results suggest that low-input cultivation of Miscanthus on shallow stony soil under low temperature conditions may be a success depending on the genotype. *Miscanthus* × *giganteus* is expected to provide high dry matter yields (in relation to the given marginal growing conditions) also in the following seasons.

The expected main recommendation of these results is that farmers should consider the possibility of growing *Miscanthus* × *giganteus* on marginal areas similar to those of OLI (shallow stony soil + low temperature). In addition to economic benefits such as high biomass

yields, low external inputs (fertilizers, pesticides) and low labour intensities (except for the establishment procedure), there are a number of eco-systemic advantages of *Miscanthus* × *giganteus* over annual cultivation systems such as improved soil fertility, habitat networking and reduced soil erosion.

Title (German): Miscanthusanbau auf Marginalstandorten in Süddeutschland

Summary (German): In den Jahren 2012 und 2014 wurden an verschiedenen Marginalstandorten im Südwesten Deutschlands mehrere Feldversuche mit Miscanthus (einem mehrjährigen C4-Gras für die Verbrennung, Biogasproduktion und andere Konversionsarten) durchgeführt. Die stärksten Marginalitätsbedingungen an einem dieser Standorte ("OLI") sind eine Kombination aus ungünstigen Bodeneigenschaften (Flachgründigkeit (10 - 20 cm) und ein hoher Steinanteil im Oberboden (50%)) und niedrigen Temperaturen (Frost und kurze Vegetationszeit). Am OLI wurden 2014 sechs Genotypen von Miscanthus etabliert (~1 Planze/m²). In den Jahren 2014 und 2015 wurde das Unkraut mechanisch entfernt. Geerntet wurde ab 2016 jedes Jahr im Frühjahr. Auf eine Düngung wurde verzichtet. Die vorherige Kultur war Grünland. Die geschätzten kumulierten Trockenmasseerträge der ersten drei Vegetationsperioden (2015, 2016 und 2017) liegen zwischen 12,4 t/ha und 30,9 t/ha. Diese vorläufigen Ergebnisse deuten darauf hin, dass ein extensiver Anbau von Miscanthus auf flachem steinigem Boden in Kombination mit niedrigen Temperaturbedingungen ein Erfolg sein kann. Es wird erwartet, dass *Miscanthus* × *giganteus* auch in den folgenden Jahren hohe Trockenmasseerträge liefert.

Die erwartete Hauptempfehlung ist, dass die Landwirte die Möglichkeit in Betracht ziehen sollten, *Miscanthus* × *giganteus* auf Marginalstandorten anzubauen, die denen vom OLI ähneln. Neben wirtschaftlichen Vorteilen wie hohen Biomasseerträgen, geringem Einsatz von Arbeitsmitteln und niedrigen Arbeitsintensitäten gibt es bei Miscanthus gegenüber einjährigen Anbausystemen eine Reihe von ökosystemischen Vorteilen wie verbesserte Bodenfruchtbarkeit, Habitatvernetzung und geringere Bodenerosion.

3.10 PA10: About Switchgrass long-term field trial in Greece

Author: CRES

Title (English): Switchgrass cultivation on marginal land in central Greece

Summary (English): Two Switchgrass field trials were established by seeds in 1998 on marginal land located in central Greece and are still on-going. The aim was to identify the appropriate cultural practices of Switchgrass when grown on marginal land. Tested factors were: 10 varieties in the first and 5 in three nitrogen rates (0, 75 and 150 kg N/ha) in the second. Varieties were: Caddo, Alamo, Blackwell, Cathage, Cave-in-rock, Forestburg, Kanlow, Pangburn, SL 93-2, SL 93-3, SL 94-1, SU 94-1 and Summer.

Biomass yields were maximized in the second growing period and come up to 20 t/ha (oven-dried), almost double to yields recorded at first year. In the 3rd year a yield reduction was measured from 5% to 20%. Yields reduction continued in year 4 and for more than a decade the dry matter yields varied from 12 to 14 t/ha. Further reduction was recorded from 18th till 20th year of the plantation and the mean dry yields varied from 8 to 10 t/ha during this period.

During two decades lowlands varieties gave always higher yields but the superiority of lowland over upland was quite profound till the 6th growing period. Lowland varieties were higher with stronger stems and thus had higher lodging resistance than upland ones. Lodging problems were recorded for the upland varieties at the mid-point of the tested years and at the end of summer, after strong rainfall with high winds. In the first years, no significant effect of nitrogen fertilization on growth and yields was recorded. From year 6 to 20 dry yields for switchgrass varieties were always higher in the plots that received 150 kg N/ha as top fertilization. From 18th growing season the plantation began to look quite old and the tiller density had been greatly reduced. The average mean yields of switchgrass (oven-dried) fields was 12 t/ha.

Title (Greek): Καλλιέργεια σε περιθωριακή γη της κεντρικής Ελλάδας

Summary (Greek): Το 1998 πραγματοποιήθηκαν δύο δοκιμές στον τομέα του switchgrass από σπόρους σε οριακές εκτάσεις που βρίσκονται στην κεντρική Ελλάδα και βρίσκονται ακόμη σε εξέλιξη. Ο στόχος ήταν να εντοπιστούν οι κατάλληλες πολιτιστικές πρακτικές του switchgrass όταν καλλιεργούνται σε περιθωριακή γη. Οι παράγοντες που ελέγχθηκαν ήταν: 10 ποικιλίες το πρώτο και 5 σε τρεις ρυθμούς αζώτου (0, 75 και 150 kg N/ha) στη δεύτερη. Οι ποικιλίες ήταν: Caddo, Alamo, Blackwell, Cathage, Cave-in-rock, Forestburg, Kanlow, Pangburn, SL 93-2, SL 93-3, SL 94-1, SU 94-1 και Summer.

Οι αποδόσεις της βιομάζας μεγιστοποιήθηκαν κατά τη δεύτερη περίοδο καλλιέργειας και ανέρχονται σε 20 τόνους/εκτάριο (φυγή), σχεδόν διπλάσιες από τις αποδόσεις που καταγράφηκαν κατά το πρώτο έτος. Κατά το 3ο έτος μετρήθηκε μείωση της απόδοσης από 5 % σε 20 %. Η μείωση των αποδόσεων συνεχίστηκε κατά το έτος 4 και για περισσότερο από μια δεκαετία οι αποδόσεις ξηρής ύλης κυμαίνονταν από 12 έως 14 τόνους/εκτάριο. Περαιτέρω μείωση σημειώθηκε από το 18ο έως το 20ο έτος της φυτείας και οι μέσες ξηρές αποδόσεις κυμαίνονταν από 8 έως 10 τόνους/εκτάριο κατά την περίοδο αυτή. Κατά τη διάρκεια δύο δεκαετιών πεδινών ποικιλιών έδιναν πάντα υψηλότερες αποδόσεις, αλλά η ανωτερότητα των πεδινών στα ορεινά εδάφη ήταν αρκετά βαθιά μέχρι την 6η περίοδο ανάπτυξης. Οι πεδινές ποικιλίες ήταν υψηλότερες με ισχυρότερους μίσχους και έτσι είχαν μεγαλύτερη αντοχή στο κατάλυμα από ό, τι τα ορεινά. Καταγράφηκαν προβλήματα στέγασης για τις ορεινές ποικιλίες στα μέσα των δοκιμασμένων ετών και στο τέλος του καλοκαιριού, μετά από έντονες βροχοπτώσεις με δυνατούς ανέμους. Κατά τα πρώτα έτη, δεν καταγράφηκε καμία σημαντική επίδραση της γονιμοποίησης του αζώτου στην ανάπτυξη και τις αποδόσεις. Από το 6 έως το 20 οι ξηρές αποδόσεις για τις ποικιλίες switchgrass ήταν πάντα υψηλότερες στις εκτάσεις που έλαβαν 150 kg N/ha ως κορυφαία γονιμοποίηση. Από την 18η καλλιεργητική περίοδο η φυτεία άρχισε να φαίνεται αρκετά παλιά και η πυκνότητα των γεωργών είχε μειωθεί σημαντικά. Η μέση μέση απόδοση των πεδίων switchgrass (με ξήρανση) ήταν 12 t/ha.

3.11 PA11: About Scots Pine long-term field trials in Latvia

Author: LSFRI SILAVA

Title (English): Scots Pine long-term field trials in Latvia

Summary (English): In Northern Europe Scots Pine (*Pinus sylvestris*) is one of the most often planted tree species in plantations. When planted in abandoned agricultural land and intensively tended, Pine successfully takes root in open areas. 15-year-old plantations in 7

sites were evaluated. Overall, the growth of plantation Pine is evaluated as average or good, yet it grows best in naturally dry podzolic sandy, sod-podzolic sandy loam and gravelly loam soils. When plantation is established on marginal or abandoned agricultural land, Scots Pine shows slow development in the first 5 years (on average 0.10 to 0.15 m/year). Diameter at Breast Height (DBH, 1.3 m) is reached at 6 - 8 years, and the growth of Pines increase at this age. 15-year plantation Pine on agricultural land shows the same DBH parameters that are found on forest land at 25 - 28 years and average height at 16 -18 years. The stock volume of well-growing plantation Pine may by the age of 15 be as high as 80 to 155 m^3/ha, and by 22 years reach even 243 m^3/ha. Pine plantations produce the highest stock volume in podzolic, cultivated, and sod-podzolic soils, where the stock volume for 15 to 16-year Pine is 112 to 155 m^3/ha, with the current volume growth 5 to 8 m^3/ha. Above ground biomass analysis show that in plantations 12 - 15-year-old tree has total biomass of 137 - 190 kg consisting of stem biomass 70 - 149 kg (51 - 78%) and crown biomass 67 - 42 kg (49 - 22%). Agricultural land can be too fertile for Scots Pine, leading to rapid growth, but also to development of thick lateral branches, which decreases wood quality and even stock volume. Therefore, it is important to prune the trees and carry out thinning no later than at 14 - 15 years of age.

Title (Latvian): Parastās priedes ilgtermiņa izmēģinajuma pētījumiLatvijā

Summary (Latvian): Ziemeļeiropā, parastā priede (*Pinus sylvestris*) ir viena no biežāk stādītajām koku sugām mežā, bet ne lauksaimniecības zemju apmežojumos. Stādot pamestās lauksaimniecības zemēs un intensīvi kopjot, priede ir ieaudzējama atklātās platībās. 15 gadīgos stādījumos 7 vietās, dažādos apstākļos vērtētas apmežošanas sekmes. Priežu plantāciju mežu augšana vērtējama kā vidēja vai laba, tomēr tā vislabāk jūtas dabiski sausās podzola, velēnu podzolētās mālsmilts un oļainās mālsmilts augsnēs ar nepaaugstinātu grunts ūdens līmeni). Kad plantāciju izveido uz marginālas zemes, parastā priede uzrāda lēnu attīstību pirmajos 5 gados (vidēji 0,10 līdz 0,15 m gadā–1). Diametrs krūšu augstumā (DBH, 1,3 m) tiek sasniegts 6 - 8 gados, paātrinās priežu augšana.

15 gadu vecumā plantāciju mežā augušiem kokiem DBH parametri atbilst mežos 25 - 28 gadus augušiem kokiem. Vidējais priežu augstums plantāciju mežā 15 gados ir līdzīgs 16 -18 gadus veciem mežā augušiem kokiem. Priežu stādījuma krāja 15 gadu vecumā variē no 80 līdz 155 m^3/ha, bet 22 gadu laikā sasniedz pat 243 m^3/ha. Priežu stādījumos vislielāko krājas apjomu iegūst podzolaugsnēs, kultūraugsnēs un velēnu podzolētas augsnes, kur 15 līdz 16 gadu parastās priedes krājas apjoms ir 112 līdz 155 m^3/ha, un ikgadējais krājas pieaugums ir 5 līdz 8 m^3/ha. Virszemes biomasa 12 –15 gadus vecu koku stādījumos variē no 137 līdz 190 kg, (stumbrs 70 –149 kg (51 –78%) un vainagi 67 –42 kg (49 –22%)). Lauksaimniecības zeme var būt pārāk auglīga, pārlieku strauja parastās priedes augšana saistīta ar kupla vainaga un daudzu sānzaru veidošanos, tas samazina stumbra – baļķa koksnes kvalitāti un pat to koksnes krājas apjomu. Tāpēc ir svarīgi atzarot mērķkokus un veikt kokaudzes retināšanu jau 14 – 15 gadu vecumā.

3.12 PA12: About biomass yield Willow long-term field trial in Poland

Author: 3B

Title (English): Biomass yield from Willow cultivated in 4-year harvest cycle on marginal land in Poland

Summary (English): In this study, the biomass yield and morphological traits of plants were reported from a field trial with six genotypes of Willow, cultivated in northern Poland. Willow was planted using a pole cutting system, which is called Eco-Salix. Two planting densities were selected: 5,200 and 7,400 plants/ha at two marginal sites. The first site had heavy textured clay soil and the second site was located on peaty muck soil. The aim of this study was to determine the morphological traits of plants and the biomass yield of six Willow genotypes (clones and varieties) under low-input agriculture on two marginal soils with a quadrennial harvest cycle. In the field trial, the average Willow biomass yield of dry matter was 7.87 t/ha. The new variety Ekotur had higher yield and more favourable morphological traits compared to other registered Polish varieties. The Willow biomass yield obtained on peat muck soil was significantly higher than from Willow grown on heavy textured clay soil. Eco-Salix system could be effective if used: (i) in regions of low forest coverage to increase biodiversity; (ii) on lands permanently or periodically too wet; (iii) and on land where heavy machinery cannot be used for soil preparation. The Eco-Salix system has the potential to produce high yields of Willow biomass under conditions of low-input agriculture (no or reduced tillage, and a limited number of other management practices) using poles on marginal soils. Furthermore, Ekotur (*Salix viminalis*) and cv. Doutur (*S. alba*) can be recommended for cultivation due to high biomass yield on peat-muck soil. When converting land to bioenergy production, the Eco-Salix system can be used on marginal lands and can provide additional environmental and financial benefits.

Title (Polish): Plon biomasy wierzby uprawianej w 4-letniej rotacji zbioru na gruntach marginalnych w Polsce

Summary (Polish): W doświadczeniu tym określono plon biomasy i cechy morfologiczne sześciu genotypów wierzby, uprawianych w północnej Polsce. Doświadczenie założono za pomocą żywokołów (nieukorzenionych pędów o długości 2.4 m) tak zwanym systemem Eko-Salix. Zastosowano dwie gęstości sadzenia: 5 200 i 7 400 roślin na hektar na dwóch gruntach marginalnych. Pierwsze stanowisko położone było na ciężkiej glebie ilastej, a drugie znajdowało się na glebie torfowo-murszowej. Celem badań było określenie cech morfologicznych roślin i produkcyjności sześciu genotypów wierzby (klonów i odmian) bez uprzedniej uprawy na dwóch glebach marginalnych w czteroletnim cyklu zbioru. Średni plon suchej biomasy wierzby z doświadczenia wynosił 7,87 t/ha. Nowa odmiana Ekotur dała wyższy plon i miała korzystniejsze cechy morfologiczne w porównaniu do wcześniej zarejestrowanych polskich odmian. Plon biomasy wierzby uzyskany na glebie torfowo-murszowej był znacznie wyższy niż z wierzby uprawianej na ciężkiej glebie ilastej. Można wnioskować, że system Eko-Salix może być skuteczny, jeżeli jest stosowany: (i) w regionach o niskiej lesistości, w celu zwiększenia różnorodności biologicznej; (ii) na gruntach trwale lub okresowo zbyt mokrych (gleby ciężkie gliniaste i ilaste, gleby torfowe); (iii) oraz na gruntach, gdzie maszyny rolnicze są zbyt ciężkie i nie mogą być użyte do przygotowania gleby. System Eko-Salix może dać wysokie plony biomasy wierzby w warunkach rolnictwa niskonakładowego (brak lub

ograniczona uprawa i niska liczba innych zabiegów agrotechnicznych) przy użyciu żywokołów na glebach marginalnych. Ponadto, odmiana Ekotur (*Salix viminalis*) i cv. Doutur (*S. alba*) mogą być zalecane do uprawy na glebie torfowo-murszowej.

3.13 PA13: About short rotation Poplar and Willow long-term field trial in Poland

Author: 3B

Title (English): Short rotation poplar and willow cultivated on marginal land as a source of energy in Poland

Summary (English): Poplar and willow are two species of short rotation coppices cultivated in Poland in the area of about 15,000 ha. These species can be grown on various soils, including marginal soils, both organic and mineral. In the MAGIC project, in Poland, willow and poplar were grown on two soil stands: heavy (clay) and light (loamy sand). After three years of cultivation the yield energy value of poplar and willow biomass acquired from heavy soil was very low and amounted to 27.21 and 14.34 GJ/ha/year, respectively. In turn, on light soil, these yields were much higher: 104 and 117 GJ/ha/year, for poplar and willow, respectively. Willow had better thermophysical properties as solid biofuel. It contained less moisture (50.1%) compared to poplar (52.2%). Willow also had less ash (1.37% d.m.) and nitrogen (0.59%) than poplar (1.71% d.m. and 0.74% d.m., respectively). The above properties indicate that poplar can be used for the production of heat and electricity. Fresh wood chips of these species can be combusted in industrial boilers, without the need for additional drying, while after drying, they can be used in small household boilers or used for the production of industrial pellets of ENplus B class.

Title (Polish): Topola i wierzba uprawiana w krótkich rotacjach na gruntach marginalnych jako źródło energii

Summary (Polish): Topola i wierzba to dwa gatunki krzewów uprawianych w krótkich rotacjach w Polsce na obszarze uprawy około 15 000 ha. Gatunki te mogą być uprawiane na różnych glebach, w tym marginalnych, zarówno organicznych jak i mineralnych. W projekcie Magic, w Polsce, wierzbę i topolę uprawiano na dwóch typach gleb: ciężkiej (ile zwykłym) oraz lekkiej (piasku słabogliniastym). Po trzech latach uprawy wartość energetyczna plonu biomasy topoli i wierzby z gleby ciężkiej była bardzo niska i wynosiła odpowiednio 27,21 i 14,34 GJ/ha/rok. Z kolei na glebie lekkie plony te był znacznie wyższe: 104 i 117 GJ/ha/rok, odpowiednio dla topoli i wierzby. Lepszymi cechami termofizycznymi jako paliwo biomasowe cechowała się wierzba. Zawierała ona mniej wilgoci (50,1%) w porównaniu do topoli (52,2%). Wierzba miała również mniej popiołu (1,37% s.m.) i azotu (0,59%) niż topola (odpowiednio 1,71% s.m. i 0,74% s.m.). Powyższe właściwości wskazują na możliwość zastosowania topoli do produkcji energii cieplnej i elektrycznej. Świeże zrębki tych gatunków mogą być spalane w kotłach przemysłowych, bez potrzeby dodatkowego dosuszania, natomiast po dosuszeniu mogą one być wykorzystane w małych kotłach przydomowych lub wykorzystane do produkcji peletu przemysłowego o klasie ENplus B.

3.14 PA14: About Siberian Elm long-term field trial in Spain

Author: CIEMAT

Title (English): Siberian Elm long-term field trial in Spain

Summary (English): Siberian Elm (*Ulmus pumila* L.) is a hardy and fast-growing tree that features greater resistance to Dutch Elm disease than other species in genus *Ulmus*. Drought tolerance, adaptation to different environments and sprouting capacity suggest that this plant species could be grown as a short rotation energy/industrial crop.

Siberian Elm was planted in two plots in 2009 and 2010 in marginal land in Soria province (North-Central Spain). The marginality factors were climate (low temperature) and soil (texture, stoniness, organic matter). In 2009, two plant densities (3,333 and 6,666 plants/ha) under two irrigation regimes (2,000 and 4,000 m^3/ha) were implemented and one plant density was established in rainfed conditions in 2010. Furthermore, two crops cycles were studied in each plot.

The results for a nine year period confirmed that Siberian Elm is a fast-growing woody species, adapted to the harsh climate of Soria: cold winters, frosts, and wind. It is also resistant to pests and diseases since no pesticide treatment has been carried out.

Siberian Elm prefers well-drained soils, although it also tolerates a wide variety of adverse conditions, such as soils with low organic matter content and flooding situations.

Yield was strongly influenced by the amount of irrigation water applied, planting densities and crop cycle. Maximum yields were obtained with planting densities of 6,666 and 3,333 trees/ha cropped every 3 and 4 years, respectively. The yield ranged between 4 - 7.5 t/ha.

The composition of the biomass was: ash content 3.0%, 48.0% C, 6.0% H, 0.5% N and Gross Calorific Value (GCV) of 19.2 MJ/kg.

Title (Spanish): Ensayo de campo a largo plazo con olmo siberiano en España

Summary (Spanish): El olmo de Siberia (*Ulmus pumila L.*) es una especie de rápido crecimiento, con mayor resistencia a plagas y enfermedades que otras especies del género *Ulmus*. Es tolerante a la sequía, se adapta a diferentes condiciones ambientales y tiene alta capacidad de rebrote, pudiendo utilizarse como cultivo energético o industrial en corta rotación.

Se establecieron dos parcelas de olmo de Siberia en tierras marginales de la Provincia de Soria en distintas fechas: noviembre de 2009 y abril de 2010. Los factores de marginalidad en ambas parcelas son debidos a las bajas temperaturas y las condiciones del suelo (textura, pedregosidad, materia orgánica). En la parcela establecida en 2009 se estudiaron dos densidades (3.333 y 6.666 plantas/ha) y dos regímenes hídricos (2000 y 4000 m^3/ha), mientras que en la parcela establecida en 2010 se ensayó una densidad de 3.333 plantas/ha en secano. Además, en cada parcela se estudiaron dos turnos de corta, cada 3 y 4 años.

Los resultados obtenidos en los 9 años de crecimiento muestran que el olmo es una especie de rápido crecimiento, adaptado al clima duro de Soria: inviernos fríos, heladas y viento. Es una especie resistente a plagas y enfermedades ya que no ha sido necesario aplicar

tratamientos fitosanitarios. Aunque prefiere suelos bien drenados, tolera situaciones de encharcamiento puntuales o baja materia orgánica.

Los rendimientos de biomasa dependieron de la cantidad de riego aplicada, la densidad de plantación y el ciclo de cultivo, obteniéndose las mayores producciones con densidades de 6.666 plantas/ha en ciclos de 3 años y 3.333 plantas/ha en ciclo de 4 años. El rendimiento de biomasa varió entre 4-7,5 t/ha.

La composición de la biomasa fue: cenizas 3,0 %; C 48,0 %; H 6,0 %; N 0,5 %; PCS 19,2 MJ/kg.

3.15 PA15: About Tall Wheatgrass long-term field trial in Spain

Author: CIEMAT

Title (English): Tall Wheatgrass long-term field trial in Spain

Summary (English): Perennial grasses have been envisaged by the scientific community as an interesting group of plant species for the sustainable production of biomass in marginal land in terms of crop diversification, improved control of soil erosion and recovery of soil organic matter content. Compared with annual grain crops, perennial biomass crops require fewer inputs, produce more energy and reduce Greenhouse Gas (GHG) emissions than annual cropping systems.

In 2010 and 2013, field trials with Tall Wheatgrass were carried out in two marginal lands in Soria province (North-Central Spain). The marginality factors were climate (low temperature) and soil (texture, stoniness, organic matter). In 2010 *Elytrigia elongata* Alkar was studied as single crop and mixed with other annual and perennial species. In 2013 three *Elytrigia elongata* cultivars: Alkar, Szarvasi-1 and Bamar were established on a parcel.

The results obtained in an eight year period showed that Tall Wheatgrass is a species well adapted to the hard climate conditions of Soria with a high tolerance to drought. Moreover, it is a crop resistant to pests and diseases since no pesticide treatment has been carried out.

Tall Wheatgrass prefers well-drained soils, although it tolerates a wide variety of adverse conditions, such as soils with low organic matter content and moderate salinity. However, flooding situations should be avoided.

Yields were between 2 and 5 t/ha. *Elytrigia elongata* Alkar produced the most yield when planted as single crop. *Elytrigia elongata* Szarvasi-1 produced the most yield.

The composition of the biomass was: ash content 5.2%, 46.0% C, 6.1% H, 0.6% N and Gross Calorific Value (GCV) of 18.5 MJ/kg.

Title (Spanish): Ensayo de campo a largo plazo con agropiro en España

Summary (Spanish): Las gramíneas perennes representan un grupo de interés para la producción sostenible de biomasa en tierras marginales, tanto en términos de diversificación de cultivos como para el control de la erosión y la mejora del contenido de materia orgánica del suelo. En comparación con los cultivos anuales, los cultivos perennes requieren menos insumos, gastan menos energía y reducen las emisiones de gases de efecto invernadero.

Se establecieron dos parcelas de agropiro en tierras marginales de la Provincia de Soria en años distintos: 2010 y 2013. Los factores de marginalidad en ambas parcelas son debidos a las bajas temperaturas y las condiciones del suelo (textura, pedregosidad, materia orgánica). En la parcela establecida en 2010 se estudió Agropiro (*Elytrigia elongata* Alkar) como cultivo solo y mezclado con otras especies anuales y perennes. En la parcela establecida en 2013, se ensayaron tres cultivares de *Elytrigia elongata*: Alkar, Szarvasi-1 y Bamar.

Los resultados obtenidos en los 8 años de crecimiento muestran que el agropiro es una especie bien adaptada a las duras condiciones climáticas de Soria, con alta tolerancia a la sequía. Además, el cultivo es resistente a plagas y enfermedades, ya que no ha sido necesario llevar a cabo tratamientos fitosanitarios.

Tolera situaciones de baja materia orgánica y moderada salinidad, debiendo evitarse el encharcamiento del suelo.

Los rendimientos de la biomasa estuvieron entre 2-5 t/ha. *Elytrigia elongata* Alkar produjo el mayor rendimiento cuando se sembró sin mezclar en 2010. En el estudio comparativo sembrado en 2013, *Elytrigia elongata* Szarvsi-1 produjo el mayor rendimiento.

La composición de biomasa fue: cenizas 5,2 %; C 46,0 %; H 6,1 %; N 0,6 %; PCS 18,5 MJ/kg.

3.16 PA16: About Switchgrass long-term field trial in Spain

Author: CIEMAT

Title (English): Switchgrass long-term field trial in Spain

Summary (English): As Tall Wheatgrass, Switchgrass is a perennial grass that offers similar advantages. Switchgrass (*Panicum virgatum* L.) is a warm season C4 grass propagated by seeds. Since the early 1990's the crop has been developed as an herbaceous energy crop for ethanol and electricity production.

In 2013 trials were carried out in Badajoz Province (South-Western Spain) under irrigation conditions. Cultivar used was Alamo. The aim of this work was to investigate the optimal dose of seeds. Two treatments were tested: 12 and 20 kg/ha, and minimum tillage conditions. The volume of water applied was 3,700 m^3/ha.

The results showed that it is a species adapted to sandy-loam soil and acidic pH of 6.6. In Spain, irrigation was necessary in order to ensure the good establishment and high biomass yields as well. In this case, higher doses of seeds resulted in higher productions, showing yields between 10 and 17 t/ha. The composition of the biomass was: ash content 5.1%, 46.2% C, 5.9% H, 0.53% N and Gross Calorific Value (GCV) of 18.6 MJ/kg.

Title (Spanish): Ensayo de campo a largo plazo con switchgrass en España

Summary (Spanish): El switchgrass (*Panicum virgatum L.*) en una gramínea perenne con ventajas similares a las del agropiro. Se trata de una especie C4 de clima cálido propagada por semillas. Desde principios de 1990 ha sido estudiada como cultivo energético herbáceo para producción de electricidad y para etanol.

Los ensayos empezaron en 2013 bajo condiciones de riego en la provincia de Badajoz (Sureste de España). El cultivar ensayado fue Álamo. El objetivo del ensayo fue investigar la dosis óptima de siembra. Para ello, se ensayaron dos dosis: 12 y 20 kg/ha, en condiciones de mínimo laboreo. El volumen medio de agua aplicada durante los años de ensayo fue de 3.700 m^3/ha.

Los resultados muestran que es una especie adaptada a suelo franco-arenoso y pH acido de 6,6. En las condiciones de España, debe garantizarse el regadío tanto para asegurar un buen establecimiento del cultivo como para lograr altos rendimientos de biomasa. Los resultados muestran que las producciones de biomasa están relacionadas con la dosis de siembra, implicando mayores dosis un incremento de las producciones. Los rendimientos de biomasa estuvieron entre 10-17 t/ha. La composición de la biomasa fue: contenido de cenizas 5,1 %; carbono 46,2 %; hidrógeno 5,9 %; nitrógeno 0,53 %; poder calorífico superior 18,6 MJ/kg.

3.17 PA17: About Miscanthus long-term trial in Ukraine

Author: IBCSB NAASU

Title (English): Growing miscanthus on marginal lands in Ukraine

Summary (English): Miscanthus can grow on soils with the following types of marginality: acidic, saline, chemically contaminated, poor in organic matter, unfavourable soil structure, and steep slopes.

On soils with a low content of organic matter, the productivity of miscanthus significantly depends on the type and amount of fertilizer applied. Therefore, fertilization should be carried out taking into account the actual removal of nutrients with the harvest. Growing miscanthus on poor soils for seven years allows increasing the content of organic matter in the arable soil layer by 0.37%. There is also a positive effect of counteracting water erosion of the soil when grown on steep slopes.

On acidic and saline soils, it is necessary to amend the soil with lime or gypsum ameliorants before planting in doses necessary for deoxidation of the root layer of the soil.

Variation of planting depth within 8−16 cm does not affect the growth, development, and productivity of plants. Therefore, in regions with cold and snowless winters, it is recommended to plant the rhizomes deeper. Planting rhizomes in the ridges is not recommended due to the freezing of the soil.

High-quality biomass can be obtained with the aid of foliar feeding with a complex of microelements. This minimizes the accumulation of heavy metals in biomass on chemically contaminated soils.

Treatment of miscanthus plants in the first and second years with humic products can improve plant adaptation to adverse growing conditions.

On soils with unstable soil moisture, at planting, it is recommended to apply moisture-retaining hydrogel in the root-containing layer of the soil or in the planting hole at the rate of 150-300 kg/ha.

Title (Ukrainian): Вирощування міскантусу на маргінальних землях в Україні

Summary (Ukrainian): Міскантус можна вирощувати на ґрунтах з такими видами маргінальності: кислі, засолені, хімічно забруднені, бідні на органічні речовини, кам'янисті, з несприятливою структурою, розташовані на крутих схилах.

На ґрунтах із низьким вмістом органічних речовин продуктивність міскантусу значно залежить від виду й кількості внесених добрив. Тому удобрення потрібно проводити з урахуванням фактичного виносу поживних речовин із урожаєм. Вирощування міскантусу на бідних ґрунтах протягом семи років дозволяє збільшити вміст органічних речовин в орному шарі ґрунту на 0,37 %. Також спостерігається позитивний ефект протидії водній ерозії ґрунту за вирощування на крутих схилах.

На кислих і солонцюватих ґрунтах перед закладанням плантації варто вносити, відповідно, вапняні або гіпсові меліоранти в дозах, необхідних для розкислення кореневмісного шару ґрунту.

Варіювання глибини садіння ризом міскантусу в межах 8−16 см не впливає на ріст, розвиток і продуктивністю рослин. Тому, в регіонах з холодними й малосніжними зимами рекомендовано садити ризоми глибше. Висаджування рослин у гребені не бажане через промерзання ґрунту.

Біомасу високої якості можна отримати, якщо проводити позакореневе підживлення комплексом мікроелементів. Це дозволяє мінімізувати накопичення в біомасі важких металів на хімічно забруднених ґрунтах.

Обробка рослин міскантусу в перший і другий роки вегетації гуматами дозволяє покращити адаптацію рослин до несприятливих умов вирощування.

На ґрунтах з нестійким вологозабезпеченням при закладанні плантації рекомендується вносити в кореневмісний шар ґрунту або в лунку вологоутримувач-гідрогель з розрахунку 150−300 кг/га.

3.18 PA18: About Energy Willow long-term field trial in Ukraine

Author: IBCSB NAASU

Title (English): Growing energy willow on marginal lands in Ukraine

Summary (English): In Ukraine, optimal conditions for willow growth exist in regions with an annual rainfall of at least 650 mm and groundwater in July at a depth of 0.6-2.0 m. Such places include floodplains, gullies, and ravines, where the following soil marginality types occur: hard clay soil, flood land, acid soil, saline soil, and peatland.

Growing willow on acid soils (pH < 5.0) is associated with the risk of release of mobile aluminum and manganese, which is manifested in the inhibition of root development, metabolic disorder, and, consequently, growth retardation. Therefore, such soils should be amended with lime ameliorants before planting in doses necessary for deoxidation of the root layer of the soil. Gypsum should be applied on saline soils (chestnut and light chestnut soils).

To control weeds effectively in the first years of growing one can mulch the soil with straw or sawdust, cover the soil with agrotextile, or mechanically destruct weeds using mulchers of plant residues.

On hard clay soils (clay content ≥ 50%) when planting, it is necessary to carry out ripping with ripper-cultivators to a depth of 45-50 cm at an interval of 140 cm. When soil crust occurs, it is necessary to carry out interrow loosening.

Treatment of willow cuttings before planting with humic products along with foliar fertilization in the first year can improve the survival and adaptation of plants to adverse growing conditions.

Title (Ukrainian): Вирощування енергетичної верби на маргінальних землях в Україні

Summary (Ukrainian): В Україні оптимальні умови для росту верби існують у регіонах з річною кількістю опадів не менше 650 мм і заляганням ґрунтових вод у липні на глибині 0,6–2,0 м. До таких місць відносяться заплави річок, балки і яри, де зустрічаються такі види маргінальності ґрунтів: ґрунти з високим вмістом глини, запливаючі, кислі, торфовища, рідше – солончаки.

Вирощування верби на кислих ґрунтах (pH < 5,0) пов'язане з ризиком вивільнення рухомих форм алюмінію й марганцю, що виявляється у пригніченні розвитку кореневої системи, порушенні обміну речовин і, як наслідок, сповільненні росту. Тому, такі ґрунти, перед закладанням плантації, необхідно розкислювати шляхом внесення вапняних меліорантів у дозах, необхідних для розкислення кореневмісного шару ґрунту. На солонцюватих ґрунтах (каштанові і світло каштанові) слід вносити гіпс.

Для ефективної боротьби з бур'янами в перші роки експлуатації плантації слід застосовувати мульчування ґрунту соломою або тирсою, агроволокно, або ж механічне знищення з використанням мульчувачів рослинних решток.

На важких глинистих ґрунтах (вміст глини ≥ 50%) при закладанні плантацій потрібно проводити щілювання культиваторами-щілювачами на глибину 45−50 см з інтервалом 140 см. При утворенні ґрунтової кірки необхідно проводити міжрядні розпушування.

Обробка живців верби перед садінням добривами на основі гуматів і позакореневе підживлення ними в перший рік вегетації дозволяють покращити приживання й адаптацію рослин до несприятливих умов вирощування.

3.19 PA19: About Switchgrass long-term field trial in Ukraine

Author: IBCSB NAASU

Title (English): Growing switchgrass on marginal lands in Ukraine

Summary (English): Switchgrass is well adapted to the main agro-ecological zones of Ukraine. Therefore it can be grown on such types of marginal land as acidic, saline, chemically contaminated, with low organic matter content, stony, with unfavourable soil texture, steep slopes.

In the first vegetation year, the crop suffers greatly from weeds. Therefore, it is recommended to sow switchgrass together with a marker crop (white mustard, 1−2 kg/ha) followed by loosening after the emergence of seedlings of the marker crop and, if necessary, 2−3 loosening after the emergence of switchgrass plants. Appropriate herbicides should also be used if the crops are severely affected by dicotyledonous weeds. In early August, in order to increase tillering and rooting of plants, mowing the plants to a height of 5−7 cm is recommended. In the second and subsequent years of vegetation, the crop itself effectively fights weeds providing that plant density is, at least, 200 plants/m^2.

On acidic and saline soils, pre-planting application of lime or gypsum in the doses necessary for deoxidation of the root layer of the soil is highly recommended, as the soil pH < 5.5 sharply increases the availability of aluminum and manganese to plants. These elements are easily accumulated by the plants, which impairs the quality of biofuels.

Switchgrass is a quite new crop to Ukraine; therefore it has no specific pests and diseases.

Title (Ukrainian): Вирощування світчграсу на маргінальних землях в Україні

Summary (Ukrainian): Просо прутоподібне добре адаптоване до основних агроекологічних зон України, тому його можна вирощувати на таких типах маргінальних ділянок як кислі, засолені, хімічно забруднені, бідні на органічну речовину, кам'янисті, та з несприятливою текстурою ґрунту, розташовані на крутих схилах.

У перший рік вегетації культура досить сильно страждає від бур'янів, а тому виправданою є сівба з маячною культурою (гірчиця біла 1−2кг/га) з наступним розпушуванням міжрядь після появи сходів маячної культури і, за потреби, 2−3 посходовими розпушуваннями міжрядь. За значного забур'янення дводольними видами бур'янів доцільно також застосовувати відповідні гербіциди. В першій декаді серпня, задля збільшення кущення й укорінення рослин, практикуються підкошування вегетативної маси проса прутоподібного на висоту 5−7 см. На 2-й і наступні роки вегетації культура сама ефективно бореться з бур'янами за умов густоти не менше 200 стебел на м2.

На кислих і засолених ґрунтах, перед закладанням плантації, варто застосовувати вапняні або гіпсові меліоранти в дозах, необхідних для розкислення кореневмісного шару ґрунту. Адже за зниження pH нижче 5,5 різко підвищується доступність рослинам алюмінію та марганцю. А ці елементи легко поглинаються і накопичуються в рослині, а потім – опиняються в твердому біопаливі, чим погіршують його якісні характеристики.

Завдяки тому що просо прутоподібне культура досить нова для України специфічних хвороб та шкідників немає**.**

3.20 PA20: About Hemp long-term field trial in Ukraine

Author: IBCSB NAASU

Title (English): Growing hemp on marginal lands in Ukraine

Summary (English): In Ukraine, the optimal conditions for growing hemp are provided in the Forest-Steppe zone, where the average annual rainfall ranges from 540 to 650 mm. High

temperatures of the Steppe zone, insufficient temperatures, and excessive rainfall of Polissia zone are unfavourable for hemp. It can be grown on marginal land with acidity, chemical contamination, and low organic matter content. If soil pH < 5.5, it is highly recommended to apply lime or gypsum in the doses necessary for deoxidation of the root layer of the soil.

Fibre in hemp is accumulated in the bark of the stem. That is why the value of hemp biomass directly depends on the thickness and height of stems: the larger the stem, the higher the yield, the more fibre and cellulose it contains. Therefore, the optimal plant density (40−45 plants/m^2) is key for the formation of a good yield.

Ploughing and seedbed preparation to a depth of 6−8 cm with cultivator ensure better results than mini-till. Both mechanical (pre-emergence harrowing on 3rd – 4th day + post-emergence harrowing, if needed) and chemical (Dual Gold 1.6 l/ha, applied before emergence) weed control methods ensure good yield results.

The high efficiency of growing hemp will be ensured with a wide-row planting on the background of fertilizers N120P90K90 (kg a.i./ha), which can ensure a stem yield of 4.02 t/ha and seed yield of 0.91 t/ha. This is a fairly high seed yield obtained on acid soils with low organic matter content due to the use of a balanced composition of nutrients.

Due to the immunity of hemp (to diseases and pests), it can withstand even the conditions of monocropping. When growing hemp to obtain green fibre, harvesting is recommended in the stage of technical maturity in order to perform timely ploughing for the following year.

Title (Ukrainian): Вирощування конопель на маргінальних землях в Україні

Summary (Ukrainian): В Україні, оптимальні умови для росту конопель існують в Лісостеповому регіоні країни, де середня кількість опадів за рік становить від 540 до 650 мм. Високі температури у Степовому регіоні, недостатня сума температур і надмірна кількість опадів у Поліссі несприятливі для культури. Коноплі можна вирощувати на таких типах маргінальних ґрунтів як кислі, хімічно забруднені, бідні на органічну речовину. У разі коли pH ґрунту нижче 5.5, перед закладанням плантації, варто застосовувати вапняні або гіпсові меліоранти в дозах.

Волокно в коноплях знаходиться у корі стебла тому цінність біомаси безпосередньо залежить від товщини й висоти стебла: чим крупніше стебло тим вища врожайність, тим більше в ньому волокна, а відповідно й целюлози. Тому для формування гарного врожаю слід забезпечити оптимальну густоту стеблостою 40−45 шт./м2.

Оранка й передпосівна підготовка на глибину 6−8 см забезпечує кращі результати, ніж мінімальний обробіток ґрунту. Однаково ефективні як механічні (досходове боронування на 3–4 день + післясходове у разі потреби) так і хімічні (Дуал Голд 1,6 л/га, досходове застосування) методи боротьби з бур'янами.

Доведена висока ефективність вирощування конопель широкорядним способом на фоні удобрення N120P90K90 (кг д.р./га), що може забезпечити урожай стебел 4,02 т/га і насіння 0,91 т/га. Це досить висока продуктивність, отримана на малозабезпечених кислих ґрунтах завдяки застосуванню збалансованого складу елементів живлення.

Завдяки імунітету (до хвороб і шкідників) рослини конопель добре витримують умови монокультури. При вирощуванні конопель на зеленець-волокно, збирання рекомендовано проводити у фазі технічної стиглості конопель з метою проведення своєчасної оранки під посів наступного року.

3.21 PA21: About no-till covercrop Miscanthus large-scale trial in France

Author: NOVABIOM

Title (English): No-till covercrop in Miscanthus x giganteus establishment year, France

Summary (English): Miscanthus x giganteus (MxG) is a perennial plant that has seen a strong development in France over the last 15 years. It's benefits are multiple, but can be summarised as: low inputs and high yields. Miscanthus does not require herbicide, except during its first year. A trial was developed to see if a cover crop could further reduce herbicide use by suppressing winter weeds without affecting miscanthus growth. To do this, 6 differents mixes of covercrops were sown in a 5 month old MxG plantation measuring up to 150cm in september 2019. A no-till disc drill was used to sow. MxG stems were slightly affected, but straightened back up after sowing. The results: Clover was too slow to establish due to a dry september and was not able to suppress ray grass. The covercrop mixtures including flax showed very good results. Also daikon radish, mustard and phacelia proved to establish quick enough to suppress winter weeds in a sufficient manner. However, daikon radish overgrew MxG in spring time and should be destroyed (FACA roller) before next year. Lastly, biodiversity increased; a lot of insects and mammals were observed. To conclude: Covercrops can be an efficient way to manage weeds in a first year MxG planting, depending on weather conditions during sowing.

Title (French): Couvert végétal dans un miscanthus de premiere année

Summary (French): Le Miscanthus x giganteus (MxG) est une plante vivace qui connaît un fort développement en France depuis 15 ans. Ses avantages sont multiples, mais peuvent se résumer ainsi : faibles intrants et rendements élevés. Le miscanthus ne nécessite pas d'herbicide, sauf pendant sa première année. Nous avons développé un essai pour voir si une couvert végétale pouvait réduire davantage l'utilisation d'herbicides en supprimant les mauvaises herbes d'hiver sans affecter la croissance du miscanthus. Pour ce faire, 6 mélanges différents de cultures de couverture ont été semés dans une plantation MxG âgée de 5 mois mesurant jusqu'à 150cm en septembre 2019. Nous avons utilisé un semoir à disques pour semer. Les tiges MxG ont été légèrement affectées, mais se sont redressées après le semis. Les résultats : Le trèfle a été trop lent à s'établir en raison d'un mois de septembre sec et n'a pas pu supprimer le raygrass venu de la bordure. Les mélanges de cultures de couverture comprenant du lin ont donné de très bons résultats. Le radis daikon, la moutarde et la phacélie se sont également avérés s'établir assez rapidement pour supprimer les mauvaises herbes d'hiver de manière suffisante. Cependant, le radis daikon a envahi MxG au printemps et devrait être détruit (rouleau FACA) avant le printemps prochaine. Enfin, la biodiversité a augmenté ; beaucoup d'insectes et de mammifères ont été observés. Pour conclure : les cultures de couverture peuvent être un moyen efficace dans la gestion des mauvaises herbes dans une plantation MxG de première année, en fonction des conditions météorologiques lors du semis.

3.22 PA22: About marginal soil cultivation of Miscanthus large-scale trial in France

Author: NOVABIOM

Title (English): Miscanthus cultivation on marginal soils in France with low inputs

Summary (English): The Loire river valley in France has very sandy soils that are often abandoned when irrigation is not possible. Miscanthus x giganteus (MxG) is a drought restistant plant that creates possibilities due to its perennial character, which allows it to establish over time and seek water where annuals cannot grow. No inputs are requiered. No fertilizers, and no herbicides after year 1. For MxG to be a success, establishment is crucial. Therefore, a trial was developed to see if MxG could be established in these sandy soils without irrigation, fertilizer, pesticides and herbicides in Mezieres lez Cléry on 1 hectare of sandy soil. 50% was rainfed, 50% irrigated. 50% of the weeds were mechanically destroyed, 50% chemically destroyed. No pesticides were used against wireworms (MxG's only establishment predator), and half of the fields had potatoes added to the interrow to distract wireworms from attacking. After maintaining these conditions over 2 years, the following results were found: The wireworm population was not strong enough to show a significant difference. The MxG establishment rates in irrigated, herbicide were highest (67,5%) and lowest in the rainfed, mechanically weeded part (42,5%). However, irrigation in the first year of MxG establishment, can compensate the dry out effect of mechanical weeding in the sandy soil (52% est.), 50% establishment is the minimum to have 10,000 plant/ha. This trial shows that MxG can be established in sandy soils. No herbicide, no fertilizers, and only mechanical weeding in the first year is needed to establish MxG on these marginal soils. Also, instead of using a row crop cultivator, a sprint tine harrow should be used: it reduces water evaporation and is still efficient enough to destroy weeds when they're small.

Title (French): Culture du miscanthus sur des sols marginaux en France avec de faibles intrants

Summary (French): La vallée de la Loire en France a des sols sablonneux qui sont abandonnés lorsque l'irrigation n'est pas possible. Le Miscanthus x giganteus (MxG) est une plante plus résistante à la sécheresse qui crée des possibilités grâce à son caractère pérenne qui lui permet de s'établir dans le temps et de chercher l'eau là où les annuelles ne peuvent pas pousser. Aucun intrant n'est nécessaire. Pas d'engrais, pas d'herbicides après la première année. Pour MxG l'établissement est crucial. Donc nous avons développé un essai pour voir si nous pouvons établir MxG dans ces sols sablonneux sans irrigation, engrais, pesticides et herbicides à Mezieres lez Cléry sur 1 hectare. 50% était en pluvial, 50% en irrigué. 50% des mauvaises herbes étaient détruites mécaniquement, 50% seraient détruites chimiquement. Aucun pesticide n'a été utilisé contre le taupin et dans la moitié des champs, des pommes de terre ont été ajoutées dans l'inter-rang comme appât. Après avoir maintenu ces conditions pendant 2 ans, voici les résultats: La population de taupins n'était pas assez forte pour montrer une différence significative. Les taux de survie de MxG en irrigué, herbicide étaient les plus élevés (67,5%) et les plus bas dans la partie pluviale, désherbée mécaniquement (42,5%). Cependant l'irrigation dans la première année d'établissement de MxG, peut compenser l'effet de dessèchement du désherbage mécanique dans le sol sablonneux (52% est.). 50% de

survie est le minimum pour avoir 10,000 plantes/ha. Ces essais montrent que nous pouvons établir MxG dans des sols sablonneux sans intrants. Au lieu d'utiliser un cultivateur en ligne, utiliser une herse étrille, qui réduit l'évaporation de l'eau et est efficace pour détruire les mauvaises herbes lorsqu'elles sont petites.

3.23 PA23: About boosting Miscanthus large-scale trial in France

Author: NOVABIOM

Title (English): Boosting miscanthus on marginal land in France

Summary (English): Miscanthus x giganteus (MxG) is a perennial plant that has seen a strong development in France over the last 15 years. It has been implanted in France on all latitudes, and adapts well to different soil and climate conditions. However, on marginal lands, rare cases of lowering yields were observed. This trial was created to define the factors that can cause this phenomenon. To do so, soil and plant matter analyses were done to expose any deficiencies. The apparently missing elements were then added by the means of fertilizers. In 2019 Urea was applied on two 10x10 m squares. In 2020 N, P, K, Mg and Zn were applied in strips, next to a control strip. The results show that Miscanthus x Giganteus responded very well to N-rich fertilizers. A dark green colour was observed on the leaves, as well as an increase in stem height by 29.4%. What was most interesting, is that the effects were again clearly visible in the second year, without receiving a second application of N. This led to conclude that in some cases, a one-time N-rich fertilizers application can boost Miscanthus yield to increase to regular standards again.

Title (French): Renforcer un Miscanthus sur terre marginale

Summary (French): Le Miscanthus x giganteus (MxG) est une plante vivace qui connaît un fort développement en France depuis 15 ans. Implanté en France sous toutes les latitudes, il s'adapte bien aux différentes conditions pédoclimatiques. Cependant, sur les terres marginales, nous avons observé des cas rares de diminution des rendements. L'essai que nous avons développé a été créé pour définir les facteurs qui peuvent provoquer ce phénomène. Pour ce faire, des analyses de sol et de matière végétale ont été effectuées pour mettre en évidence les éventuelles carences. Les éléments apparemment manquants ont ensuite été ajoutés au moyen d'engrais. En 2019, l'urée a été appliquée sur deux carrés de 10x10 m. En 2020, N, P, K, Mg et Zn ont été appliqués en bandes, à côté d'une bande de contrôle. Les résultats montrent que Miscanthus x Giganteus a très bien réagi aux engrais riches en N. Une coloration vert foncé a été observée sur les feuilles, ainsi qu'une augmentation de la hauteur de la tige de 29,4%. Ce qui était le plus intéressant, c'est que les effets étaient à nouveau clairement visibles la 2ème année, sans recevoir une 2ème application de N. Ceci nous amène à conclure que dans certains cas, une application unique d'engrais riches en N peut relancer un Miscanthus et obtenir des rendements habituels.

3.24 PA24: About Castor large-scale trial in Volos, Greece

Author: CREA/CRES

Title (English): Castor experimental field in Volos, Greece

Summary (English): In 2021 an experimental field in Volos, Greece, was established to test the effects of three terminating products: Glyphosate GLY 6 l ha^{-1} applied 20 days before harvesting; DEF Spotlight© BASF (carfentrazone-ethyl) 6 l ha^{-1} 20 days before harvesting and Diquat at 5 l ha^{-1} 10 days before harvesting. Residual moisture, seed loss and effects on the direct combine harvesting were recorded and compared with Control plants. Seeds of dwarf cultivar C 1012 were provided by KAIIMA, they were sown in April 2021 on a marginal field and the same day a fertilization with 270 kg ha^{-1} of fertilizer NPK 21-17-3 was carried out. Row spacing was 50 cm x 75 cm and weed management was performed mechanically after germination. The combine harvester used was a New Holland mod. CX 780 equipped with a New Holland cereal header Type 17 V 5.10 m wide. All other factors, as fan speed, upper sieve and lower sieve clearance of the combine harvester were kept constant, namely: 800 r.p.m., 17 mm and 10 mm opening, respectively. The working speed of the machinery averaged at 2.3 km/h. The effects on seeds loss were assessed as well as the quality of collected seeds. According to the results, DIQ showed a significantly lower moisture content of capsules (7.32%) in comparison to the other treatments, while for plant moisture the lowest values were achieved by both DIQ (62.38%) and GLY (59.12%). Focusing on seed loss, DIQ showed the lowest value for seed loss for natural dehiscence (3.28%) and a very low value of seed loss related to the cleaning shoe of the combine harvester (0.41%).

Title (Italian): Campo sperimentale di ricino a Volos, Grecia

Summary (Italian): Nel 2021 è stato creato un campo sperimentale a Volos, in Grecia, per testare gli effetti di tre prodotti terminanti: Glifosate GLY 6 l ha^{-1} applicato 20 giorni prima del raccolto; DEF SpotlightBASF 6 l ha^{-1} 20 giorni prima del raccolto e Diquat a 5 l ha^{-1} 10 giorni prima del raccolto. L'umidità residua, la perdita di semi e gli effetti sulla raccolta diretta della mietitrebbia sono stati registrati e confrontati con le piante di controllo. I semi della cultivar nana C1012 sono stati forniti da KAIIMA, sono stati seminati in aprile 2021 su un campo marginale e lo stesso giorno è stata effettuata una concimazione con 270 kg ha^{-1} di fertilizzante NPK 21-17-3. La spaziatura delle file era di 50 x 75 cm e la gestione delle infestanti è stata eseguita meccanicamente dopo la germinazione. La mietitrebbia utilizzata era una New Holland mod. CX780 equipaggiata con una testata per cereali New Holland tipo 17 V larga 5,10 m. Tutti gli altri fattori, come la velocità della ventola, la distanza dal setaccio superiore e inferiore della mietitrebbia sono stati mantenuti costanti, vale a dire: 800 r.p.m., 17 mm e 1 mm di apertura, rispettivamente. La velocità di lavoro della macchina è stata in media di 2,3 km/h. Sono stati valutati gli effetti sulla perdita di semi e la qualità dei semi raccolti. Secondo i risultati, DIQ ha mostrato un contenuto di umidità delle capsule significativamente più basso (7,32%) rispetto agli altri trattamenti, mentre per l'umidità della pianta i valori più bassi sono stati raggiunti sia da DIQ (62,38%) che da GLY (59,12%). Concentrandosi sulla perdita di semi, DIQ ha mostrato il valore più basso di perdita di semi per deiscenza naturale (3,28%) e un valore molto basso di perdita di semi legato alla scarpa di pulizia della mietitrebbia (0,41%).

3.25 PA25: About Castor large-scale trial in Xanthi, Greece

Author: CREA/CRES

Title (English): Castor experimental field in Greece

Summary (English): In 2021 an experimental field in Xanthi, Greece, was established to test the performance of direct combining harvesting castor beans (*Ricinus communis* L.) grown on marginal land. Seeds of dwarf cultivar C 1012 were provided by KAIIMA, they were sown in April 2021 and on the same day a first fertilization with 270 kg ha^{-1} of fertilizer NPK 21-17-3 was carried out. Row spacing was 50 cm x 100 cm Weed management was performed by applying 4.0 kg ha^{-1} of Stomp (BASF, Ludwigshafen, Germany) after emergence. The crop was terminated 10 days before harvesting via the application of 6.0 l ha^{-1} of Reglone 20 SL (Syngenta, Basel, Switzerland). Before harvesting plants measured 78 cm in height on average, the potential seed yield (PSY) was 2 t d.m. ha^{-1} , seed and plant moisture were 4.1 % and 80.7% on average respectively. The mechanical harvesting was performed with Combine harvester New Holland CX8060 equipped with cereal header and a sunflower header. The average working speed of the combine harvester was 2.3 km h^{-1}, corresponding to an Effective Field Capacity of 1.03 ha h^{-1}, with a fuel consumption of 21.27 l h^{-1}. Seeds loss and performance and were evaluated in both cases. Seed loss due to the impact accounted for 14% and 8% in dry matter of PSY in cereal and sunflower header, respectively. On the other hand, the two headers did not affect the seed loss due to the cleaning system which was estimated ranging between 7 and 8% of PSY.

Title (Italian): Campo sperimentale di ricino in Grecia

Summary (Italian): Nel 2021 è stato istituito un campo sperimentale a Xanthi, in Grecia, per testare le prestazioni della raccolta diretta dei semi di ricino (*Ricinus communis* L.) coltivati su terreni marginali. I semi della cultivar nana C 1012 sono stati forniti da KAIIMA, sono stati seminati nell'aprile 2021 e lo stesso giorno è stata effettuata una prima concimazione con 270 kg ha^{-1} di fertilizzante NPK 21-17-3. La distanza tra le file era di 50 cm x 100 cm La gestione delle infestanti è stata eseguita applicando 4,0 kg ha^{-1} di Stomp (BASF, Ludwigshafen, Germania) dopo l'emergenza. La coltura è stata interrotta 10 giorni prima della raccolta mediante l'applicazione di 6,0 l ha^{-1} di Reglone 20 SL (Syngenta, Basilea, Svizzera). Prima della raccolta, le piante misuravano in media 78 cm di altezza, la resa potenziale in semi (PSY) era di 2 t d.m. ha^{-1}, l'umidità del seme e della pianta era rispettivamente del 4,1% e dell'80,7%. La raccolta meccanica è stata eseguita con mietitrebbia New Holland CX8060 dotata di testata cereali e testata girasole. La velocità media di lavoro della mietitrebbia è stata di 2,3 km h^{-1}, corrispondente ad una capacità effettiva di campo di 1,03 ha h^{-1}, con un consumo di carburante di 21,27 l h^{-1}. Perdita di semi e prestazioni valutate in entrambi i casi. La perdita di semi a causa dell'impatto ha rappresentato rispettivamente il 14% e l'8% sulla sostanza secca di PSY nella testata di cereali e girasole. Le due testate, invece, non hanno influito sulla perdita di seme dovuta al sistema di pulizia che è stata stimata compresa tra il 7 e l'8% di PSY.

3.26 PA26: About Wild Sugar Cane large-scale trial in Italy

Author: UNICT

Title (English): Wild Sugar Cane on marginal lands affected by drought in southern Italy

Summary (English): Mediterranean climates are characterized by long periods of drought during summer and short dry periods from autumn to spring, what limits plant CO_2 assimilation and biomass production to a great extent. More limiting scenarios are forecasted due to climate change in the coming years in the Mediterranean basin. Under these circumstances, plants

with excellent adaptation are needed. Perennial crops, and grasses in particular, have proved to be more efficient than annual crops for biomass production for several environmental and economic reasons. The Joint Research Centre (JRC) has set thresholds to define marginal lands in terms of biophysical constraints. In this case, climate limitation given by the ratio between precipitations and potential evapotranspiration (P/ET) was focused. Areas with P/ET ≤0.60 are classified as affected by dryness. The study follows up a long-term plantation of the C4 perennial grass wild sugarcane (*Saccharum spontaneum* ssp. *aegypticum*) under different water regimes in a semi-arid environment. The species were established at the experimental farm of the University of Catania in 2005 by using rhizome cuttings. Biomass dry matter yield was significantly affected by irrigation treatment and meteorological conditions of the growing season (mainly precipitation amount and distribution) with yield values ranging between 29.9 and 37.1 t/ha in full-irrigation, between 24.5 and 32.0 t/ha in half-irrigation and between 19.1 and 27.4 t/ha in rainfed conditions. Wild Sugar Cane is well adapted to environments dominated by dryness, and even after 10 years the biomass yield remain quite stable and at very high levels. However, agronomic, energetic, environmental and economic issues need further research.

Title (Italian): La canna d'Egitto in terreni marginali siccitosi

Summary (Italian): I climi mediterranei sono caratterizzati da lunghi periodi di siccità durante l'estate e brevi periodi di siccità dall'autunno alla primavera, il che limita in larga misura l'assimilazione della CO_2 e la produzione di biomassa. Scenari più limitanti sono previsti a causa del cambiamento climatico. In queste circostanze, sono necessarie specie in grado di ottimizzare le risorse naturali. Le colture perenni e in particolare le graminacee hanno dimostrato di essere più efficienti delle colture annuali per la produzione di biomassa per diverse ragioni agronomiche ed ambientali. Il JRC ha stabilito una serie di soglie per definire le terre marginali in termini di vincoli biofisici. Il nostro studio focalizza sulla limitazione climatica data dal rapporto tra precipitazioni ed evapotraspirazione potenziale (P/ET ≤0,60). Il presente studio riporta una piantagione di lungo termine della canna d'Egitto (*Saccharum spontaneum ssp. aegypticum*) in diversi regimi idrici in un ambiente mediterraneo semi-arido. La resa della biomassa è stata significativamente influenzata dal trattamento di irrigazione e dalle condizioni meteorologiche della stagione di crescita (principalmente dalla quantità e distribuzione delle precipitazioni) con valori di resa compresi tra 29,9 e 37,1 t/ha in irrigazione completa, tra 24,5 e 32,0 t/ha in irrigazione ridotta e tra 19,1 e 27,4 t/ha condizioni idriche naturali. La specie si adatta bene agli ambienti dominati dall'aridità, e anche dopo 10 anni dalla piantagione la resa della biomassa rimane abbastanza stabile. Tuttavia, ulteriori ricerche conseguite per altre graminacee perenni (ad esempio, *A. donax, Miscanthus spp. P. virgatum, P. arundicnacea*, ecc.), devono essere affrontate.

3.27 PA27: About Camelina slope harvesting large-scale trial in Italy

Author: CREA/UNIBO

Title (English): Camelina slope harvesting in Italy

Summary (English): Field survey was carried out on marginal soil (steep soil of 15%) to evaluate seed yield of the spring camelina cultivar Alba, supplied by Camelina Company

(Spain), and to assess seed loss during direct mechanical harvesting. A large plot trial was established in January 2021 on a surface of about 1,000 m^2 at the experimental farm of Bologna University in Ozzano (Bologna). The experimental field is characterized by a slope of about 15%. The agronomic management was defined as low input organic. Harvesting was performed with a New Holland TC 5080 self-levelling combine harvester with 6 m working width and conventional cleaning shoe. Seed yield of camelina cultivar Alba reached on average 1.52 t d.m. ha^{-1}. Results of the work performance analysis showed that seed loss was substantially lower than what found in current literature for flat land, i.e. 0.53 %, mostly as a consequence of the lower working speed. Therefore, it is possible to harvest camelina via self-levelling combine harvester also in steep slope conditions, confirming the suitability of such crop to grow on marginal lands.

Title (Italian): Raccolta delle piste di camelina in Italia

Summary (Italian): È stata condotta un'indagine di campo su terreno marginale (terreno ripido del 15%) per valutare la resa in seme della cultivar di camelina Alba, fornita da Camelina Company (Spagna), e per valutare la perdita di seme durante la raccolta meccanica diretta. Un grande appezzamento di prova è stato istituito nel gennaio 2021 su una superficie di circa 1000 m^2 presso l'azienda agricola sperimentale dell'Università di Bologna a Ozzano (Bologna). Il campo sperimentale è caratterizzato da una pendenza di circa il 15% La gestione agronomica è stata definita biologica a basso input. La raccolta è stata eseguita con una mietitrebbia autolivellante New Holland TC 5080 con larghezza di lavoro di 6 m e pattino di pulizia convenzionale. La resa in semi della cultivar di camelina Alba ha raggiunto in media 1,52 t d.m. ha^{-1}. I risultati dell'analisi delle prestazioni lavorative hanno mostrato che la perdita di semi è stata sostanzialmente inferiore a quella riscontrata nella letteratura attuale per i terreni pianeggianti, ovvero 0,53%, principalmente come conseguenza della minore velocità di lavoro. Pertanto, è possibile raccogliere la camelina tramite mietitrebbia autolivellante anche in condizioni di forte pendenza, a conferma dell'idoneità di tale coltura a crescere su terreni marginali.

3.28 PA28: About Arundo and Miscanthus large-scale trials in Italy

Author: UNICT

Title (English): Arundo and Miscanthus on marginal land affected by dryness in fertilized and unfertilized conditions in southern Italy

Summary (English): Perennial, non-food grasses have been proposed as the most efficient species for biomass production due to their agronomic, environmental and social benefits. Species characterized by high water use efficiency and low nitrogen requirement, well adapted to use natural resources of a specific environment, can be recommended as ideal crops. Along with irrigation and water savings, nitrogen requirement is a significant issue in intensive agriculture and has a great effect over the energetic balance of crops. Therefore, low input cropping systems could directly mitigate greenhouse gas emissions. In this case long-term plantations of two perennial grasses (*Arundo donax* and *Miscanthus x giganteus*), grown in rainfed conditions under two nitrogen regimes, were compared in an environment affected by dryness (according to the thresholds set by the Joint Research Centre (JRC) in terms of ratio

between precipitations and potential evapotranspiration (P/ET ≤0.60)). *Miscanthus x giganteus* and *Arundo donax* were transplanted in summer 1993 and in spring 1997, respectively. In 2015 (22-year for Miscanthus and 18-year for Arundo), Arundo and Miscanthus (fertilized with 80 kg N ha^{-1}) showed similar yields (11.9 and 10.4 t/ha), while Arundo unfertilized (N0) produced 10 t/ha against 5.3 t/ha of Miscanthus N0. In 2016 (23-year for Miscanthus and 19-year for Arundo) Arundo and Miscanthus N0 produced 10.6 and 6.2 t/ha, while Arundo and Miscanthus N80 attained 15.3 and 8.7 t/ha. In 2017 (24-year for Miscanthus and 20-year for Arundo) a similar trend was observed, Arundo N80 showed the highest yield (14.9 t/ha) followed by Miscanthus N80 (9.7 t/ha), Arundo N0 (8.4 t/ha) and Miscanthus N0 (5.9 t/ha).

Title (Italian): Arundo e Miscanthus in terreni marginali siccitosi in condizioni concimate e non-concimate

Summary (Italian): Le graminacee perenni, non alimentari, sono state proposte come le specie più efficienti per la produzione di biomassa grazie all'elevata efficienza dell'uso delle risorse naturali. Le specie caratterizzate da un'elevata efficienza d'uso dell'acqua e un basso fabbisogno di azoto, possono essere raccomandate come colture ideali. Accanto al risparmio di acqua, il fabbisogno di azoto è un problema significativo nell'agricoltura intensiva e influisce notevolmente sull'equilibrio energetico delle colture. Nel presente studio sono state confrontate coltivazioni a lungo termine di due graminacee perenni (*Arundo donax e Miscanthus x giganteus*) coltivate in condizioni di idriche naturali in due regimi di concimazione azota in un ambiente affetto da siccità (secondo le soglie stabilite dal JRC in termini di rapporto tra precipitazioni ed evapotraspirazione potenziale (P/ET ≤0,60)). Miscanthus e Arundo sono stati trapiantati nell'estate del 1993 e nella primavera del 1997, rispettivamente. Nel 2015 (22 anni per Miscanthus e 18 anni per Arundo), Arundo e Miscanthus (concimati con 80 kg/ha di N) hanno mostrato rese simili (11,9 e 10,4 t/ha), mentre Arundo non concimato (N0) ha prodotto 10 t/ha contro 5,3 t/ha di Miscanthus N0. Nel 2016, Arundo e Miscanthus N0 hanno prodotto 10,6 e 6,2 t/ha, mentre Arundo e Miscanthus N80 hanno ottenuto 15,3 e 8,7 t/ha. Nel 2017 è stata osservata una tendenza simile, Arundo N80 ha mostrato la resa più elevata (14,9 t/ha) seguito da Miscanthus N80 (9,7 t/ha), Arundo N0 (8,4 t/ha) e Miscanthus N0 (5,9 t/ha).

3.29 PA29: About large-scale trial recultivation in Latvia

Author: LSFRI SILAVA

Title (English): Recultivation of peat mining area in Latvia

Summary (English): An experimental tree plantation was established in peat post-mining area in Latvia. The upper layer of the remaining soil consists of acidic (pH$CaCl_2$ ~3.5) moderately decomposed raised bog peat and is above 50 cm in thickness. Such soil is rich in organic matter and N but lacks essential plant-available nutrients. Therefore, in addition to control plots, wood ash treatment was applied in doses of 5, 10 and 15 t ha^{-1} in three replications. Wood-ash chemical content: K 24.7, Mg 18.2, Ca 120.4, P 6.6 g kg^{-1}. In each replication poplar (*Populus tremula*) (clone Vesten), birch (*Betula pendula*), pine (*Pinus Syvestris*) and alder (*Alnus Glutinosa*) were planted (1055 trees per hectare). Five years after establishment, survival rate of poplar was the lowest of all species – 0% in control plots, 27, 62 and 57%

survival in plots amended with wood ash in doses 5, 10 and 15 t ha^{-1} respectively. On average, after four years, poplar was 112, 331, 452 and 452 cm high under control and 5, 10 and 15 t ha^{-1} wood ash treatments. The results highlight the high nutritional and pH requirements of poplar. Fertilisation and liming is essential to ensure survival of poplar stands in poor post-mining areas, and application of 10 t ha^{-1} wood ash dose is sufficient. The initial growth of pine is rather slow, however it exhibited >98% survival regardless of treatment, thus, proving to be a promising species in poor post-mining conditions. Initially 5 t ha^{-1} treatment was enough to ensure adequate growth and survival, but after five years pine, birch and alder showed best growth parameters (180, 367 and 476 cm, respectively) under 15 t ha^{-1} wood ash treatment compared to control (100, 78 and 154 cm, respectively). The site was established as LIFE Restore project (LIFE14 CCM/LV/001103) demo site.

Title (Latvian): Kūdras ieguves vietas rekultivācija

Summary (Latvian): Eksperimentāls kokaugu stādījums ierīkots bijušajā kūdras ieguves teritorijā. Augsnes virsējās kārtas (>50 cm) veido skāba ($pHCaCl_2$ ~3.5), daļēji sadalījusies augstā purva kūdra. Šādas augsnes ir bagātas ar organiskajām vielām un slāpekli, bet tām trūkst citu svarīgu augiem pieejamo barības elementu. Tādēļ, papildus kontroles variantam, augsne ielabota ar trīs devām koksnes pelnu – 5, 10 un 15 t ha^{-1}. Koksnes pelnu sastāvs: K 24.7, Mg 18.2, Ca 120.4, P 6.6 g kg^{-1}. Visi varianti ierīkoti trīs atkārtojumos, un katrā iestādītas papeles (*Populus tremula*) (klons Vesten), bērzi (*Betula pendula*), melnalkšņi (*Alnus Glutinosa*) un priedes (*Pinus Sylvestris*) (1055 koki ha^{-1}). Pēc pieciem augšanas gadiem papeles uzrādīja vissliktāko saglabāšanos – 0% kontroles variantā, 27, 62 un 57% variantos, kas ielaboti attiecīgi ar 5, 10 un 15 t ha^{-1} koksnes pelniem. Vidējie papeļu augstumi pēc četriem augšanas gadiem bija 112, 331, 452 un 452 cm kontroles un ar 5, 10 un 15 t ha^{-1} pelnu ielabotajos variantos. Šie rezultāti norāda uz papeļu jutību pret barības vielu trūkumu un augsnes pH. Augsnes ielabošana ir vitāli nepieciešama, lai nodrošinātu papeles izdzīvošanu nabadzīgās augsnēs. Ielabošana ar 10 t ha^{-1} koksnes pelniem ir pietiekama. Kaut arī sākotnējā priedes augšanas gaita ir salīdzinoši lēna, tā ir piemērota audzēšanai nabadzīgos apstākļos, jo visos variantos priežu izdzīvotība bija >98%. Sākotnēji pietiek ar 5 t ha^{-1} koksnes pelnu devu, lai nodrošinātu koku augšanu, tomēr pēc pieciem gadiem vislabākie rādītāji priedei, bērzam un melnalksnim bija izmantojot 15 t ha^{-1} koksnes pelnu devu (attiecīgi 180, 367 un 476 cm) salīdzinājumā ar kontroli (attiecīgi 100, 78 un 154 cm). Stādījums ierīkots LIFE Restore projekta ietvaros (LIFE14 CCM/LV/001103).

3.30 PA30: About White Willow large-scale trial in Latvia

Author: LSFRI SILAVA

Title (English): Elaboration of innovative White Willow agroforesty systems on marginal mineral soils improved by wood ash and less demanded peat fractions amendments in Latvia

Summary (English): The use of industrial by-products as fertilizers helps to reduce the cost of soil improvement and complies with the basic principles of the circular economy. Wood-ash is abundant with potassium and phosphorus which is available to plants. Less demanded peat fractions can be used to diminish the lack of nitrogen and organic matter in poor mineral soils. In addition, in acid soils, wood-ash also acts as a liming agent reducing pH and enhancing

nutrient availability to plants. Growing traditional crops in marginal areas is not an economically viable practise, hence, more acceptable is to choose crops with high ecological plasticity. Willow genus and clones are easy to vegetative propagated and used both as a wood resource and as a source of nectar and pollen during flowering. A total of 21 clones including White Willow cuttings and female and male juvenile fast-growing clones were used in study. If male clones are planted, the plantation does not produce seeds and there is no risk of willow seeds spreading from the plantation in the adjacent areas. A mixture of different fractions of peat (0-7; 5-10; 7-20; 20-40 mm) and wood-ash (10; 20; 30% of the fertilizer mixture) was added to the substrate to determine the most efficient mixture for cuttings. During study, several S. alba clones that grow well in poor mineral soils (0218B, 0214W, LVX1, Platonis) were selected. Clone Platonis was selected due to the good morphological traits of the male mother plant (CPVO No. A20210392).

Elaboration of innovative White Willow – perennial grass agroforestry systems on marginal mineral soils improved by wood ash and less demanded peat fractions amendments (ERAF Nr.1.1.1.1/19/A/112).

Title (Latvian): Inovatīvu Baltā vītola agromežsaimniecības sistēmu ierīkošana ar koksnes pelnu un mazāk pieprasīto kūdras frakciju maisījumiem ielabotās marginālās minerālaugsnēs

Summary (Latvian): Rūpniecības blakusproduktu izmantošana kā mēslojums palīdz samazināt augsnes ielabošanas izmaksas, kā arī atbilst aprites ekonomikas pamatprincipiem. Koksnes pelni ir bagāti ar augiem pieejamu K un P. Nabadzīgās minerālās augsnēs trūkstošo slāpekli un organiskās vielas var pievienot izmantojot mazāk pieprasītās kūdras frakcijas. Turklāt skābās augsnēs koksnes pelni darbojas arī kā kaļķošanas līdzeklis, optimālāka vides reakcija ir saistīta ar augsnē esošo barības vielu uzņemšanu. Tradicionālo lauksaimniecības kultūru audzēšana marginālos apgabalos nav ekonomiski dzīvotspējīga, alternatīva ir pieticīgas kultūras ar augstu ekoloģisko plastiskums. Vītolu ģints sugas un kloni ir viegli veģetatīvi pavairojami un izmantojami gan kā koksnes resurss, gan ziedēšanas laikā kā nektāraugs un putekšņu avots. Šajā pētījumā kā pētāmo objektu izmantoja vietējās sugas Baltā vītola spraudeņus, tā sievišķos un vīrišķos juvenīli ātraudzīgus klonus, kopā 21 klonu. Ja stāda vīrišķos klonu – audze neveido sēklas un nepastāv risks, ka piegulošajās platībās izplatīsies kārklu sēklas no stādījuma. Substrātam pievienoja dažādu frakciju kūdras (0-7; 5-10; 7-20; 20-40 mm) un koksnes pelnu koncentrācijas (10; 20; 30 % no mēslojuma maisījuma) maisījumu, lai noteiktu efektīvāko maisījumu spraudeņu audzēšanai. Pētījumā atlasīti vairāki S. alba kloni, kas labi aug nabadzīgā mineralaugsnē (0218B, 0214W, LVX1, Platonis). Klons Platonis atlasīts vīrišķā mātesauga labo īpašību dēļ (CPVO Nr. A20210392). (ERAF Nr.1.1.1.1/19/A/112).

Inovatīvu Baltā vītola - daudzgadīgo zālaugu agromežsaimniecības sistēmu ierīkošana ar koksnes pelnu un mazāk pieprasīto kūdras frakciju maisījumiem ielabotās marginālās minerālaugsnēs (ERAF Nr.1.1.1.1/19/A/112).

3.31 PA31: About Willow and Poplar large-scale trial in Poland

Author: 3B

Title (English): Willow and poplar cultivation on sandy and heavy soil sites in Poland

Summary (English): Poplar and willow are species grown as short rotation coppices (SRC). These plants are grown mainly on marginal or contaminated soils of poor quality, less suitable for the cultivation of food or feed crops. The aim of the study, located in north-eastern Poland, was to compare the yield of willow and poplar cultivation on sandy and heavy clay soil. The crops were planted in 2018 and the results are from two years of experiment (2019 and 2020). The results show that the survival of both species was satisfactory on light soil (81.3%) and very low on heavy soil (44.4% on average). This low survival rate was the result of unfavorable weather conditions, especially the lack of precipitation in the first year after the cuttings were planted.

The yield of fresh biomass of two-year-old poplar plants, was 14.5 t/ha on average and was significantly higher by approximately 2 t/ha than for willow. In turn, the yield of fresh biomass obtained from light soil (22.9 t/ha on average) was over five times higher than that obtained from heavy soil. A significant influence of the type of soil on the amount of dry biomass yield was found. The yield of poplar and willow on sandy soil was 5.13 and 5.14 t/ha/year d.m., respectively. On the other hand, on heavy soil, the yield of dry biomass was six times lower and amounted to 1.12 and 0.67 t/ha/year d.m, respectively. The correlation analysis showed that the dry matter yield was significantly influenced by plant density, survival, plant height and shoot diameter.

In conclusion, willow and poplar can be grown on light soil, achieving satisfactory yield, but it is not recommended to cultivate them on heavy clay soil, because such a site does not provide the appropriate conditions for the cultivation of these species.

Title (Polish): Uprawa wierzby i topoli na glebie piaszczystej i ciężkiej glebie ilastej

Summary (Polish): Topola i wierzba są gatunkami uprawianymi w krótkich rotacjach (SRC). Rośliny te są uprawiane głównie na słabej jakości glebach marginalnych czy skażonych, mniej przydatnych do uprawy roślin żywnościowych czy paszowych. Celem badań, zlokalizowanych w północno-wschodniej Polsce, było porównanie plonowania uprawy wierzby i topoli na sandy i heavy clay soil. Rośliny był sadzone w roku 2018, a wynki pochodzą z dwóch lat doświadczeń (2019 i 2020). Wyniki wskazują, że przeżywalność obu gatunków była zadowalająca na glebie lekkiej (81,3%) i bardzo niska na glebie ciężkiej (średnio 44,4%). Ta niska przeżywalność była wynikiem niekorzystnych warunków meteorologicznych, a szczególnie braku opadów w pierwszym roku po wysadzeniu zrzezów.

Plon świeżej biomasy dwuletnich roślin topoli, średnio 14,5 t/ha był istotnie wyższy o ok. 2 t/ha niż u wierzby. Z kolei plon świeżej biomasy uzyskany z gleby lekkiej (średnio 22,9 t/ha) był aż ponad 5-krotnie wyższy w porównaniu do tego uzyskanego z gleby ciężkiej. Stwierdzono istotny wpływ rodzaju gleby na wysokość plonu suchej biomasy, ponieważ na sandy soil plon topoli i wierzby wyniósł odpowiednio 5,13 i 5,14 t/ha/rok d.m. Natomiast na glebie ciężkiej plon suchej biomasy był 6-krotnie niższy i wynosił odpowiednio 1,12 i 0,67 t/ha/d.m. Analiza korelacji wykazała, że na plon suchej masy istotnie wpływały obsada roślin, przeżywalność oraz wysokość roślin i średnica pędów.

Podsumowując wierzba i topola mogą być uprawiane na glebie lekkiej, osiągając zadowalające plony, natomiast nie zaleca się ich uprawy na ciężkiej glebie ilastej, gdyż takie stanowisko nie zapewnia odpowiednich warunków do uprawy tych gatunków.

3.32 PA32: About Short Rotation Coppices large-scale field trial in Poland

Author: 3B

Title (English): Short Rotation Coppices cultivation on sandy soil with different soil enrichment method in Poland

Summary (English): Poplar, Willow and Black locust are Short Rotation Coppices (SRC) species. Their plantations are established mainly on poor quality marginal or contaminated soils. The aim of this research, located in North-Eastern Poland, was to determine the impact of soil enrichment method on survivability, productivity and energy value of a yield of three plant species cultivated in four-year harvest cycle on sandy soil. This sandy soil was characterized by unfavourable air and water conditions. Such conditions caused in periods of no precipitation permanent water shortage for plants. The highest average yield of dry biomass, in four-year rotation, was found for Willow, 33.36 t/ha. Poplar yielded 0.5 t/ha lower and Black Locust almost three times lower. The highest yield in the whole experiment was obtained for Poplar fertilized with lignin and mineral fertilizers (41.96 t/ha). A similar yield was obtained for Willow fertilized with lignin, mycorrhiza and mineral fertilizers (41.20 t/ha) and fertilized with lignin and mineral fertilizers (39.32 t/ha). The use of lignin in combination with mineral fertilizers resulted in an increase in the yield by 8-14% compared to mineral fertilizers alone for Willow and Poplar and in a nearly twofold increase for Black Locust. The energy value of the yield ranged from 28.6 to 176.7 GJ/ha, respectively, for Black Locust grown on the control plot and for Poplar grown on the plot with mineral fertilization and lignin used in combination. Thus, real possibilities of increasing the biomass and energy yield of SRC on sandy soils have been found, including marginal ones, by appropriate selection of woody species and soil enrichment. These results should be verified in subsequent harvesting cycles.

Title (Polish): Zaganiki uprawiane w krótkich rotacjach na glebie lekkiej wraz z różnymi metodami wzbogacenia gleby w Polsce

Summary (Polish): Topola, wierzba i robinia akacjowa to gatunki uprawiane w krótkich rotacjach (SRC). Ich plantacje prowadzone są głównie na glebach marginalnych lub skażonych i niskiej jakości. Celem tych badań, zlokalizowanych w północno-wschodniej Polsce, było określenie wpływu metod wzbogacania gleby na przeżywalność, produkcyjność i wartość energetyczną plonu trzech gatunków roślin uprawianych w czteroletnim cyklu zbiorów na glebie piaszczystej. Gleba ta charakteryzowała się niekorzystnymi warunkami powietrzno-wodnymi. Takie warunki powodowały w okresach braku opadów stały niedobór wody dla roślin. Najwyższy plon suchej biomasy, w czteroletniej rotacji, stwierdzono dla wierzby (33,36 t/ha). Topola dała 0,5 t/ha mniejszy, a robinia prawie trzy razy mniejszy plon. Najwyższy plon uzyskano dla topoli nawożonej ligniną i nawozami mineralnymi (41,96 t/ha). Podobny plon uzyskano dla wierzby nawożonej ligniną, mikoryzą i nawozami mineralnymi (41,20 t/ha) i nawożonej ligniną i nawozami mineralnymi (39,32 t/ha). Zastosowanie ligniny w połączeniu z nawozami mineralnymi spowodowało wzrost plonu wierzby i topoli o 8-14% w porównaniu do samego stosowania nawozów mineralnych oraz prawie dwukrotny wzrost dla robinii. Wartość energetyczna plonu wahała się od 28,6 do 176,7 GJ/ha, odpowiednio dla robinii uprawianej w kotroli i topoli uprawianej na poletku z łącznym nawożeniem mineralnym i ligniną. Wyniki te pokazują realne możliwości zwiększenia plonu biomasy i wydajności energetycznej SRC na

glebach piaszczystych, w tym na marginalnych, poprzez odpowiedni dobór gatunków i metod wzbogacanie gleby. Wyniki te należy zweryfikować w kolejnych cyklach zbiorów.

3.33 PA33: About Camelina large-scale trial in Poland

Author: 3B

Title (English): Camelina cultivation on sandy and heavy soil sites in Poland

Summary (English): Camelina is an oil plant that was known in Europe already in the Bronze Age. The yield of camelina seeds is 1.0-3.0 t/ha, and the oil content is 30-49% d.m. The aim of this study, located in north-eastern Poland, was to compare the yield of camelina in two soil sites.

The site in the village of Leginy was located on heavy soil made of clay. This soil belongs to nutrient and potentially fertile soils. The site in the village of Fingaty was located on light soil made of sand. Such soils are poor in nutrients, permanently too dry, hence the fertilization gives a slight increase in yields. The trial was run in years 2018-2020.

Camelina seed yield on sandy soil was 0.38 t/ha d.m. and ranged from 0.18 to 0.53 t/ha d.m. It was noticed that despite good emergence on sandy soil, in the end the yield was lower than on heavy clay soil. The reasons for this were, among others, unfavorable distribution of precipitation but also low water capillary action of the soil. The average seed yield on clay soil was 0.75 t/ha d.m. and ranged from 0.50 to 0.99 t/ha d.m. in 2018 and 2020, respectively.

The seed quality analysis carried out in 2019 showed that larger seeds were obtained on heavy soil than on light soil. Also, the fat and protein contents were higher on heavy soil (41.85 and 26.87% d.m., respectively) than on light soil (40.70 and 23.91% d.m., respectively). On the other hand, the soil position did not affect the composition of fatty acids.

Therefore, it can be concluded that heavy clay soil is better suited for the cultivation of camelina than sandy soil, which due to low capillary action is more susceptible to lack of water during drought. This results in a lower yield and poorer quality of the camelina seeds.

Title (Ukrainian): Uprawa lnianki na glebie piaszczystej i ciężkiej glebie ilastej

Summary (Ukrainian): Camelina jest rośliną oleistą, która w Europie była znana już w epoce brązu. Plony nasion lnianki wynoszą 1,0-3,0 t/ha, a zawartość oleju 30-49% s.m. Celem niniejszych badań, zlokalizowanych w północno-wschodniej Polsce, było porównanie plonowania lnianki na dwóch stanowiskach glebowych.

Stanowisko we wsi Leginy zlokalizowane było na ciężkiej glebie ilastej. Ta gleba należy do gleb zasobnych i potencjalnie żyznych. Działka we wsi Fingaty zlokalizowana była się na lekkiej glebie piaszczystej. Gleby takie są ubogie w składniki pokarmowe, zwykle zbyt suche, stąd nawożenie daje nieznaczny wzrost plonów. Badanie prowadzono w latach 2018-2020.Plon nasion lnianki na glebie lekkiej wyniósł 0.38 t/ha s.m. i wahał się od 0,18 do 0,53 t/ha s.m. Zauważono, że pomimo dobrych wschodów na glebie piaszczystej, w końcowym efekcie uzyskiwano niższe plony niż na glebie ciężkiej ilastej. Powodem tego były m. in. niekorzystny rozkład opadów ale również niska pojemność wodna gleby. Średni plon nasion

na glebie ilastej wyniósł 0,75 t/ha s.m. i wahał się od 0,50 do 0,99 t/ha s.m. odpowiednio w roku 2018 i 2020.

Przeprowadzone w 2019 roku badania jakości nasion wykazały, że większe nasiona uzyskiwano na glebie ciężkiej niż na lekkiej. Również zawartość tłuszczu i białka była wyższa na glebie ciężkiej (odpowiednio 41,85 i 26,87% s.m.) niż na lekkiej (odpowiednio 40,70 i 23,91% s.m.). Natomiast stanowisko glebowe nie wpływało na różnice w składzie kwasów tłuszczowych.

Można zatem stwierdzić, że gleba ilasta ciężka lepiej nadaje się pod uprawę lnianki siewnej niż gleba piaszczysta, która z powodu niskiej pojemności wodnej jest bardziej podatna na brak wody w okresie suszy. Skutkuje to niższym plonem oraz gorszymi cechami nasion lnianki.

3.34 PA34: About Fiber Hemp small-scale trial on marginal lands in Poland

Author: IWNiRZ

Title (English): Cultivation of fiber hemp on land degraded by open cast mining of lignite in Poland

Summary (English): The study comparing fibrous hemp Bialobrzeskie cultivation in two nitrogen fertilization schemes – mineral (calcium nitrate: 0.90,180 kg/ha) and organic (cattle manure: 0, 15, 30 t/ha) was conducted on former site of lignite mining in MAGIC project. As a result of mining activity the soil was removed and loam was deposited resulting in very low carbon and poor structure causing high compaction in arable layer. This causes difficult air penetration in soil, water stagnation in wet periods, rock-like hardness in dry periods and in consequence late start of tillage in spring and short time when conditions allow for tillage.

The best hemp straw yield response was observed at moderate manure dose (15 t/ha) especially in 2020 (8.57 t/ha) while yields at 0 and 30 t/ha were by ca 60% lower. In 2019 much lower yields were noted (1.29, 2.86 and 2.76 t/ha at manure doses 0, 15 and 30 t, respectively) and only yield obtained at no manure combination was significantly lower.

The straw yield obtained under mineral N fertilization was less differentiated upon doses compared to manure. In 2020 hemp responded with gradually growing yields of straw on increasing N doses – 5.47,6.39 and 7.7 t/ha, while in 2019, the yields were approximately 5-fold lower and with almost no difference to the N dose used – 1.29, 1.47 and 1.38 t/ha. Fibre concentration obtained on mineral fertilization were generally higher as compared to those obtained at manure, however the loss of yield could not be compensated by higher fibre concentrations. Given these results, it is recommended to apply cattle manure on such marginal soils also because it contributes to accumulation of organic matter which is in high deficiency on such sites.

Title (Polish): Uprawa konopi włóknistych na terenach zdegradowanych przez odkrywkową eksploatację węgla brunatnego w Polsce

Summary (Polish): Badania porównujące uprawę konopi włóknistych w dwóch schematach nawożenia – azotem mineralnym (saletra wapniowa: 0,90 180 kg/ha) i organicznym (obornik bydlęcy: 0,15, 30 t/ha) przeprowadzono w ramach projektu Magic na byłym obrzarze wydobycia węgla brunatnego. W wyniku działalności górniczej usunięto glebe, a następnie

zdeponowano ił, co spowodowało bardzo niską zawartość węgla i słabą strukturę powodującą duże zagęszczenie warstwy ornej. Utrudnia to penetrację powietrza do gleby, stagnację wody w okresach mokrych, twardość skały w okresach suchych, a w konsekwencji późne rozpoczęcie uprawy na wiosnę i krótki czas, gdy warunki na nią pozwalają.

Najlepszą reakcję plonowania słomy zaobserwowano przy umiarkowanej dawce obornika (15 t/ha), zwłaszcza w roku 2020 (8,57t/ha), natomiast plony przy 0 i 30 t/ha były o ok. 60% niższe. W 2019 r. odnotowano znacznie niższe plony (1,29, 2,86 i 2,76t/ha przy dawkach obornika odpowiednio 0,15 i 30t) i tylko plon uzyskany przy braku kombinacji obornikowej był istotnie niższy.

Plon słomy uzyskany przy nawożeniu mineralnym N był mniej zróżnicowany przez zastosowane dawki w porównaniu z obornikiem. W 2020 r. konopie reagowały stopniowo rosnącymi plonami słomy na wzrastające dawki N – 5,47,6,39 i 7,7 t/ha, natomiast w 2019 r. plony były ok. 5-krotnie niższe i prawie bez różnicy w stosunku do zastosowanej dawki N – 1,29, 1,47 oraz 1,38 t/ha. Całkowita zawartość włókna uzyskana przy nawożeniu mineralnym była generalnie wyższa niż przy nawożeniu obornikiem jednak spadek plonu nie był przez nią rekompensowany. Biorąc pod uwagę te wyniki, na takich marginalnych glebach zaleca się stosowanie obornika bydlęcego, również dlatego, że przyczynia się on do akumulacji materii organicznej, której na takich stanowiskach występuje duży niedobór.

3.35 PA35: About phytomanagement of contaminated sites

Author: AUA

Title (English): Phytomanagement of contaminated sites

Summary (English): Phytomanagement is a new technology in which industrial non-food cash crops are used to reduce and control risks arising from soil contamination. Simultaneously, a profitable and sustainable use of contaminated sites is assured by producing marketable biomass. Several recent studies focus on fast growing, high yielding and high value non-food crops, that could be used as a feedstock for bioenergy and bioproducts (e.g. construction biomaterials, bio-lubricants, bioplastics, pulp for paper, biopolymers, biochemicals, biofuels, biochar, etc). Crops suitable to be used for phytomanagement should have the following characteristics: (i) tolerance to high levels of soil contaminants, (ii) ability to uptake the contaminants and/or stabilize them in soil fractions in relatively high levels, iii) ability to degrade organic pollutants, (iv) rapid growth rates and high biomass yield (v) widespread highly branched root system, (vi) low input requirements and easy harvest ability, (vii) non consumable by humans and animals. Promising candidates are miscanthus, industrial hemp, fiber sorghum, castor bean, safflower, cardoon, giant reed, kenaf, switchgrass, poplar, willow, etc. The exploitation of contaminated lands could open new economic opportunities for local farmers and rural communities by increasing the availability of domestic raw materials for use in new emerging markets.

Title (Greek): Αξιοποίηση ρυπασμένων εδαφών με την καλλιέργεια βιομηχανικών φυτών

Summary (Greek): Η Φυτοδιαχείριση (Phytomenagement) είναι μια νέα τεχνολογία, στην οποία χρησιμοποιούνται βιομηχανικές μη τροφικές καλλιέργειες για τη μείωση και τον έλεγχο

των κινδύνων που προκύπτουν από την ρύπανση του εδάφους. Ταυτόχρονα πραγματοποιείται οικονομική αξιοποίηση των ρυπασμένων περιοχών με την παραγωγή εμπορεύσιμης βιομάζας. Αρκετές μη τροφικές καλλιέργειες με γρήγορη ανάπτυξη, υψηλή απόδοση και μεγάλο οικονομικό ενδιαφέρον μπορούν να καλλιεργηθούν σε ρυπασμένες περιοχές και να αποδώσουν βιομάζα χρήσιμη για την παραγωγή βιοενέργειας και βιοπροϊόντων (π.χ. κατασκευαστικά υλικά, βιολιπαντικά, βιοπλαστικά, πολτό για χαρτί, βιοπολυμερή, βιοχημικά κλπ). Οι καλλιέργειες που είναι κατάλληλες για φυτοδιαχείριση θα πρέπει να έχουν τα ακόλουθα χαρακτηριστικά: (i) αντοχή σε υψηλές συγκεντρώσεις ρύπων στο έδαφος, (ii) ικανότητα απορρόφησης των ρύπων ή/και σταθεροποίησής τους στο έδαφος σε σχετικά υψηλά επίπεδα, iii) ικανότητα διάσπασης των οργανικών ρύπων, (iv) ταχείς ρυθμούς ανάπτυξης και υψηλή απόδοση βιομάζας (v) μεγάλο και ευρέως διακλαδισμένο ριζικό σύστημα, (vi) χαμηλές απαιτήσεις εισροών και εύκολη συγκομιδή, (vii) όλα τα φυτικά τμήματα να μην είναι βρώσιμα από τον άνθρωπο και τα ζώα. Παραδείγματα τέτοιων καλλιεργειών είναι: ο μίσχανθος, η βιομηχανική κάνναβη, το κλωστικό σόργο, η ρετσινολαδιά, η ατρακτυλίδα, το καλάμι, το κενάφ, οι λεύκες, η ιτιά κ.λπ. Η εκμετάλλευση των ρυπασμένων εκτάσεων θα δημιουργήσει νέες οικονομικές ευκαιρίες για τους τοπικούς αγρότες και τις αγροτικές κοινότητες αυξάνοντας τη διαθεσιμότητα εγχώριων πρώτων υλών και τη δυνατότητα προώθησής τους σε νέες αναδυόμενες αγορές.

3.36 PA36: About Kenaf cultivation in contaminated sites

Author: AUA

Title (English): Kenaf cultivation in contaminated sites.

Summary (English): Kenaf is an annual fiber crop having great potential for fiber, energy, and feedstock. Its stem fibers are an excellent source for textile, paper pulp, and cordage industries, for building materials, for biofuel production, etc. Kenaf young plants can be used in livestock feeding, due to their palatability and high protein content. A quite new application of this crop is its use as food additive, while its leaves can also be used as hot beverage. However, it is well known that food consumption is identified as the major pathway of human exposure to contaminants. Thus, it is important to investigate the possible bioaccumulation of several contaminants in the aerial biomass of kenaf. A pot experiment was conducted using a soil heavily contaminated with cadmium (Cd: 132.5 mg/kg), lead (Pb: 25,875.7 mg/kg), zinc (Zn: 16,821.6 mg/kg), antimony (Sb: 369.6 mg/kg) and arsenic (As: 3,430.7 mg/kg). The soil was mixed with uncontaminated soil in percentages of 0% (control), 10%, 50% and 100 % respectively. Each soil mixture was used to fill three pots and five kenaf seeds were sown in each pot. The results showed that -in all treatments- plant growth was not affected, indicating the tolerance of this crop to contaminants. The concentrations of heavy metals and metalloids measured in kenaf aerial biomass were higher than in the control plants but within the normal limits, apart from Cd, Pb and Sb. Cadmium concentration was up to 11.0 mg/kg, lead was up to 59.18 mg/kg and antimony was up to 3.4 mg/kg. Especially Cd contents in plants were 55-fold higher than in the control plants. In conclusion, this work indicate that kenaf grown on soils bearing Cd, Pb and Sb could be dangerous as a carrier of these trace elements in the food chain.

Title (Greek): Καλλιέργεια του κενάφ σε ρυπασμένα εδάφη.

Summary (Greek): Το κενάφ είναι ένα ετήσιο κλωστικό φυτό χρήσιμο για τις βιομηχανίες κλωστοϋφαντουργίας, την παραγωγή χαρτοπολτού και σχοινιών, για την κατασκευή οικοδομικών υλικών, την παραγωγή βιοκαυσίμων κ.λπ. Τα νεαρά φυτά κενάφ μπορούν να χρησιμοποιηθούν σαν ζωοτροφή λόγω της γευστικότητας και της υψηλής περιεκτικότητάς τους σε πρωτεΐνες. Επίσης χρησιμοποιείται ως πρόσθετο τροφίμων, ενώ τα φύλλα του μπορούν να χρησιμοποιηθούν και ως ζεστό ρόφημα. Δεδομένου ότι η κατανάλωση τροφίμων είναι η κύρια πηγή έκθεσης των ανθρώπων σε επικίνδυνους ρυπαντές, είναι σημαντικό να διερευνηθεί η δυνατότητα του φυτού αυτού να συσσωρεύει ρύπους στη βιομάζα του. Για το σκοπό αυτό πραγματοποιήθηκε ένα πείραμα σε γλάστρες χρησιμοποιώντας έδαφος ρυπασμένο με κάδμιο (Cd: 132,5 mg/kg), μόλυβδο (Pb: 25.875,7 mg/kg), ψευδάργυρο (Zn: 16.821,6 mg/kg), αντιμόνιο (Sb: 369,6 mg/kg) και αρσενικό (As: 3.430,7 mg/kg). Το έδαφος αυτό αναμίχθηκε με καθαρό σε ποσοστά 0% (μάρτυρας), 10%, 50% και 100% αντίστοιχα. Κάθε μίγμα εδάφους χρησιμοποιήθηκε για να γεμίσει τρεις γλάστρες και σε κάθε γλάστρα σπάρθηκαν πέντε σπόροι κενάφ. Τα αποτελέσματα έδειξαν ότι η ανάπτυξη των φυτών δεν επηρεάστηκε. Οι συγκεντρώσεις των βαρέων μετάλλων και των μεταλλοειδών που μετρήθηκαν στην αέρια βιομάζα του κενάφ ήταν εντός των φυσιολογικών ορίων, εκτός από το Cd, Pb και Sb. Η συγκέντρωση του Cd ήταν 11,0 mg/kg, του Pb ήταν 59,18 mg/kg και του Sb ήταν 3,4 mg/kg. Ειδικότερα η περιεκτικότητα των φυτών σε Cd ήταν 55 φορές υψηλότερη από αυτήν των φυτών που αναπτύχτηκαν σε καθαρό έδαφος. Επομένως χρειάζεται ιδιαίτερη προσοχή όταν το κενάφ καλλιεργείται σε εδάφη με αυξημένες συγκεντρώσεις Cd, Pb και Sb γιατί μπορεί να μεταφέρει αυτούς τους ρύπους στην τροφική αλυσίδα.

3.37 PA37: About industrial crops on heavy metal contaminated lands

Author: AUA

Title (English): Cultivation of industrial crops on heavy metal contaminated lands

Summary (English): Under the frame of MAGIC project, fifteen industrial crops have been tested for their ability to be cultivated in soils contaminated with cadmium (Cd), nickel (Ni), lead (Pb) and zinc (Zn). The tested crops are: biomass sorghum, camelina, cardoon, castor bean, crambe, Ethiopian mustard, giant reed, hemp, lupin, miscanthus x giganteus, pennycress, safflower, switchgrass, tall wheatgrass, and wild sugarcane. All plants were grown to relatively low contamination levels, namely: Cd in 0, 4, 8 mg/kg, Ni in 0, 110, 220 mg/kg, and both Pb and Zn in 0, 450, 900 mg/kg. The results showed that the most toxic heavy metal was zinc since its high soil concentration was lethal -at least for one year- to eight crops, namely to: biomass sorghum, camelina, castor bean, hemp, lupin, pennycress, switchgrass and tall wheatgrass. In addition, the low Zn treatment was lethal to four crops, namely to: camelina, hemp, lupin, and pennycress. Second on the row of toxicity was nickel, as in its high treatment all crops were dried or did not germinate at all in four crops: camelina, hemp, lupin, and pennycress. Cadmium was the third less toxic element: camelina's yield was reduced under the high soil concentration, while low tolerance was observed in tall wheatgrass and moderate tolerance was recorded in giant reed, miscanthus x giganteus, castor bean and crambe. Under low Cd treatment, the crops Ethiopian mustard and tall wheatgrass showed low tolerance. Finally, lead was the less toxic element since it was not lethal to any of the tested crops. In

addition, its high soil concentration reduce by 50%-75% the yield of only three crops i.e. of Ethiopian mustard, giant reed and tall wheatgrass.

Title (Greek): Καλλιέργεια βιομηχανικών φυτών σε εδάφη ρυπασμένα με βαριά μέταλλα

Summary (Greek): Στο πλαίσιο του προγράμματος MAGIC διερευνήθηκε η δυνατότητα δεκαπέντε βιομηχανικών φυτών να καλλιεργηθούν σε εδάφη ρυπασμένα με σχετικά χαμηλές συγκεντρώσεις καδμίου(Cd: 0, 4, 8 mg/kg), νικελίου (Ni: 0, 110, 220 mg/kg), μολύβδου (Pb: 0, 450, 900 mg/kg) και ψευδαργύρου (Zn: 0, 450, 900 mg/kg). Τα φυτά αυτά είναι: το σόργο, η καμελίνα, η αγριαγκινάρα, η ρετσινολαδιά, η κράμβη, η ελαιοκράμβη Αιθιοπίας, το καλάμι, η κάνναβη, το λούπινο, ο μίσχανθος, το pennycress (*Thlaspi arvense* L.), η ατρακτυλίδα, το πάνικον το ραβδωτό (switchgrass, είδος κεχριού), το tall wheatgrass (*Agropyron elongatum* L.) και το wild sugarcane (*Saccharum spontaneum* L.). Τα αποτελέσματα έδειξαν ότι το πιο τοξικό μέταλλο είναι ο ψευδάργυρος δεδομένου ότι στις υψηλές συγκεντρώσεις του ξεράθηκαν όλα τα φυτά των ειδών: σόργο, καμελίνα, ρετσινολαδιά, κάνναβη, λούπινο, pennycress, πάνικο και tall wheatgrass. Οι χαμηλές συγκεντρώσεις ψευδαργύρου ήταν καταστροφικές για τέσσερα είδη: καμελίνα, κάνναβη, λούπινο και pennycress. Δεύτερο σε τοξικότητα ήταν το νικέλιο. Στις υψηλές συγκεντρώσεις του τα φυτά ξεράθηκαν -ή δεν βλάστησαν καθόλου ο σπόροι- στα είδη: καμελίνα, κάνναβη, λούπινο και pennycress. Το κάδμιο έρχεται τρίτο σε σειρά τοξικότητας: στις υψηλές συγκεντρώσεις του μειώθηκε σημαντικά η παραγωγή της καμελίνας και του tall wheatgrass, ενώ μικρότερη μείωση παρατηρήθηκε στα είδη: καλάμι, μίσχανθο, ρετσινολαδιά και κράμβη. Οι χαμηλές συγκεντρώσεις καδμίου ήταν τοξικές μόνο για τα είδη ελαιοκράμβη Αιθιοπίας και tall wheatgrass. Τέλος ο μόλυβδος ήταν το λιγότερο τοξικό μέταλλο. Μόνο στις υψηλές συγκεντρώσεις του παρατηρήθηκε μείωση της παραγωγής σε τρία είδη: στην ελαιοκράμβη Αιθιοπίας, στο καλάμι και στο tall wheatgrass.

3.38 PA38: About biofertilisation on marginal lands

Author: INRAE

Title (English): Biofertilisation as a tool to improve crop biomass production on marginal lands

Summary (English): Biofertilisation of soils with earthworms is a means proposed to improve poor soil characteristics. Earthworm activities may increase crop yield by increasing nutrient availability, improving soil structure and promoting C and N cycles. Relating MAGIC project, it was proposed to apply biofertilisation to a marginal land exhibiting a combined marginality factors as unfavourable soil texture and trace element contamination. A sandy textured soil located in Paris was used, multicontaminated after 100 years of raw wastewater spreading. The aim was to make the proof of concept both ex situ in controlled conditions and in situ in natural conditions, with the tested factor being the absence or presence of earthworms.

The ex-situ experiments involved a two months post experiment with *Lolium perenne* and the ubiquist endogeic earthworm *Aporrectodea caliginosa*. Results confirmed that even in marginal soils, earthworms improve biomass production, but also reduce trace element uptake by plants while increasing trace elements in soil solution.

The field trial involved switchgrass and miscanthus established in June 2019 by seeds and rhizomes respectively. Earthworms were introduced manually in selected blocs of around 1 m^2

surrounded by a geotextile (both endogeic species *Aporrectodea caliginosa*, and anecic species *Lumbricus terrestris*). Contrarily to miscanthus, switchgrass could not compete with the weeds. After two years, biomass yield of miscanthus in the presence of earthworms was significantly higher compared to the plots without earthworms. But in the absence of irrigation the unstable soil moisture induced a low mean yield of miscanthus around 2 t/ha in 2021. Increasing soil fauna activity reveals a way to counteract soil marginality.

Title (French): Utilisation de la biofertilisation pour améliorer la production de biomasse sur les terres marginales

Summary (French): La biofertilisation des sols par inoculation de vers de terre est un moyen souvent proposé pour améliorer des caractéristiques défavorables aux cultures. En effet, les activités des vers de terre peuvent améliorer les rendements des cultures en augmentant la disponibilité des nutriments, en améliorant la structure des sols ou d'une façon générale en stimulant les cycles du carbone et de l'azote. Concernant projet MAGIC, nous avons appliqué la biofertilisation à un sol marginal combinant deux facteurs de marginalité une texture défavorable et une contamination. Nous avons utilisé un site localisé dans la banlieue parisienne (France) avec une texture sableuse et multi-contaminé sur le long terme par 100 ans d'irrigation avec des eaux usées brutes. Notre objectif était de faire une preuve de concept à la fois ex-situ en conditions contrôlées et in situ en conditions de terrain, le facteur à tester étant l'absence ou la présence de vers de terre inoculés.

L'expérimentation ex-situ a mis en jeu une exposition en pots de deux mois de Lolium perenne et de l'espèce de ver de terre endogé ubiquiste Aporrectodea caliginosa. Les résultats ont confirmé que même en conditions de sols marginaux, les vers de terre améliorent la production de biomasse, mais aussi diminuent la bioaccumulation des éléments trace par les plantes même si une augmentation des éléments trace en solution est observée.

L'essai sur le terrain a porté sur le switchgrass et le miscanthus, mis en place en juin 2019 à partir de graines ou de rhizomes respectivement. Les vers de terre (à la fois endogés Aporrectodea caliginosa, et aneciques Lumbricus terrestris) ont été introduits manuellement dans des blocs spécifiques de 1m^2 entourés de géotextile. Contrairement au miscanthus, le switchgrass n'a pas pu pousser en raison des mauvaises herbes. Après deux ans, le rendement en biomasse de miscanthus en présence de vers de terre était significativement plus important comparé aux blocs sans vers de terre. Mais en absence d'irrigation, l'humidité instable du sol sableux a induit en moyenne un faible taux de rendement du miscanthus d'environ 2t/ha en 2021. L'étude de terrain in situ a confirmé les résultats ex situ. Augmenter l'activité de la faune du sol est un moyen de contrer la marginalité du sol pour les cultures.

3.39 PA39: About low-input agricultural practices

Author: Spanish Co-ops (based on D4.1., prepared by UHOH)

Title (English): Low-input agricultural practices for industrial crops on marginal land

Summary (English): The identification of the most suitable industrial crops that can be cultivated in the European "prevalent marginal agro-ecological zones" (MAEZ), as well as of

the "marginal agricultural land low-input systems" (MALLIS) for growing these crops were among the main issues addressed by MAGIC.

In addition to the economic and environmental aspects, the research was also based on the current knowledge on best low-input agricultural practices for food crop production on good soils. It sought to optimize the use of on-farm resources and minimize off-farm inputs, which translates into having a more 'closed' production cycle and requires more advanced agronomic skills.

As a conclusion, the selection of suitable industrial crops was found to be the most important component in the development of MALLIS, because all other measures (tillage, fertilization, weeding, irrigation, etc.) very much depend on the site-specific performance of the crop. The expected overall performance of the crops was analysed by means of a multi-criteria analysis.

Some examples of the conclusions are:

-in Mediterranean climate conditions and soils with unfavourable texture and stoniness tall wheatgrass can be cultivated using practices of minimum/no tillage. Also, Siberian elm could be cultivated in rainfed;

-in Atlantic climate conditions and soils contaminated by wastewater the lignocellulosic crops such as miscanthus can be cultivated with minimum/no tillage and bio-fertilisation;

-in Continental climate conditions and soils with hard clay and limited soil drainage there can be cultivated crops such as tall wheatgrass, willow, hemp, poplar or reed canary grass with minimum/no tillage, reduced fertilization and weed control practices.

3.40 PA40: About good practices in MAGIC

Author: Spanish Co-ops (based on D 7.1, prepared by Imperial)

Title (English): Good Practices in MAGIC

Summary (English): Marginal land is largely attributed to agricultural fields which have been abandoned due to biophysical and/ or socio-economic restrictions. This has become a major problem in Europe with several environmental, socioeconomic and landscape implications, including higher risk of fires, loss of biodiversity, water scarcity, etc., which reduce the health and quality of life of rural communities. Recently, the European Commission Joint Research Centre (JRC) applied the LUISA Territorial Modelling Platform to generate projections of agricultural land abandonment in the EU in the period 2015-2030. The resulted potential risk map of agricultural land abandonment in the EU in 2030 produced with this modelling framework indicates that 11% of EU's agricultural land will be under high (19.6 million ha, 10.7%) and very high (800.000 ha, 0.4%) potential risk of abandonment.

The aim of identifying Good Practices in the MAGIC project is to understand the context of restoring marginal land for cropping, the state and prospects for industrial crops, the conditions framing their cultivation and the supply chains as well as their operational capacities across time and development stages.

The work performed analysed practices which rehabilitate the biophysical constraints related to the soil and water conditions of the land while improving environmental, economic and

societal performance and operational aspects of the value chain. These practices can guide policy in integrating industrial crops cultivated in marginal lands as raw materials in bio-based value chains. The 'Good Practice' when assessed scores highest on the specific indicators compared to other practices in the region.

3.41 PA41: About the analysis of good practices in MAGIC

Author: Spanish Co-ops (based on D 7.2, prepared by Imperial)

Title (English): Analysis of Good Practices in MAGIC

Summary (English): The performance of twelve cases of Good industrial crop Practices on biophysically marginal lands has been examined in this report around (i) stages of the value chain, focusing on land use and biomass production, and (ii) competitive priorities at different phases of development.

The methodological approach provides a conceptual link of Value Chain Analysis (VCA), and a two-dimensional perspective (the key attributes of the value chain in the form of competitive priorities (CP) and their performance at different stages of development) to investigate a set of Good Practice cases growing industrial crops on marginal lands. A set of indicators has been employed, assessing the performance of the studied Good Practice cases at the land use and biomass production phases.

The results of this study show how industrial crops on land with low soil fertility, high salinity, sandy soils, unfavourable texture and stoniness, pollution, etc. can improve to end biophysical and socioeconomic challenges by providing outlets for rural communities to support feedstock supply to bio-based sectors.

The most common marginal land challenges that industrial crop cultivation helped to surmount include (i) presentation of low-input practices to restore land with low fertility, soil contamination, adverse texture, stoniness, drought, etc. (ii) Increased transparency in the establishment of low indirect land use biomass crops and (iii) created new income opportunities for farmers in rural areas with a high percentage of marginality.

3.42 PA42: About key findings and transferability in MAGIC

Author: Spanish Co-ops (based on D 7.1, prepared by Imperial)

Title (English): Key findings and transferability in MAGIC

Summary (English): This report has studied the essential characteristics of selected industrial crops and the challenges of marginality ameliorated with their cultivation. The review includes the level of potential transferability of lessons learned by key attribute biophysical-environmental, economic, and social attributes and stage of development to other European regions.

The results extracted from the twelve Best Practice cases across Europe of industrial crops grown on land with biophysical marginalities are (i) the cultivation of lignocellulosic perennial species facilitates improvements on contaminated land. (ii) Regions surrounded by primary activities were more likely to undertake industrial crops on marginal lands. (iii) Minimal farmer interaction with the research community. (iv) Availability of public and private funds with

simplified rules and procedures. (v) Good relationship between farmers and regional government. (vi) Availability of well-trained farmers and good interactions with research institutions. (vii) Increased public knowledge on reclamation of marginal lands with industrial crops for bio-based products. (viii) Restoring marginal lands with low-input practices to maintain low GHG emission levels can be complicated, as in most cases significant inputs are required to make the land productive. (ix) Establishment of perennial plants through an arid and dry climate, with no irrigation available during the first year. (x) Farmers were doubtful about the long-term economic viability of industrial crops on marginal land. (xi) The small scale of farming implies a level of training, networking and complex interactions that are time consuming and delay value chain integration in farming systems.

3.43 PA43: About vegetable oils and metathesis chemistry

Author: ARKEMA

Title (English): Conversion of vegetable oils through metathesis chemistry

Summary (English): Metathesis is a chemical reaction which involves the double bonds of the fatty acid chains. With a homogeneous catalyst the double bond react with a short olefin (which can be ethylene, or 1-butene for example) and produce a shorter fatty acid (10 and 12 carbons chains) and an olefin (10 or 12 carbon chains). The shorter fatty acids can substitute the acids from palm kernel and coconut oils, while the olefins can be used for synthetic lubricants (PAO) for example. The most appropiate oils for this process should have a high ratio of Oleic to Linoleic acid (high MonoUnsaturated/PolyUnsaturated fatty acids ratio). Currently this chemistry is practiced by Elevance-Wilmar in Indonesia on Palm oil. However other high oleic oils such as High Oleic Sunflower and High Oleic Safflower are also appropriate, provided that their cost is limited. The challenge with this chemistry is that it generates a lot of coproducts for which a value has to be identified. Ethylene would be the best reagent to generate the highest value from the products, but it is also a poison for most of the catalysts. This is the reason why the process implemented by Elevance uses 1-butene. High oleic oils, reacting with ethylene would generate alpha-olefins and C10 unsaturated fatty acid ester. Although the olefins would have a direct market in lubricants, cosmetics, surfactants, the C10 unsaturated fatty acid still has to find its market, and in the worst case could be a substitute for the imported medium chain fatty acids present in tropical oils. The economic analysis shows that large plant would have to be built to cover the cost, and that initially incentives to the large fuel/petrochemical markets would be necessary, before addressing the specialties.

Title (French): Conversion d'huiles végétales par métathèse

Summary (French): La métathèse est une réaction chimique qui implique les doubles liaisons des chaînes d'acides gras. Avec un catalyseur homogène, la double liaison réagit avec une oléfine courte (qui peut être l'éthylène, ou le 1-butène par exemple) et produit un acide gras plus court (chaînes de 10 ou 12 carbones) et une oléfine (10 ou 12 carbones). Les acides gras plus courts peuvent remplacer les acides des huiles de palmiste et de noix de coco, tandis que les oléfines peuvent être utilisées pour les lubrifiants synthétiques (PAO) par exemple. Si les oléfines auraient un marché direct dans les lubrifiants, les cosmétiques, les tensioactifs, l'acide gras insaturé en C10 doit encore trouver son marché. Les huiles les plus appropriées pour ce

processus devraient avoir un rapport élevé d'acides gras monoinsaturés/polyinsaturés. Actuellement cette chimie est pratiquée par Elevance-Wilmar en Indonésie sur l'huile de palme. Cependant, d'autres huiles à haute teneur en acide oléique telles que le tournesol à haute teneur en acide oléique et le carthame à haute teneur en acide oléique sont également appropriées, à condition que leur coût soit limité. L'enjeu de cette chimie est qu'elle génère beaucoup de coproduits pour lesquels une valeur doit être identifiée. L'éthylène serait le meilleur réactif pour générer la valeur la plus élevée des produits, mais c'est aussi un poison pour la plupart des catalyseurs. C'est la raison pour laquelle le procédé mis en place par Elevance utilise du 1-butène. L'analyse économique montre qu'il faudrait construire de grandes usines pour couvrir les coûts, et que dans un premier temps des incitations aux grands marchés du carburant/pétrochimie seraient nécessaires, avant d'aborder les spécialités.

3.44 PA44: About vegetable oils, azelaic acid and pelargonic acid

Author: ARKEMA

Title (English): Conversion of vegetable oils to azelaic acid and pelargonic acid

Summary (English): The most interesiting vegetable oils for the chemical conversion to azelaic acid (a C9 diacid) and pelargonic acid (a C9 fatty acid) are the oils rich in oleic acid (C18:1). In order, to have a high purity and high value of the final products, the amount of linoleic acid (C18:2) and Linolenic (C18:3) should be minimal. Azelaic acid has market applications in polymers, lubricants, plasticizers... while pelargonic acid has also applications as herbicide, lubricants... There are two main processes in use today: the ozonolysis practiced by Emery Oleochemicals in the US and Croda Sipo in China, and the oxidative cleavage practiced by Matrica in Italy. The oxidative cleavage requires the use of hydrogen peroxide and air as oxidants. Although Palm oil is rather cheap and has a high ratio of Oleic/linoleic acids, it is not the most appropriate oil for that chemistry, because a lot of coproducts, such as saturated fatty acids which cannot react in the process do not generate much value. This oil would require a much bigger plant, which would compensate for the cheaper oil. Instead appropriate oils for that chemistry include High Oleic Sunflower OIl, but also High Oleic Safflower oil, for example. An econmic analysis, of the process allows us to estimate that an increase of 1% of oleic acid content in the oil, could justify a maximum 3% increase in the oil value, based on a difference between High Oleic Safflower (82% Oleic) and High Oleic Sunflower (85% Oleic).

Title (French): Conversion d'huiles végétales en acide azélaique et en acide pélargonique

Summary (French): Les huiles végétales les plus intéressantes pour la conversion chimique en acide azélaïque (un diacide en C9) et en acide pélargonique (un acide gras en C9) sont les huiles riches en acide oléique (C18:1). Afin d'avoir une pureté élevée et une valeur élevée des produits finaux, la quantité d'acide linoléique (C18:2) et linolénique (C18:3) doit être minimale. L'acide azélaïque a des applications de marché dans les polymères, lubrifiants, plastifiants... tandis que l'acide pélargonique a aussi des applications comme herbicide, lubrifiants... Il existe aujourd'hui deux procédés principaux: l'ozonolyse pratiquée par Emery Oleochemicals aux USA et Croda Sipo en Chine , et la coupure oxydante pratiquée par Matrica en Italie. La coupure oxydante nécessite l'utilisation de peroxyde d'hydrogène et d'air comme oxydants.

Bien que l'huile de palme soit plutôt bon marché et ait un ratio élevé d'acides oléique/linoléique, ce n'est pas l'huile la plus appropriée pour cette chimie, car de nombreux coproduits, tels que les acides gras saturés qui ne peuvent pas réagir dans le processus, ne génèrent pas beaucoup de valeur. Cette huile nécessiterait une usine beaucoup plus grande, ce qui compenserait l'huile moins chère. Au lieu de cela, les huiles appropriées pour cette chimie comprennent l'huile de tournesol à haute teneur en acide oléique, mais aussi l'huile de carthame à haute teneur en acide oléique, par exemple. Une analyse économique du procédé nous permet d'estimer qu'une augmentation de 1% de la teneur en acide oléique dans l'huile, pourrait justifier une augmentation maximale de 3 % de la valeur de l'huile, sur la base d'une différence entre le Carthame Haut Oléique (82% Oleic) et Tournesol à haute teneur en acide oléique (85% d'acide oléique).

3.45 PA45: About vegetable oils and sebacic acid

Author: ARKEMA

Title (English): Conversion of vegetable oils to sebacic acid (C10 diacid)

Summary (English): Castor Oil, extracted from the seeds of "*Ricinus communis*" is the only oil today used to produce sebacic acid, a C10 linear diacid. Castor can be cultivaed in Europe, as an annual crop, provided that it is mechanized. Sebacic acid is used for the synthesis of polymers (polyamides, polyesters…), lubricants, plasticizers. Although 80% of the world production of Castor is made in India, most of the sebacic acid is currently produced in China through the "Alkaline Cleavage process". There is also some production in India, and more recently in Oman. Alternative processes to make sebacic acid, include the fermentation of petrosourced C10 paraffin (Cathay Indsutrial Biotech) and the fermentation of the C10 fatty acid present in Coconut and Palm Kernel oils (in the past Verdezyne intended to produce it). The Alkaline cleavage process is a reaction in sodium hydroxyde, in which only the Ricinoleic acid (C18:1,OH) chain - present at 85% in castor oil - will react in successive reaction steps leading to the diacid and to 2-Octanol as major products. Only Castor oil contains ricinoleic acid in high quantity and can lead to sebacic acid. However, Lesquerella which is a desertic crop, contains an other hydroxyfatty acid (lesquerolic acid) C20:1,OH, which would lead to the C12 diacid when using the same chemistry; and a micro-organism: claviceps purpurea, also accumulates ricinoleic acid in significant quantities. The process requires the following steps: hydrolysis of the oil; alkaline cleavage; separation of 2-octanol; acidification to separate the unreacted acids; further acidification to recover the diacid. It also generates a large amount of sodium sulfate.

Title (French): Conversion d'huile végétale en acide sébacique (diacide à 10 atomes de carbone)

Summary (French): L'huile de ricin, extraite des graines de "*Ricinus communis*" est la seule huile aujourd'hui utilisée pour produire de l'acide sébacique, un diacide linéaire en C10. Le ricin peut être cultivé en Europe, comme culture annuelle, à condition qu'elle soit mécanisée. L'acide sébacique est utilisé pour la synthèse de polymères (polyamides, polyesters…), lubrifiants, plastifiants. Bien que 80% de la production mondiale de ricin soit localisée en Inde, la majeure partie de l'acide sébacique est actuellement produite en Chine par le biais du

«procédé de clivage alcalin». Il y a aussi une petite production en Inde, et plus récemment au Sultanat d'Oman. Des procédés alternatifs pour fabriquer de l'acide sébacique, comprennent la fermentation de la paraffine C10 pétro-sourcée (Cathay Indsutrial Biotech) et la fermentation de l'acide gras C10 présent dans les huiles de noix de coco et de palmiste (Verdezyne avait l'intention de le produire). Le procédé de clivage alcalin est une réaction dans l'hydroxyde de sodium, dans laquelle seule la chaîne acide ricinoléique (C18:1,OH) - présente à 85% dans l'huile de ricin - réagira par étapes successives de réaction conduisant au diacide et au 2-octanol comme principaux produits. Seule l'huile de ricin contient de l'acide ricinoléique en grande quantité et peut conduire à de l'acide sébacique. Cependant, Lesquerella qui est une culture désertique, contientl'acide lesquérolique C20:1,OH, qui conduirait au diacide C12 en utilisant la même chimie ; et un micro-organisme : le claviceps purpurea, accumule également l'acide ricinoléique en quantités importantes. Le procédé nécessite les étapes suivantes: hydrolyse; clivage alcalin; séparation du 2-octanol; acidification pour séparer les acides n'ayant pas réagi ; acidification supplémentaire pour récupérer le diacide. Il génère également une grande quantité de sulfate de sodium.

3.46 PA46: About potential biomass supply from marginal lands

Author: Spanish Co-ops (based on D 5.2, prepared by INRA)

Title (English): Potential biomass supply from marginal lands

Summary (English): With the aim of increasing bioenergy production and food security, as well as benefiting the environment and ecosystems, the MAGIC project has evaluated and mapped out the potential of marginal lands to supply biomass in two regions of the EU: Soria in Spain and Brittany in France. The productivity of energy crops on such lands has been modelled for these regions, factoring in biophysical constraints to crop growth. On the one hand, the Soria region currently has a potential of 376,500 ha of marginal lands suitable for energy crops such as tall wheatgrass and Siberian elm. On the other hand, Brittany has a potential of 57,544 ha of marginal lands suitable for miscanthus, a perennial grass. Marginal lands make up 3% and 37% of current cropland area in Brittany and Soria, respectively, pointing at contrasted local configurations. Overall, marginal lands could supply 1,431 kton of biomass dry matter per year in Soria, and 1,582 kton in Brittany, respectively. Researchers from the MAGIC project also evaluated the potential of sourcing biomass from agricultural and forest residues, pointing to a similar amount (1,574 kton) in Soria and a much larger one in Brittany (at 5,637 kton per year). Thus, residues could complement the supply of biomass processing facilities and mitigate the risks of biomass shortages.

These quantifications provide data for the development of industrial, lignocellulosic crops in Brittany and Soria, and the methodology used in this research could be generalized to other contexts. Such approaches can support the design of efficient biomass utilization value-chains in locations with different feedstock availability, thus lowering the overall risks of investing in bioenergy/biorefinery projects.

3.47 PA47: About arable marginal lands for bioenergy purposes in Spain

Author: Spanish Co-ops (based on an article by CEDER-CIEMAT)

Title (English): Identification of arable marginal lands under rainfed conditions for bioenergy purposes in Spain

Summary (English): CEDER- CIEMAT has identified those areas in Spain where food crops are not economically profitable, but energy crops could be cultivated. In this work, it has estimated the profit margin of wheat and barley, the spatial location of cultivation areas and the biophysical limitations.

Almost 10 million hectares in Spain present biophysical and/or economic constraints in rainfed arable areas. The results showed an average potential of 83.33 GJ per ha using triticale (x *Triticosecale*) and 174.85 GJ per ha, using cardoon (*Cynara cardunculus* L). in these lands. These numbers represent between 3%-5% of the primary energy needs in Spain, which can optimise rural development, promote the bioeconomy, and achieve environmental objectives.

Furthermore, the economic balance of rainfed wheat and barley indicates that yields of less than 1.5 t per ha make cultivation of the land unprofitable for farmers using traditional management, so that these areas are considered marginal. This directly links economic restraints and biophysical limitations. Finally, a change in seedbed preparation or sown crops could improve marginal areas. The systematics developed in this study can be used to identify marginal lands and their limiting factors. It could be reproduced in other EU countries with the same challenges, mainly in the Mediterranean basin.

3.48 PA48: About the Hemp value chain in Denmark

Author: Spanish Co-ops

Title (English): Value chain for multifunctional refining of industrial hemp in Denmark

Summary (English): Thanks to EU H2020 projects exchange, MAGIC partners had the opportunity to retrieve information from COOPID project about a value chain for multifunctional refining of industrial hemp in Denmark, with several phases and associated businesses.

Hemp is an excellent crop to have in rotation in Denmark. As a late sown crop, it gives time to handle weeds mechanically early in spring. It is also good for under sowing with nitrogen-fixing crops, such as yellow clover or yellow trefoil. After harvest, the stubble with the yellow clover and some waste seeds, is an ideal forage for wildlife, including insects, birds, and deer.

Finola is a variety of hemp that has been ploughed and fertilized with 100 kg N/ha embedded slurry. Typically, it can be harvested between 1 and 1.5 tonnes of seeds per ha. Harvesting is done by a traditional combined harvester with only minor modifications. It does not need herbicides or pesticides, and only needs a small amount of fertilizer, making it very suitable for unfertile land. Hemp has no insect pests, although there may be minor fungal attacks.

It is appreciable how the hemp fibres are turned into sustainable products, replacing fossil fuel-based materials. There are four steps for treatment of recycled or biobased materials, such as hemp. The cleaned seeds can be de-hulled, toasted or transformed into flour. The hemp flour is sold to another company, and it's processed into meat replacement products based on 100% plant protein. The hulls are sold to make pet-food or fibre-rich full-flour. The dried hemp straw,

consist of skews and fibres destined to clothing processes. The shives can be used for construction materials and the hempcrete can replace the concrete.

3.49 PA49: About combating desertification in the Mediterranean

Author: FCT/UNL

Title (English): Combating desertification in the Mediterranean – key findings of the MediOpuntia project

Summary (English): MediOpuntia is a project whose purpose is to promote the establishment of *Opuntia* spp. in dry marginal lands of the Mediterranean adopting efficient water management systems. *O. ficus-indica* was planted under different irrigation applications to understand the effect of severe water deficit on crop development: (I1) 12 L/plant/week regardless soil water content in effective root zone (554 $m^3 \cdot yr^{-1}$); (I2) received water only when soil water content (SWC) dropped under 85% of soil available water (AW) (16.6 $m^3 \cdot yr^{-1}$); (I3) received water each time SWC dropped below 70% of AW (12.5 $m^3 \cdot yr^{-1}$). The results revealed higher fruit yield under I1 (340 $kg \cdot ha^{-1}$) than I2 and I3 (226-227 $kg \cdot ha^{-1}$). Yet, water productivity was the lowest in I1 (0.62 $kg \cdot m^{-3}$), the highest in I3 (18.1 $kg \cdot m^{-3}$), and in between in I2 (13.6 $kg \cdot m^{-3}$). No significant difference was found in soil water content and canopy cover, among the applied irrigation scheduling. It is recommended to irrigate the crop following the intermittent I3 irrigation system. Although fruit yield was reduced by 34%, the water applied in I3 represented only 2.25% of the water applied in I1, providing savings of 97.75%. Considering that several regions of the Mediterranean have limited water resources, this solution contributes to improve the sustainability of the Opuntia spp. production in arid marginal lands, contributing positively to achieve food security. In the framework of the project, a prototype was developed by CREA-IT for the application of subsurface water retention technology (SWRT) in the experimental fields. This technology increases water holding capacity in the root zones in permeable sandy soil which will impact positively agriculture production in marginal arid soils.

Title (Portuguese): Combate à desertificação no Mediterrâneo - principais conclusões do projeto MediOpuntia

Summary (Portuguese): O projeto MediOpuntia tem por objetivo o cultivo de *Opuntia* spp. em terras áridas do Mediterrâneo, adotando sistemas eficientes de gestão da água. O *O. ficus-indica* foi plantado sob diferentes regimes de irrigação para estudar o efeito do déficit hídrico no desenvolvimento da cultura: (I1) 12 L / planta / semana, independentemente do teor de água no solo na rizosfera (554 $m^3 \cdot ano^{-1}$); (I2) e (I3) recebeu água quando o conteúdo de água no solo foi inferior a 85% e a 70% da água disponível no solo (16,6 $m^3 \cdot ano^{-1}$ e 12,5 $m^3 \cdot ano^{-1}$, respetivamente). Os resultados revelaram maior produção de frutos em I1 (340 $kg \cdot ha^{-1}$) do que em I2 e I3 (226-227 $kg \cdot ha^{-1}$). No entanto, a produtividade da água foi a mais baixa em I1 (0,62 $kg \cdot m^{-3}$), a mais alta em I3 (18,1 $kg \cdot m^{-3}$) e intermédia em I2 (13,6 $kg \cdot m^{-3}$). Não se verificaram diferenças significativas no teor de água do solo e cobertura do solo, entre os regimes de irrigação aplicados. Recomenda-se a rega seguindo o sistema de irrigação intermitente I3. Embora a produção de frutos tenha sido 34% inferior, o uso de água em I3 representou apenas 2,25% dos recursos aplicados em I1, proporcionando uma economia de

97,75%. Considerando que várias regiões do Mediterrâneo apresentam recursos hídricos limitados, esta solução contribui para melhorar a sustentabilidade da produção de *Opuntia* spp. em terras áridas, contribuindo positivamente para a segurança alimentar. No âmbito do projeto, um protótipo foi desenvolvido pelo CREA-IT para a aplicação da tecnologia de retenção de água subterrânea em campos experimentais. Esta tecnologia aumenta a capacidade de retenção de água, na rizosfera, em solo arenoso permeável, o que terá um impacto positivo na produção agrícola em solos áridos.

4 Conclusions

This document gathers forty-nine practice abstracts that have been produced in the forty-eight months of the MAGIC Project. These PAs (Practice Abstracts) have been presented in the document according to different thematic “blocks”.

The first one (PA1-PA5) provides an overview of the general purpose of the project, presenting some of the factors and tools to define and identify MAGIC marginal lands and the most promising crops to be cultivated in them. Subsequently, PA6 and PA7 describe the structure of the factsheets for the existing resource-efficient industrial crops and for the available harvesting technology. PA8-PA34 present the main outcomes of the field trials carried out by MAGIC partners all over Europe. Furthermore, PA35 to PA49 include a wide variety of topics related with MAGIC activities such as the identification of good practices, the extraction of chemical compounds from industrial crops, the phytomanagement of contaminated sites, the biofertilisation on marginal lands, etc.

This deliverable is linked with Tasks 8.3 (EIP and Operational Groups interaction) and 8.4 (Multi-Actor networking) from WP8.

In this sense, contacts with the EIP-Service point staff have been held to arrange collaboration as closest as possible, including feeding the newsletter and webpage of EIP-AGRI with easily understandable practical knowledge for broad dissemination in the common EIP format, such us the practice abstracts presented in this document. All PAs included in “D8.10 - List with the practice abstracts following the EIP common format (version 1)” and D8.11 (version 2) were sent in the Common Format template (see Annex B) to the EIP-AGRI staff at different stages of the project life, being uploaded to their website just after it (see *Figure 1*). This procedure will also be aplied to this deliverable soon after the project conclusion.

In addition, MAGIC took advantage of the seat on the EIP-AGRI subgroup of innovation (through Spanish Cooperatives-COGECA) and fostered the interaction with it. Thus, MAGIC partners periodically reported its findings to COPA-COGECA, through its Working Groups (WGs). In this sense, several presentations to the COPA-COGECA WGs were performed by Spanish Co-ops staff and other MAGIC partners (see D8.8). PAs were used in all occassions as supporting material to report the advances of the project.

5 References

AGRICULTURAL UNIVERSITY OF ATHENS – AUA, 2021. *PA35: About phytomanagement of contaminated sites.*

AGRICULTURAL UNIVERSITY OF ATHENS – AUA, 2021. *PA36: About Kenaf cultivation in contaminated sites.*

AGRICULTURAL UNIVERSITY OF ATHENS – AUA, 2021. *PA37: About industrial crops on heavy metal contaminated lands.*

ARKEMA, 2021. *PA43: About vegetable oils and metathesis chemistry.*

ARKEMA, 2021. *PA44: About vegetable oils, azelaic acid and pelargonic acid.*

ARKEMA, 2021. *PA45: About vegetable oils and sebacic acid.*

BIOMASS TECHNOLOGY GROUP BV– BTG, 2021. *PA5: About Bio2Match tool*

CENTRE FOR RENEWABLE ENERGY SOURCES AND SAVING – CRES, 2019. *PA10: About Switchgrass long-term field trial in Greece.*

CENTRE FOR RENEWABLE ENERGY SOURCES AND SAVING – CRES, 2020. *PA6: About factsheets of the existing resource-efficient industrial crops.*

CENTRE FOR RENEWABLE ENERGY SOURCES AND SAVING – CRES, 2021. *PA24: About Castor large-scale trial in Volos, Greece.*

CENTRE FOR RENEWABLE ENERGY SOURCES AND SAVING – CRES, 2021. *PA25: About Castor large-scale trial in Xanthi, Greece.*

CENTRO DE INVESTIGACIONES ENERGÉTICAS, MEDIOAMBIENTALES Y TECNOLÓGICAS – CIEMAT, 2019. *PA47*: *About arable marginal lands for bioenergy purposes in Spain.*

CENTRO DE INVESTIGACIONES ENERGÉTICAS, MEDIOAMBIENTALES Y TECNOLÓGICAS – CIEMAT, 2018. *PA14: About Siberian Elm long-term field trial in Spain.*

CENTRO DE INVESTIGACIONES ENERGÉTICAS, MEDIOAMBIENTALES Y TECNOLÓGICAS – CIEMAT, 2018. *PA15: About Tall Wheatgrass long-term field trial in Spain.*

CENTRO DE INVESTIGACIONES ENERGÉTICAS, MEDIOAMBIENTALES Y TECNOLÓGICAS – CIEMAT, 2018. *PA16: About Switchgrass long-term field trial in Spain.*

CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA – CREA, 2020. *PA7: About factsheets of the inventory on available harvesting technology.*

CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA – CREA, 2021. *PA24: About Castor large-scale trial in Volos, Greece.*

CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA – CREA, 2021. *PA25: About Castor large-scale trial in Xanthi, Greece.*

CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA – CREA, 2021. *PA27: About Camelina slope harvesting large-scale trial in Italy.*

COOPERATIVAS AGROALIMENTARIAS DE ESPAÑA – Spanish Co-ops, 2021. *PA4: About MAGIC tools.*

COOPERATIVAS AGROALIMENTARIAS DE ESPAÑA – Spanish Co-ops, 2021. *PA48: About the hemp value chain in Denmark.*

EIP-AGRI Agricultural and Innovation. EIP-AGRI common format

https://ec.europa.eu/eip/agriculture/en/eip-agri-common-format

EIP-AGRI Agricultural and Innovation. EIP-AGRI MAGIC specific website

https://ec.europa.eu/eip/agriculture/en/find-connect/projects/magic-marginal-lands-growing-industrial-crops

FACULDADE DE CIENCIAS E TECNOLOGIADA UNIVERSIDADE NOVA DE LISBOA - FCT/UNL, 2021. *PA49: About combating desertification in the Mediterranean*.

FRENCH NATIONAL RESEARCH INSTITUTE FOR AGRICULTURE, FOOD AND THE ENVIRONMENT– INRA, 2021. *PA46: Potential Biomass Supply from Marginal Lands.*

FRENCH NATIONAL RESEARCH INSTITUTE FOR AGRICULTURE, FOOD AND THE ENVIRONMENT– INRA, 2021. *PA38: About biofertilisation on marginal lands.*

IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE – IMPERIAL, 2021. *PA40: About good practices in MAGIC.*

IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE – IMPERIAL, 2021. *PA41: About the analysis of good practices in MAGIC.*

IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE – IMPERIAL, 2021. *PA42: About key findings and transferability in MAGIC.*

INSTITUTE OF BIOENERGY CROPS AND SUGAR BEET NATIONAL ACADEMY OF AGRARIAN SCIENCES OF UKRAINE - IBCSB NAASU, 2020. *PA18: About Energy Willow long-term field trial in Ukraine.*

INSTITUTE OF BIOENERGY CROPS AND SUGAR BEET NATIONAL ACADEMY OF AGRARIAN SCIENCES OF UKRAINE - IBCSB NAASU, 2020. *PA17: About Miscanthus long-term field trial in Ukraine.*

INSTITUTE OF BIOENERGY CROPS AND SUGAR BEET NATIONAL ACADEMY OF AGRARIAN SCIENCES OF UKRAINE - IBCSB NAASU, 2021. *PA20: About Hemp long-term field trial in Ukraine.*

INSTITUTE OF BIOENERGY CROPS AND SUGAR BEET NATIONAL ACADEMY OF AGRARIAN SCIENCES OF UKRAINE - IBCSB NAASU, 2021. *PA19: About Switchgrass long-term field trial in Ukraine.*

INSTYTUT WLOKIEN NATURALNYCH I ROSLIN ZIELARSKICH – IWNiRZ, 2021. *PA34: About fiber hemp small-scale trial on marginal lands in Poland.*

BIOWARMIA BIOENERGY AND BIORESOURCES MICHAL KRZYZANIAK – 3B, 2019. *PA32: About Short Rotation Coppices large-scale field trial in Poland.*

BIOWARMIA BIOENERGY AND BIORESOURCES MICHAL KRZYZANIAK – 3B, 2019. *PA12: About Willow long-term field trial in Poland.*

BIOWARMIA BIOENERGY AND BIORESOURCES MICHAL KRZYZANIAK – 3B, 2021. *PA31: About Willow and Poplar large-scale trial in Poland.*

BIOWARMIA BIOENERGY AND BIORESOURCES MICHAL KRZYZANIAK – 3B, 2021. *PA33: About Camelina large-scale trial in Poland.*

LATVIJAS VALSTS MEZZINATNES INSTITUTS SILAVA – LSFRI SILAVA, 2019. *PA11: About Scots Pine long-term field trials in Latvia.*

LATVIJAS VALSTS MEZZINATNES INSTITUTS SILAVA – LSFRI SILAVA, 2019. *PA29: About large-scale trial recultivation in Latvia.*

LATVIJAS VALSTS MEZZINATNES INSTITUTS SILAVA – LSFRI SILAVA, 2019. *PA30: About White Willow large-scale trial in Latvia.*

MAGIC Project, 2017. *Definition and classification of marginal land suitable for industrial crops in Europe.* Deliverable 2.1.

MAGIC Project, 2017. *Dissemination plan.* Deliverable 8.1.

MAGIC Project, 2017. *MAP-DB (version 1).* Deliverable 2.2.

MAGIC Project, 2017. *Methodological approaches to identify and map marginal land suitable for industrial crops in Europe.* Deliverable 2.6.

MAGIC Project, 2017. *Low-input agricultural practices for industrial crops on marginal land.* Deliverable 4.1.

MAGIC Project, 2018. *Report with profiles of Best Practice Cases.* Deliverable 7.1.

MAGIC Project, 2018. *Handbook with factsheets of the existing resource-efficient industrial crops.* Deliverable 1.5.

MAGIC Project, 2019. *Inventory on available harvesting technologies for industrial crops on marginal land.* Deliverable 5.1.

MAGIC Project, 2019. *List with the practice abstracts following the EIP common format (version 1).* Deliverable 8.10.

NOVABIOM- SAS NOVABIOM,2021. *PA21: About no-till covercrop Miscanthus large-scale trial in France.*

NOVABIOM- SAS NOVABIOM,2021. *PA22: About marginal soil cultivation of Miscanthus large-scale trial in France.*

NOVABIOM- SAS NOVABIOM,2021. *PA23: About boosting Miscanthus large-scale trial in France.*

NOVA-INSITITUT FUR POLITISCHE UND OKOLOGISCHE INNOVATION GMBH – nova, 2019. *PA1: About MAGIC Project.*

STICHTING WAGENINGEN RESEARCH – WR, 2020. *PA2: About definition and classification of marginal lands*.

STICHTING WAGENINGEN RESEARCH – WR, 2018. *PA3: About spatially explicit map database of MAGIC*.

UNIVERSITA DEGLI STUDI DI CATANIA – UNICT, 2018. *PA26: About wild sugar cane large-scale trial in Italy*.

UNIVERSITA DEGLI STUDI DI CATANIA – UNICT, 2018. *PA28: About arundo and miscanthus large-scale trials in Italy.*

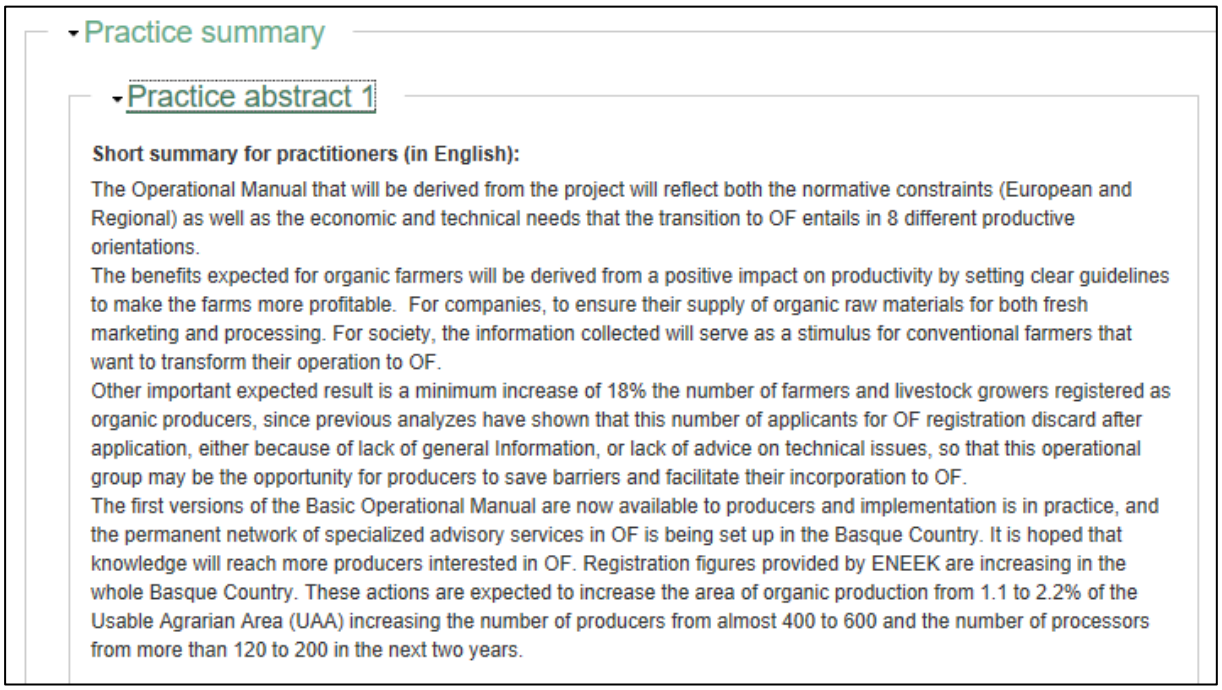
UNIVERSITAET HOHENHEIM – UHOH, 2018. *PA8: About MAGIC long-term field trials*.

UNIVERSITAET HOHENHEIM – UHOH, 2018. *PA9: About miscanthus long-term field trial in Germany.*

UNIVERSITAET HOHENHEIM – UHOH, 2020. *PA39: About low-input agricultural practices.*

6 Annexes

Annex A: An example of a practice abstract published at the EIP-AGRI website



Practice summary

Practice abstract 1

Short summary for practitioners (in English):

The Operational Manual that will be derived from the project will reflect both the normative constraints (European and Regional) as well as the economic and technical needs that the transition to OF entails in 8 different productive orientations.

The benefits expected for organic farmers will be derived from a positive impact on productivity by setting clear guidelines to make the farms more profitable. For companies, to ensure their supply of organic raw materials for both fresh marketing and processing. For society, the information collected will serve as a stimulus for conventional farmers that want to transform their operation to OF.

Other important expected result is a minimum increase of 18% the number of farmers and livestock growers registered as organic producers, since previous analyzes have shown that this number of applicants for OF registration discard after application, either because of lack of general Information, or lack of advice on technical issues, so that this operational group may be the opportunity for producers to save barriers and facilitate their incorporation to OF.

The first versions of the Basic Operational Manual are now available to producers and implementation is in practice, and the permanent network of specialized advisory services in OF is being set up in the Basque Country. It is hoped that knowledge will reach more producers interested in OF. Registration figures provided by ENEEK are increasing in the whole Basque Country. These actions are expected to increase the area of organic production from 1.1 to 2.2% of the Usable Agrarian Area (UAA) increasing the number of producers from almost 400 to 600 and the number of processors from more than 120 to 200 in the next two years.

Annex B: Final version of the H2020 EIP excel template to be submitted to EIP-AGRI for MAGIC Project

Project Information

Project identifier (see INSTRUCTIONS)	2017H2020_727698_MAGIC
Title of the project in native language (*can be the language of the coordinator / one of the partners - otherwise repeat the title in English*)	MAGIC - Marginal Lands for Growing Industrial Crops. Turning a Burden into an Opportunity
Title of the project in English (*provide the project ACRONYM + short title within the characters limit*)	MAGIC - Marginal Lands for Growing Industrial Crops. Turning a Burden into an Opportunity

Geographical location

Country (*of the coordinator*)	Greece
Main geographical location (NUTS3) (of coordinator - *for geolocalisation on map*)	EL305 - Eastern Attica

Editor of the text: person/organisation responsible for delivering the text	Efthymia Alexopoulou - CRES

Project coordinator (lead-partner) according to the cooperation/consortium agreement:

Name	Center for Renewable Energy Sources and Saving - CRES
Address	Biomass Department of CRES Center for Renewable Energy Sources and Saving 19th Km Marathonos Avenue 19009 Pikermi Attikis
E-mail	ealex@cres.gr
Telephone	+30 210 6603300

Project period:

start year (YYYY)	2017
end year (YYYY)	2021

Project status: ongoing (after selection of the project) or completed (after final payment)	Ongoing
Main **funding source** (Rural development programme, H2020, or other EU, national/regional or private funds)	H2020
Total budget of the project (total costs - in euros)	5,999,987.00

Objective of the project in English: what problems/opportunities does the project address that are relevant for the practitioner/end-user, and how will they be solved? - (300-600 characters, word count – no spaces)	Due to changing climatic conditions in Europe, the areas that are less favourable for conventional agriculture are expanding. This land has been either abandoned because of its productivity, or it is used as grassland. Moreover, contaminated soils cannot be used for food or feed production for sanitary reasons and thus provide great potential for the production of biomass for material or energy use. Cultivating industrial crops on marginal land unsuitable for food production is consistently proposed as a viable alternative to minimize land-use competition for food production, and its adverse effects (direct or indirect) on food security, land-based greenhouse gas emissions and biodiversity loss.
Description of project activities in English: (max 600 characters, word count – no spaces): short summary highlighting main project activities.	MAGIC is an up-to-date database that combines two different data sets (MAGIC CROPS and MAGIC MAPS) into a Decision Support System (DSS). MAGIC CROPS categorize resource-efficient industrial crops according to their agronomic characteristics: input requirements, yield performance and quality traits for end-user applications. MAGIC MAPS chart and analyse marginal land in Europe that are exposed to natural constraints. These classifications serve as a basis for the development of best-practice options for industrial crops. Moreover, the DSS gives farmers a quick and easy overview of the most productive industrial crops that meets the geological requirements of their soils.
Additional comments (in English): free text field which can be used by the editor e.g. for listing facilitating elements or obstacles for the implementation of the produced results, for suggestions for future actions/research, for messages to end-users etc.	Industrial crops can be broadly categorised as: -Oil, -Lignocellulosic, -Carbonhydrate, - Speciality Crops

Project partners (mandatory information) - *N.B. : "Name" can be that of an organisation - "Address" should include the country*					
	Name	**Address**	**E-mail**	**Telephone**	**Type of partner**
project coordinator (lead partner) *from PROJECT INFORMATION*	Center for Renewable Energy Sources and Saving - CRES				Research institute
project partner	UNIBO				Research institute
project partner	WR				Research institute
project partner	WU				Research institute
project partner	UNHO				Research institute
project partner	INRA				Research institute
project partner	IFEU				Research institute
project partner	Imperial College				Research institute
project partner	Nova-Institut GmbH				SME
project partner	UNICT				Research institute
project partner	FCT/UNL				Research institute
project partner	ARKEMA				Other
project partner	CIEMAT				Research institute
project partner	Spanish Co-ops				SME
project partner	3B				SME
project partner	CREA				Research institute
project partner	IWNiRZ				Research institute
project partner	AUA				Research institute
project partner	IBCSB NAASU				Research institute
project partner	LSFRI SILAVA				Research institute
project partner	IIASA				Research institute
project partner	SAS Novabiom				SME
project partner	VDS				SME
project partner	BIOS				SME
project partner	BTG				SME

Keyword - category

Keyword - category 1	Agricultural production system
Keyword - category 2	Plant production and horticulture
Keyword - category 3	Soil management / functionality
Keyword - category 4	Farming/forestry competitiveness and diversification
Keyword - category 5	
Keyword - category 6	
Keyword - category 7	
Keyword - category 8	
Keyword - category 9	
Keyword - category 10	

Audiovisual material which is useful and attractive for practitioners (e.g. YouTube link, videos, other dissemination material)

Title/description (in English)	**URL**
MAGIC Project Website	http://magic-h2020.eu/
Leaflet & poster	http://magic-h2020.eu/press-publications/
Documents & reports	http://magic-h2020.eu/documents-reports/
First press release	http://magic-h2020.eu/press/

Official website of the project

Title/description	**URL**
MAGIC - Marginal Lands for Growing Industrial Crops	http://magic-h2020.eu

Links to other website(s) hosting information on the project (results) that are available after the project has ended, by preference using the existing local/regional/national communication channels that practitioners most often use.

Title/description	**URL**
	http://

Practice "abstract" 1:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in English

Marginal lands for growing industrial crops

Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English*

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

Marginal lands for Growing Industrial Crops (MAGIC) is a 4-year project and gets funding by the European Commission. The project aims to promote the sustainable development of resource-efficient and economically profitable industrial crops grown on marginal lands.
Industrial crops can provide abundant renewable biomass feedstocks for the production of high added-value bio-based commodities (such as bio-plastics, bio-lubricants, bio-chemicals, pharmaceuticals, bio-composites, etc.) and bioenergy. Most of these crops are multi-purpose and offer the opportunity to follow a cascade biorefinery concept to produce a number of high-quality bio-products and bioenergy, to strengthen the bio-based economy. To achieve the project objectives, an up-to-date database of existing resource-efficient industrial crops will be developed with information on their agronomic characteristics, input requirements, yield performance and quality traits for end use applications. In parallel, current and future marginal lands in Europe facing natural constraints will be mapped, characterised and analysed to provide a spatially explicit classification that will serve as a basis for developing sustainable best-practice options for industrial crops. A Decision Support System (DSS) based on both MAGIC-CROPS and MAGIC-MAPS will be developed and validated with the active involvement of farmers and end users in order to choose the most promising industrial crop at any geo-location in Europe.
In the long term, this strategy will foster the sustainable development of the EU bio-based economy and will contribute to achieving EU energy and climate targets.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 2:

Short title in native language	Definition and classification of marginal lands suitable for industrial crops in Europe
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Industrial crops will provide feedstocks for bio-based applications, thereby, will foster the bioeconomy and provide diversification opportunities to farmers. MAGIC project has identified and mapped those marginal lands across Europe where industrial crops (oil, lignocellulosic, carbohydrate and specialty crops) could be grown in a sustainable way. This mapping was based on a previous classification of marginal lands according to features such as: -Biophysical constraints, considering adverse climate due to low temperature, dryness, or excessive wetness; analysing soil problems such as adverse chemical composition, low fertility, or limitations in rooting; and paying attention to adverse terrain due to steep slope. -Socio-economic constraints regarding limited access to markets, difficult accessibility and bad infrastructure. -Sustainability, since the impact of growing industrial crops depend very much on whether other land uses are replaced by the industrial crops (leading to potential competition with food production); on whether biodiversity and other ecosystem services will be affected; and on what industrial crops and what management systems are to be used. Moreover, to determine whether a land is suitable for growing industrial crops or not, four key main features of the terrains classified as marginal lands must be pointed out: land can be marginal for agricultural use, but not for forestry use; marginality refers to the mentioned biophysical and socio-economic constraints; there are synonymous uses of “marginal lands” (abandoned farmland, low productivity, etc.); and that “marginality” is a dynamic feature which can change in time.

Practice "abstract" 3:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in native language	Mapping marginal lands for growing industrial crops
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	The purpose of the MAGIC mapping is to characterize and analyse projections for current and future marginal lands in Europe facing natural constraints. Identified MAGIC marginal lands are defined as: “Lands having limitations which in aggregate are severe for sustained application of a given use and/or are sensitive to land degradation, as a result of inappropriate human use, and/or have lost already part or all of their productive capacity as a result of inappropriate human use”. The elements that were considered in building the classification include biophysical limitations clustered in six main groups. In addition, the resulting marginal land map was further classified according to, land use management, socio-economic limitations, ecosystem services and drives and pressures influencing the ecosystem functions. As a result, in total 29% of the agricultural land (i.e. land classified as agricultural by Corine Land Cover since 1992) in the European Union are classified as marginal. The most common limitations are rooting limitations, with 12% of the agricultural area. This is followed by adverse climate and excessive soil moisture occurring in respectively 11% and 8% of the agricultural land. The spatial explicit classification created by MAGIC will serve as a basis for developing sustainable best-practice options for industrial crops in Europe. In addition, the spatially explicit map database is accessible via the project website and will be maintained and further improved during the project’s lifetime and at least five years beyond the project completion. Visitors to the public website can access the map to inform themselves about the marginal land status in their region but can also help to evaluate the quality of the map.

Practice "abstract" 4:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in native language	MAGIC Tools
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	MAGIC project has developed four databases' tools. MAGIC MAPS is an online service that features and presents the European marginal lands. It allows to consult at local administration level (LAU1) not only the overall percentage of agricultural lands facing marginal conditions over the selected area, but also the extension of area affected by specific constraints such as chemicals, climate, fertility, rooting, terrain and wetness. This information is shown over an ArcGIS Web App where those LAU with higher marginality rates are represented in darker colours. Alternatively, MAGIC-CROPS is an Excel database that offers detailed description of 37 industrial crops. Crop performance is provided according to different parameters such as dryness, soil moisture, drainage, texture, rooting depth, salinity, acidity, pollutants etc. It also includes agronomical information such as the fertilization needs, adequate temperature, cycle, harvesting period, harvesting method, possible applications use they may have, etc. This tool is excellent to increase farmers' knowledge and encourage them to cultivate a crop that suits most under their land and market conditions. MAGIC DSS shows practical information on (i) average rate of marginal lands, (ii) marginal land types (climate, moisture, soil, rooting, fertility and chemicals) (iii) marginal area in km^2 and (iv) types of potential crops suitable for cultivation in these marginal areas. All the information is automatically recalculated depending on the chosen area, it is also possible to filter by country (resolution provided at a LAU2 level). Bio2Match was created in S2Biom-project and it has been expanded in MAGIC project. There is a practice abstract which explains in detail how it works.

Practice "abstract" 5:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Bio2Match tool
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Bio2Match is an internet tool created to guide the user for matching industrial crops with their associated conversion technologies. This is done by combining two databases, biomass information and conversion technologies. The biomass properties can be affected by the plant and wood species, the soil, the harvesting time and climate, the part of the plant or wood considered and the type of fertilization. Firstly, the tool checks if the biomass is suitable for the conversion, taking into account the post-harvesting biomass properties that are inalterable. For instance, ash, cellulose, hemicellulose, nitrogen, and chlorine content. Secondly, a match is generated when the technology criteria are met by the biomass properties. Subsequently, a second match can be made by checking the physical biomass properties, such as dimensions or humidity content. If there is no match, the device will suggest the physical properties needed to alter, to make the conversion possible. This tool also provides biomass pre-treatment recommendation. Bio2Match was created in S2Biom-project, which incorporated lignocellulosic crops and their associated conversion technologies. However, it has been expanded in MAGIC project, including the industrial MAGIC crop database and the corresponding technologies. The tool is available on the MAGIC-website: http://magic-h2020.eu/bio2match-tool/. The biomass database and technology database can be downloaded on the website. Additionally, there is a guide and a tutorial video available for the users, in order to get them familiarized with the tool.

Practice "abstract" 6:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Handbook with factsheets of the existing resource-efficient industrial crops
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	MAGIC consortium has gained an extensive knowledge on industrial crops by coordinating and participating in several relevant national & EU projects. This experience has allowed to create a handbook with fact sheets of the existing resource-efficient industrial crops. In them, useful agronomic information is presented in a synthetic way. Although not all aspects were available for each crop, most factsheets present information on crop features such as varieties, soil and climate preferences, soil preparation and sowing, water and fertilization needs, yields, uses, qualitative traits, harvesting, handling, storing, environmental impacts and risks associated with cultivation (diseases, insects and weed control). All this information was supported by a thoroughly research work on literature, position papers, project reports, etc. In total, twenty factsheets are available for the following crops: • Amaranth • Calendula • Camelina • Caper spurge • Castor bean • Crambe • Ethiopian mustard • Flax • Industrial hemp • Kenaf • Nettle • Pennycress • Poplar • Safflower • Sorghum • Spartium • Sunflower • Sunn hemp • Switchgrass • Wild tobacco All the factsheets can be found at MAGIC website over the Reports&Deliverables tab (D1.5 – Handbook with fact sheets of the existing resources-efficient). In addition, MAGIC has created MAGIC-CROPS, a database that provides a description of 37 industrial crops suitable for growing on marginal land in Europe where more information can be found. You can also access MAGIC-CROPS through the main page of MAGIC website.

Practice "abstract" 7:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Inventory on available harvesting technology for industrial crops on marginal lands
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	The apparent lack of appropriate machinery significantly affects farmers' perception of the possibility to cultivate industrial crops. Thus, the development of a comprehensive inventory on currently available harvesting systems of industrial crops on marginal land has been considered as a need in the MAGIC project. This inventory gathers information obtained from direct data collection in previous projects, scientific literature review and market analysis on the current existing technologies used to harvest non-food crops in marginal lands and included in the MAGIC CROPS database. The inventory document is organized in fact-sheets representing an “easy-to-find” and “easy-to-use” instrument for final users, providing a rapid identification of the principal mechanized harvesting solutions for a specific crop, according to the final use of the biomass. For each crop a traffic light is included to provide indications about the status of knowledge on harvest technologies. In total, twenty factsheets are available for the following crops: • Sorghum bicolor L. • Camelina sativa L. • Crambe abyssinica L. • Ricinus communis L. • Panicum virgatum L. • Miscanthus x giganteus • Arundo donax L. • Agropyron elongatum (Host) • Brassica carinata L. • Cannabis sativa L. • Phalaris arundinaceae L. • Carthamus dictorius L. • Cynara cardunculus L. • Thlaspi arvense L. • Salix spp • Populus spp • Robinia pseudoacacia L. • Ulmus pumila L. • Saccharum spontaneum L. • Lupinus mutabilis Sweet Factsheets can be found at MAGIC website over the Reports&Deliverables tab (D5.1 – Inventory on available harvesting technology for industrial crops on marginal lands).

Practice "abstract" 8:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Long-term field trials with industrial crops on marginal land
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	One of the expected results of the MAGIC Project will be a comprehensive overview of the long-term performance potential of industrial crop cultivation on marginal land in Europe. For this purpose, the results of several long-term field trials with important industrial plants such as Miscanthus, Giant Reed, Reed Canary Grass, Camelina, Hemp and Poplar, which are carried out Europe-wide under the most important marginal growth conditions such as adverse rooting conditions, adverse climatic conditions and unfavourable terrain, will be compiled and evaluated. Many of these field trials are still on-going. In particular, the best low-input agricultural cultivation strategies for the crop categories ‘tillage’, ‘nitrogen fertilization’, ‘weed control’ and ‘irrigation’ will be identified. Practitioners should benefit from the results by implementing low-input agricultural practices for industrial crop cultivation, which are adapted to both the marginality conditions of their locations and to the market requirements in their region. It is assumed that this will increase both the overall income of the farms and the net profit due to higher biomass yields (and qualities) and higher production efficiencies. In addition, to these direct benefits, it is expected to bring indirect benefits through improved legal frameworks resulting from the policy recommendations.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 9:

Short title in English	Miscanthus cultivation on marginal land in southwest Germany
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	In 2012 and 2014, several field trials with Miscanthus (a perennial C4 grass for combustion and other conversion routes) were carried out at various marginal sites in southwest Germany. The most severe marginality conditions at one of these sites ('OLI') are a combination of adverse root conditions (shallow soil (26 cm) and stoniness (20%)) and low temperatures (frost and short vegetation period). At OLI, six genotypes of Miscanthus were established in 2014 (~1 plantlet/m²). Weeding was performed by hand in 2014 and 2015. The harvest was carried out each year in spring starting from 2016. No fertilization was applied. The previous crop was grassland. The estimated accumulated dry matter yields of the first three growing seasons (2015, 2016 and 2017) range between 12.4 t/ha (GNT 4) and 30.9 t/ha (Miscanthus × giganteus). These preliminary results suggest that low-input cultivation of Miscanthus on shallow stony soil under low temperature conditions may be a success depending on the genotype. Miscanthus × giganteus is expected to provide high dry matter yields (in relation to the given marginal growing conditions) also in the following seasons. The expected main recommendation of these results is that farmers should consider the possibility of growing Miscanthus × giganteus on marginal areas similar to those of OLI (shallow stony soil + low temperature). In addition to economic benefits such as high biomass yields, low external inputs (fertilizers, pesticides) and low labour intensities (except for the establishment procedure), there are a number of eco-systemic advantages of Miscanthus × giganteus over annual cultivation systems such as improved soil fertility, habitat networking and reduced soil erosion.

Short title in native language	Miscanthusanbau auf Marginalstandorten in Süddeutschland

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

In den Jahren 2012 und 2014 wurden an verschiedenen Marginalstandorten im Südwesten Deutschlands mehrere Feldversuche mit Miscanthus (einem mehrjährigen C4-Gras für die Verbrennung, Biogasproduktion und andere Konversionsarten) durchgeführt. Die stärksten Marginalitätsbedingungen an einem dieser Standorte ("OLI") sind eine Kombination aus ungünstigen Bodeneigenschaften (Flachgründigkeit (10 - 20 cm) und ein hoher Steinanteil im Oberboden (50%)) und niedrigen Temperaturen (Frost und kurze Vegetationszeit). Am OLI wurden 2014 sechs Genotypen von Miscanthus etabliert (~1 Planze/m²). In den Jahren 2014 und 2015 wurde das Unkraut mechanisch entfernt. Geerntet wurde ab 2016 jedes Jahr im Frühjahr. Auf eine Düngung wurde verzichtet. Die vorherige Kultur war Grünland. Die geschätzten kumulierten Trockenmasseerträge der ersten drei Vegetationsperioden (2015, 2016 und 2017) liegen zwischen 12,4 t/ha und 30,9 t/ha. Diese vorläufigen Ergebnisse deuten darauf hin, dass ein extensiver Anbau von Miscanthus auf flachem steinigem Boden in Kombination mit niedrigen Temperaturbedingungen ein Erfolg sein kann. Es wird erwartet, dass Miscanthus × giganteus auch in den folgenden Jahren hohe Trockenmasseerträge liefert. Die erwartete Hauptempfehlung ist, dass die Landwirte die Möglichkeit in Betracht ziehen sollten, Miscanthus × giganteus auf Marginalstandorten anzubauen, die denen vom OLI ähneln. Neben wirtschaftlichen Vorteilen wie hohen Biomasseerträgen, geringem Einsatz von Arbeitsmitteln und niedrigen Arbeitsintensitäten gibt es bei Miscanthus gegenüber einjährigen Anbausystemen eine Reihe von ökosystemischen Vorteilen wie verbesserte Bodenfruchtbarkeit, Habitatvernetzung und geringere Bodenerosion.

Practice "abstract" 10:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Switchgrass cultivation on marginal land in central Greece
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Two Switchgrass field trials were established by seeds in 1998 on marginal land located in central Greece and are still on-going. The aim was to identify the appropriate cultural practices of Switchgrass when grown on marginal land. Tested factors were: 10 varieties in the first and 5 in three nitrogen rates (0, 75 and 150 kg N/ha) in the second. Varieties were: Caddo, Alamo, Blackwell, Cathage, Cave-in-rock, Forestburg, Kanlow, Pangburn, SL 93-2, SL 93-3, SL 94-1, SU 94-1 and Summer. Biomass yields were maximized in the second growing period and come up to 20 t/ha (oven-dried), almost double to yields recorded at first year. In the 3rd year a yield reduction was measured from 5% to 20%. Yields reduction continued in year 4 and for more than a decade the dry matter yields varied from 12 to 14 t/ha. Further reduction was recorded from 18th till 20th year of the plantation and the mean dry yields varied from 8 to 10 t/ha during this period. During two decades lowlands varieties gave always higher yields but the superiority of lowland over upland was quite profound till the 6th growing period. Lowland varieties were higher with stronger stems and thus had higher lodging resistance than upland ones. Lodging problems were recorded for the upland varieties at the mid-point of the tested years and at the end of summer, after strong rainfall with high winds. In the first years, no significant effect of nitrogen fertilization on growth and yields was recorded. From year 6 to 20 dry yields for switchgrass varieties were always higher in the plots that received 150 kg N/ha as top fertilization. From 18th growing season the plantation began to look quite old and the tiller density had been greatly reduced. The average mean yields of switchgrass (oven-dried) fields was 12 t/ha.

Short title in native language	Καλλιέργεια σε περιθωριακή γη της κεντρικής Ελλάδας
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Το 1998 πραγματοποιήθηκαν δύο δοκιμές στον τομέα του switchgrass από σπόρους σε οριακές εκτάσεις που βρίσκονται στην κεντρική Ελλάδα και βρίσκονται ακόμη σε εξέλιξη. Ο στόχος ήταν να εντοπιστούν οι κατάλληλες πολιτιστικές πρακτικές του switchgrass όταν καλλιεργούνται σε περιθωριακή γη. Οι παράγοντες που ελέγχθηκαν ήταν: 10 ποικιλίες το πρώτο και 5 σε τρεις ρυθμούς αζώτου (0, 75 και 150 kg N/ha) στη δεύτερη. Οι ποικιλίες ήταν: Caddo, Alamo, Blackwell, Cathage, Cave-in-rock, Forestburg, Kanlow, Pangburn, SL 93-2, SL 93-3, SL 94-1, SU 94-1 και Summer. Οι αποδόσεις της βιομάζας μεγιστοποιήθηκαν κατά τη δεύτερη περίοδο καλλιέργειας και ανέρχονται σε 20 τόνους/εκτάριο (φυγή), σχεδόν διπλάσιες από τις αποδόσεις που καταγράφηκαν κατά το πρώτο έτος. Κατά το 3ο έτος μετρήθηκε μείωση της απόδοσης από 5 % σε 20 %. Η μείωση των αποδόσεων συνεχίστηκε κατά το έτος 4 και για περισσότερο από μια δεκαετία οι αποδόσεις ξηρής ύλης κυμαίνονταν από 12 έως 14 τόνους/εκτάριο. Περαιτέρω μείωση σημειώθηκε από το 18ο έως το 20ο έτος της φυτείας και οι μέσες ξηρές αποδόσεις κυμαίνονταν από 8 έως 10 τόνους/εκτάριο κατά την περίοδο αυτή. Κατά τη διάρκεια δύο δεκαετιών πεδινών ποικιλιών έδιναν πάντα υψηλότερες αποδόσεις, αλλά η ανωτερότητα των πεδινών στα ορεινά εδάφη ήταν αρκετά βαθιά μέχρι την 6η περίοδο ανάπτυξης. Οι πεδινές ποικιλίες ήταν υψηλότερες με ισχυρότερους μίσχους και έτσι είχαν μεγαλύτερη αντοχή στο κατάλυμα από ό, τι τα ορεινά. Καταγράφηκαν προβλήματα στέγασης για τις ορεινές ποικιλίες στα μέσα των δοκιμασμένων ετών και στο τέλος του καλοκαιριού, μετά από έντονες βροχοπτώσεις με δυνατούς ανέμους. Κατά τα πρώτα έτη, δεν καταγράφηκε καμία σημαντική επίδραση της γονιμοποίησης του αζώτου στην ανάπτυξη και τις αποδόσεις. Από το 6 έως το 20 οι ξηρές αποδόσεις για τις ποικιλίες switchgrass ήταν πάντα υψηλότερες στις εκτάσεις που έλαβαν 150 kg N/ha ως κορυφαία γονιμοποίηση. Από την 18η καλλιεργητική περίοδο η φυτεία άρχισε να φαίνεται αρκετά παλιά και η πυκνότητα των γεωργών είχε μειωθεί σημαντικά. Η μέση μέση απόδοση των πεδίων switchgrass (με ξήρανση) ήταν 12 t/ha.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 11:

Short title in English

Scots Pine long-term field trials in Latvia

Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English*

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

In Northern Europe Scots Pine (Pinus sylvestris) is one of the most often planted tree species in plantations. When planted in abandoned agricultural land and intensively tended, Pine successfully takes root in open areas. 15-year-old plantations in 7 sites were evaluated. Overall, the growth of plantation Pine is evaluated as average or good, yet it grows best in naturally dry podzolic sandy, sod-podzolic sandy loam and gravelly loam soils. When plantation is established on marginal or abandoned agricultural land, Scots Pine shows slow development in the first 5 years (on average 0.10 to 0.15 m/year). Diameter at Breast Height (DBH, 1.3 m) is reached at 6 - 8 years, and the growth of Pines increase at this age. 15-year plantation Pine on agricultural land shows the same DBH parameters that are found on forest land at 25 - 28 years and average height at 16 -18 years. The stock volume of well-growing plantation Pine may by the age of 15 be as high as 80 to 155 m3/ha, and by 22 years reach even 243 m3/ha. Pine plantations produce the highest stock volume in podzolic, cultivated, and sod-podzolic soils, where the stock volume for 15 to 16-year Pine is 112 to 155 m3/ha, with the current volume growth 5 to 8 m3/ha. Above ground biomass analysis show that in plantations 12 - 15-year-old tree has total biomass of 137 - 190 kg consisting of stem biomass 70 - 149 kg (51 - 78%) and crown biomass 67 - 42 kg (49 - 22%). Agricultural land can be too fertile for Scots Pine, leading to rapid growth, but also to development of thick lateral branches, which decreases wood quality and even stock volume. Therefore, it is important to prune the trees and carry out thinning no later than at 14 - 15 years of age.

Short title in native language	Parastās priedes ilgtermiņa izmēģinajuma pētījumiLatvijā
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Ziemeļeiropā, parastā priede (Pinus sylvestris) ir viena no biežāk stādītajām koku sugām mežā, bet ne lauksaimniecības zemju apmežojumos. Stādot pamestās lauksaimniecības zemēs un intensīvi kopjot, priede ir ieaudzējama atklātās platībās. 15 gadīgos stādījumos 7 vietās, dažādos apstākļos vērtētas apmežošanas sekmes. Priežu plantāciju mežu augšana vērtējama kā vidēja vai laba, tomēr tā vislabāk jūtas dabiski sausās podzola, velēnu podzolētās mālsmilts un oļainās mālsmilts augsnēs ar nepaaugstinātu grunts ūdens līmeni). Kad plantāciju izveido uz marginālas zemes, parastā priede uzrāda lēnu attīstību pirmajos 5 gados (vidēji 0,10 līdz 0,15 m gadā–1). Diametrs krūšu augstumā (DBH, 1,3 m) tiek sasniegts 6 - 8 gados, paātrinās priežu augšana. 15 gadu vecumā plantāciju mežā augušiem kokiem DBH parametri atbilst mežos 25 - 28 gadus augušiem kokiem. Vidējais priežu augstums plantāciju mežā 15 gados ir līdzīgs 16 -18 gadus veciem mežā augušiem kokiem. Priežu stādījuma krāja 15 gadu vecumā variē no 80 līdz 155 m3/ha, bet 22 gadu laikā sasniedz pat 243 m3/ha. Priežu stādījumos vislielāko krājas apjomu iegūst podzolaugsnēs, kultūraugsnēs un velēnu podzolētas augsnes, kur 15 līdz 16 gadu parastās priedes krājas apjoms ir 112 līdz 155 m3/ha, un ikgadējais krājas pieaugums ir 5 līdz 8 m3/ha. Virszemes biomasa 12 –15 gadus vecu koku stādījumos variē no 137 līdz 190 kg, (stumbrs 70 –149 kg (51 –78%) un vainagi 67 –42 kg (49 –22%)). Lauksaimniecības zeme var būt pārāk auglīga, pārlieku strauja parastās priedes augšana saistīta ar kupla vainaga un daudzu sānzaru veidošanos, tas samazina stumbra – baļķa koksnes kvalitāti un pat to koksnes krājas apjomu. Tāpēc ir svarīgi atzarot mērķkokus un veikt kokaudzes retināšanu jau 14 – 15 gadu vecumā.

Practice "abstract" 12:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Biomass yield from Willow cultivated in 4-year harvest cycle on marginal land in Poland
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	In this study, the biomass yield and morphological traits of plants were reported from a field trial with six genotypes of Willow, cultivated in northern Poland. Willow was planted using a pole cutting system, which is called Eco-Salix. Two planting densities were selected: 5,200 and 7,400 plants/ha at two marginal sites. The first site had heavy textured clay soil and the second site was located on peaty muck soil. The aim of this study was to determine the morphological traits of plants and the biomass yield of six Willow genotypes (clones and varieties) under low-input agriculture on two marginal soils with a quadrennial harvest cycle. In the field trial, the average Willow biomass yield of dry matter was 7.87 t/ha. The new variety Ekotur had higher yield and more favourable morphological traits compared to other registered Polish varieties. The Willow biomass yield obtained on peat muck soil was significantly higher than from Willow grown on heavy textured clay soil. Eco-Salix system could be effective if used: (i) in regions of low forest coverage to increase biodiversity; (ii) on lands permanently or periodically too wet; (iii) and on land where heavy machinery cannot be used for soil preparation. The Eco-Salix system has the potential to produce high yields of Willow biomass under conditions of low-input agriculture (no or reduced tillage, and a limited number of other management practices) using poles on marginal soils. Furthermore, Ekotur (Salix viminalis) and cv. Doutur (S. alba) can be recommended for cultivation due to high biomass yield on peat-muck soil. When converting land to bioenergy production, the Eco-Salix system can be used on marginal lands and can provide additional environmental and financial benefits.

Short title in native language	Plon biomasy wierzby uprawianej w 4-letniej rotacji zbioru na gruntach marginalnych w Polsce
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	W doświadczeniu tym określono plon biomasy i cechy morfologiczne sześciu genotypów wierzby, uprawianych w północnej Polsce. Doświadczenie założono za pomocą żywokołów (nieukorzenionych pędów o długości 2.4 m) tak zwanym systemem Eko-Salix. Zastosowano dwie gęstości sadzenia: 5 200 i 7 400 roślin na hektar na dwóch gruntach marginalnych. Pierwsze stanowisko położone było na ciężkiej glebie ilastej, a drugie znajdowało się na glebie torfowo-murszowej. Celem badań było określenie cech morfologicznych roślin i produkcyjności sześciu genotypów wierzby (klonów i odmian) bez uprzedniej uprawy na dwóch glebach marginalnych w czteroletnim cyklu zbioru. Średni plon suchej biomasy wierzby z doświadczenia wynosił 7,87 t/ha. Nowa odmiana Ekotur dała wyższy plon i miała korzystniejsze cechy morfologiczne w porównaniu do wcześniej zarejestrowanych polskich odmian. Plon biomasy wierzby uzyskany na glebie torfowo-murszowej był znacznie wyższy niż z wierzby uprawianej na ciężkiej glebie ilastej. Można wnioskować, że system Eko-Salix może być skuteczny, jeżeli jest stosowany: (i) w regionach o niskiej lesistości, w celu zwiększenia różnorodności biologicznej; (ii) na gruntach trwale lub okresowo zbyt mokrych (gleby ciężkie gliniaste i ilaste, gleby torfowe); (iii) oraz na gruntach, gdzie maszyny rolnicze są zbyt ciężkie i nie mogą być użyte do przygotowania gleby. System Eko-Salix może dać wysokie plony biomasy wierzby w warunkach rolnictwa niskonakładowego (brak lub ograniczona uprawa i niska liczba innych zabiegów agrotechnicznych) przy użyciu żywokołów na glebach marginalnych. Ponadto, odmiana Ekotur (Salix viminalis) i cv. Doutur (S. alba) mogą być zalecane do uprawy na glebie torfowo-murszowej.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 13:

Short title in English	Short rotation poplar and willow cultivated on marginal land as a source of energy in Poland
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Poplar and willow are two species of short rotation coppices cultivated in Poland in the area of about 15,000 ha. These species can be grown on various soils, including marginal soils, both organic and mineral. In the MAGIC project, in Poland, willow and poplar were grown on two soil stands: heavy (clay) and light (loamy sand). After three years of cultivation the yield energy value of poplar and willow biomass acquired from heavy soil was very low and amounted to 27.21 and 14.34 GJ/ha/year, respectively. In turn, on light soil, these yields were much higher: 104 and 117 GJ/ha/year, for poplar and willow, respectively. Willow had better thermophysical properties as solid biofuel. It contained less moisture (50.1%) compared to poplar (52.2%). Willow also had less ash (1.37% d.m.) and nitrogen (0.59%) than poplar (1.71% d.m. and 0.74% d.m., respectively). The above properties indicate that poplar can be used for the production of heat and electricity. Fresh wood chips of these species can be combusted in industrial boilers, without the need for additional drying, while after drying, they can be used in small household boilers or used for the production of industrial pellets of ENplus B class.

Short title in native language	Topola i wierzba uprawiana w krótkich rotacjach na gruntach marginalnych jako źródło energii
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Topola i wierzba to dwa gatunki krzewów uprawianych w krótkich rotacjach w Polsce na obszarze uprawy około 15 000 ha. Gatunki te mogą być uprawiane na różnych glebach, w tym marginalnych, zarówno organicznych jak i mineralnych. W projekcie Magic, w Polsce, wierzbę i topolę uprawiano na dwóch typach gleb: ciężkiej (ile zwykłym) oraz lekkiej (piasku słabogliniastym). Po trzech latach uprawy wartość energetyczna plonu biomasy topoli i wierzby z gleby ciężkiej była bardzo niska i wynosiła odpowiednio 27,21 i 14,34 GJ/ha/rok. Z kolei na glebie lekkie plony te był znacznie wyższe: 104 i 117 GJ/ha/rok, odpowiednio dla topoli i wierzby. Lepszymi cechami termofizycznymi jako paliwo biomasowe cechowała się wierzba. Zawierała ona mniej wilgoci (50,1%) w porównaniu do topoli (52,2%). Wierzba miała również mniej popiołu (1,37% s.m.) i azotu (0,59%) niż topola (odpowiednio 1,71% s.m. i 0,74% s.m.). Powyższe właściwości wskazują na możliwość zastosowania topoli do produkcji energii cieplnej i elektrycznej. Świeże zrębki tych gatunków mogą być spalane w kotłach przemysłowych, bez potrzeby dodatkowego dosuszania, natomiast po dosuszeniu mogą one być wykorzystane w małych kotłach przydomowych lub wykorzystane do produkcji peletu przemysłowego o klasie ENplus B.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 14:

Short title in English	Siberian Elm long-term field trial in Spain
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Siberian Elm (Ulmus pumila L.) is a hardy and fast-growing tree that features greater resistance to Dutch Elm disease than other species in genus Ulmus. Drought tolerance, adaptation to different environments and sprouting capacity suggest that this plant species could be grown as a short rotation energy/industrial crop. Siberian Elm was planted in two plots in 2009 and 2010 in marginal land in Soria province (North-Central Spain). The marginality factors were climate (low temperature) and soil (texture, stoniness, organic matter). In 2009, two plant densities (3,333 and 6,666 plants/ha) under two irrigation regimes (2,000 and 4,000 m3/ha) were implemented and one plant density was established in rainfed conditions in 2010. Furthermore, two crops cycles were studied in each plot. The results for a nine year period confirmed that Siberian Elm is a fast-growing woody species, adapted to the harsh climate of Soria: cold winters, frosts, and wind. It is also resistant to pests and diseases since no pesticide treatment has been carried out. Siberian Elm prefers well-drained soils, although it also tolerates a wide variety of adverse conditions, such as soils with low organic matter content and flooding situations. Yield was strongly influenced by the amount of irrigation water applied, planting densities and crop cycle. Maximum yields were obtained with planting densities of 6,666 and 3,333 trees/ha cropped every 3 and 4 years, respectively. The yield ranged between 4 - 7.5 t/ha. The composition of the biomass was: ash content 3.0%, 48.0% C, 6.0% H, 0.5% N and Gross Calorific Value (GCV) of 19.2 MJ/kg.
Short title in native language	Ensayo de campo a largo plazo con olmo siberiano en España

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	El olmo de Siberia (Ulmus pumila L.) es una especie de rápido crecimiento, con mayor resistencia a plagas y enfermedades que otras especies del género Ulmus. Es tolerante a la sequía, se adapta a diferentes condiciones ambientales y tiene alta capacidad de rebrote, pudiendo utilizarse como cultivo energético o industrial en corta rotación. Se establecieron dos parcelas de olmo de Siberia en tierras marginales de la Provincia de Soria en distintas fechas: noviembre de 2009 y abril de 2010. Los factores de marginalidad en ambas parcelas son debidos a las bajas temperaturas y las condiciones del suelo (textura, pedregosidad, materia orgánica). En la parcela establecida en 2009 se estudiaron dos densidades (3.333 y 6.666 plantas/ha) y dos regímenes hídricos (2000 y 4000 m3/ha), mientras que en la parcela establecida en 2010 se ensayó una densidad de 3.333 plantas/ha en secano. Además, en cada parcela se estudiaron dos turnos de corta, cada 3 y 4 años. Los resultados obtenidos en los 9 años de crecimiento muestran que el olmo es una especie de rápido crecimiento, adaptado al clima duro de Soria: inviernos fríos, heladas y viento. Es una especie resistente a plagas y enfermedades ya que no ha sido necesario aplicar tratamientos fitosanitarios. Aunque prefiere suelos bien drenados, tolera situaciones de encharcamiento puntuales o baja materia orgánica. Los rendimientos de biomasa dependieron de la cantidad de riego aplicada, la densidad de plantación y el ciclo de cultivo, obteniéndose las mayores producciones con densidades de 6.666 plantas/ha en ciclos de 3 años y 3.333 plantas/ha en ciclo de 4 años. El rendimiento de biomasa varió entre 4-7,5 t/ha. La composición de la biomasa fue: cenizas 3,0 %; C 48,0 %; H 6,0 %; N 0,5 %; PCS 19,2 MJ/kg.

Practice "abstract" 15:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in English

Tall Wheatgrass long-term field trial in Spain

Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English*

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

Perennial grasses have been envisaged by the scientific community as an interesting group of plant species for the sustainable production of biomass in marginal land in terms of crop diversification, improved control of soil erosion and recovery of soil organic matter content. Compared with annual grain crops, perennial biomass crops require fewer inputs, produce more energy and reduce Greenhouse Gas (GHG) emissions than annual cropping systems.
In 2010 and 2013, field trials with Tall Wheatgrass were carried out in two marginal lands in Soria province (North-Central Spain). The marginality factors were climate (low temperature) and soil (texture, stoniness, organic matter). In 2010 Elytrigia elongata Alkar was studied as single crop and mixed with other annual and perennial species. In 2013 three Elytrigia elongata cultivars: Alkar, Szarvasi-1 and Bamar were established on a parcel.
The results obtained in an eight year period showed that Tall Wheatgrass is a species well adapted to the hard climate conditions of Soria with a high tolerance to drought. Moreover, it is a crop resistant to pests and diseases since no pesticide treatment has been carried out.
Tall Wheatgrass prefers well-drained soils, although it tolerates a wide variety of adverse conditions, such as soils with low organic matter content and moderate salinity. However, flooding situations should be avoided.
Yields were between 2 and 5 t/ha. Elytrigia elongata Alkar produced the most yield when planted as single crop. Elytrigia elongata Szarvasi-1 produced the most yield.
The composition of the biomass was: ash content 5.2%, 46.0% C, 6.1% H, 0.6% N and Gross Calorific Value (GCV) of 18.5 MJ/kg.

Short title in native language	Ensayo de campo a largo plazo con agropiro en España
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Las gramíneas perennes representan un grupo de interés para la producción sostenible de biomasa en tierras marginales, tanto en términos de diversificación de cultivos como para el control de la erosión y la mejora del contenido de materia orgánica del suelo. En comparación con los cultivos anuales, los cultivos perennes requieren menos insumos, gastan menos energía y reducen las emisiones de gases de efecto invernadero. Se establecieron dos parcelas de agropiro en tierras marginales de la Provincia de Soria en años distintos: 2010 y 2013. Los factores de marginalidad en ambas parcelas son debidos a las bajas temperaturas y las condiciones del suelo (textura, pedregosidad, materia orgánica). En la parcela establecida en 2010 se estudió Agropiro (Elytrigia elongata Alkar) como cultivo solo y mezclado con otras especies anuales y perennes. En la parcela establecida en 2013, se ensayaron tres cultivares de Elytrigia elongata: Alkar, Szarvasi-1 y Bamar. Los resultados obtenidos en los 8 años de crecimiento muestran que el agropiro es una especie bien adaptada a las duras condiciones climáticas de Soria, con alta tolerancia a la sequía. Además, el cultivo es resistente a plagas y enfermedades, ya que no ha sido necesario llevar a cabo tratamientos fitosanitarios. Tolera situaciones de baja materia orgánica y moderada salinidad, debiendo evitarse el encharcamiento del suelo. Los rendimientos de la biomasa estuvieron entre 2-5 t/ha. Elytrigia elongata Alkar produjo el mayor rendimiento cuando se sembró sin mezclar en 2010. En el estudio comparativo sembrado en 2013, Elytrigia elongata Szarvsi-1 produjo el mayor rendimiento. La composición de biomasa fue: cenizas 5,2 %; C 46,0 %; H 6,1 %; N 0,6 %; PCS 18,5 MJ/kg.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 16:

Short title in English	Switchgrass long-term field trial in Spain

Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English*

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

As Tall Wheatgrass, Switchgrass is a perennial grass that offers similar advantages.
Switchgrass (Panicum virgatum L.) is a warm season C4 grass propagated by seeds. Since the early 1990's the crop has been developed as an herbaceous energy crop for ethanol and electricity production.
In 2013 trials were carried out in Badajoz Province (South-Western Spain) under irrigation conditions. Cultivar used was Alamo. The aim of this work was to investigate the optimal dose of seeds. Two treatments were tested: 12 and 20 kg/ha, and minimum tillage conditions. The volume of water applied was 3,700 m3/ha.
The results showed that it is a species adapted to sandy-loam soil and acidic pH of 6.6. In Spain, irrigation was necessary in order to ensure the good establishment and high biomass yields as well.
In this case, higher doses of seeds resulted in higher productions, showing yields between 10 and 17 t/ha.
The composition of the biomass was: ash content 5.1%, 46.2% C, 5.9% H, 0.53% N and Gross Calorific Value (GCV) of 18.6 MJ/kg.

Short title in native language	Ensayo de campo a largo plazo con switchgrass en España

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

El switchgrass (Panicum virgatum L.) en una gramínea perenne con ventajas similares a las del agropiro.
Se trata de una especie C4 de clima cálido propagada por semillas. Desde principios de 1990 ha sido estudiada como cultivo energético herbáceo para producción de electricidad y para etanol.
Los ensayos empezaron en 2013 bajo condiciones de riego en la provincia de Badajoz (Sureste de España). El cultivar ensayado fue Álamo. El objetivo del ensayo fue investigar la dosis óptima de siembra. Para ello, se ensayaron dos dosis: 12 y 20 kg/ha, en condiciones de mínimo laboreo. El volumen medio de agua aplicada durante los años de ensayo fue de 3.700 m3/ha.
Los resultados muestran que es una especie adaptada a suelo franco-arenoso y pH acido de 6,6. En las condiciones de España, debe garantizarse el regadío tanto para asegurar un buen establecimiento del cultivo como para lograr altos rendimientos de biomasa.
Los resultados muestran que las producciones de biomasa están relacionadas con la dosis de siembra, implicando mayores dosis un incremento de las producciones. Los rendimientos de biomasa estuvieron entre 10-17 t/ha.
La composición de la biomasa fue: contenido de cenizas 5,1 %; carbono 46,2 %; hidrógeno 5,9 %; nitrógeno 0,53 %; poder calorífico superior 18,6 MJ/kg.

Practice "abstract" 17:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Growing miscanthus on marginal lands in Ukraine
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Miscanthus can grow on soils with the following types of marginality: acidic, saline, chemically contaminated, poor in organic matter, unfavourable soil structure, and steep slopes. On soils with a low content of organic matter, the productivity of miscanthus significantly depends on the type and amount of fertilizer applied. Therefore, fertilization should be carried out taking into account the actual removal of nutrients with the harvest. Growing miscanthus on poor soils for seven years allows increasing the content of organic matter in the arable soil layer by 0.37%. There is also a positive effect of counteracting water erosion of the soil when grown on steep slopes. On acidic and saline soils, it is necessary to amend the soil with lime or gypsum ameliorants before planting in doses necessary for deoxidation of the root layer of the soil. Variation of planting depth within 8−16 cm does not affect the growth, development, and productivity of plants. Therefore, in regions with cold and snowless winters, it is recommended to plant the rhizomes deeper. Planting rhizomes in the ridges is not recommended due to the freezing of the soil. High-quality biomass can be obtained with the aid of foliar feeding with a complex of microelements. This minimizes the accumulation of heavy metals in biomass on chemically contaminated soils. Treatment of miscanthus plants in the first and second years with humic products can improve plant adaptation to adverse growing conditions. On soils with unstable soil moisture, at planting, it is recommended to apply moisture-retaining hydrogel in the root-containing layer of the soil or in the planting hole at the rate of 150-300 kg/ha.

Short title in native language	Вирощування міскантусу на маргінальних землях в Україні
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Міскантус можна вирощувати на ґрунтах з такими видами маргінальності: кислі, засолені, хімічно забруднені, бідні на органічні речовини, кам'янисті, з несприятливою структурою, розташовані на крутих схилах. На ґрунтах із низьким вмістом органічних речовин продуктивність міскантусу значно залежить від виду й кількості внесених добрив. Тому удобрення потрібно проводити з урахуванням фактичного виносу поживних речовин із урожаєм. Вирощування міскантусу на бідних ґрунтах протягом семи років дозволяє збільшити вміст органічних речовин в орному шарі ґрунту на 0,37 %. Також спостерігається позитивний ефект протидії водній ерозії ґрунту за вирощування на крутих схилах. На кислих і солонцюватих ґрунтах перед закладанням плантації варто вносити, відповідно, вапняні або гіпсові меліоранти в дозах, необхідних для розкислення кореневмісного шару ґрунту. Варіювання глибини садіння ризом міскантусу в межах 8−16 см не впливає на ріст, розвиток і продуктивністю рослин. Тому, в регіонах з холодними й малосніжними зимами рекомендовано садити ризоми глибше. Висаджування рослин у гребені не бажане через промерзання ґрунту. Біомасу високої якості можна отримати, якщо проводити позакореневе підживлення комплексом мікроелементів. Це дозволяє мінімізувати накопичення в біомасі важких металів на хімічно забруднених ґрунтах. Обробка рослин міскантусу в перший і другий роки вегетації гуматами дозволяє покращити адаптацію рослин до несприятливих умов вирощування. На ґрунтах з нестійким вологозабезпеченням при закладанні плантації рекомендується вносити в кореневмісний шар ґрунту або в лунку вологоутримувач-гідрогель з розрахунку 150−300 кг/га.

Practice "abstract" 18:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in English	Growing energy willow on marginal lands in Ukraine
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	In Ukraine, optimal conditions for willow growth exist in regions with an annual rainfall of at least 650 mm and groundwater in July at a depth of 0.6-2.0 m. Such places include floodplains, gullies, and ravines, where the following soil marginality types occur: hard clay soil, flood land, acid soil, saline soil, and peatland. Growing willow on acid soils (pH < 5.0) is associated with the risk of release of mobile aluminum and manganese, which is manifested in the inhibition of root development, metabolic disorder, and, consequently, growth retardation. Therefore, such soils should be amended with lime ameliorants before planting in doses necessary for deoxidation of the root layer of the soil. Gypsum should be applied on saline soils (chestnut and light chestnut soils). To control weeds effectively in the first years of growing one can mulch the soil with straw or sawdust, cover the soil with agrotextile, or mechanically destruct weeds using mulchers of plant residues. On hard clay soils (clay content ≥ 50%) when planting, it is necessary to carry out ripping with ripper-cultivators to a depth of 45-50 cm at an interval of 140 cm. When soil crust occurs, it is necessary to carry out interrow loosening. Treatment of willow cuttings before planting with humic products along with foliar fertilization in the first year can improve the survival and adaptation of plants to adverse growing conditions.
Short title in native language	Вирощування енергетичної верби на маргінальних землях в Україні

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

В Україні оптимальні умови для росту верби існують у регіонах з річною кількістю опадів не менше 650 мм і заляганням ґрунтових вод у липні на глибині 0,6–2,0 м. До таких місць відносяться заплави річок, балки і яри, де зустрічаються такі види маргінальності ґрунтів: ґрунти з високим вмістом глини, запливаючі, кислі, торфовища, рідше – солончаки.
Вирощування верби на кислих ґрунтах (pH < 5,0) пов'язане з ризиком вивільнення рухомих форм алюмінію й марганцю, що виявляється у пригніченні розвитку кореневої системи, порушенні обміну речовин і, як наслідок, сповільненні росту. Тому, такі ґрунти, перед закладанням плантації, необхідно розкислювати шляхом внесення вапняних меліорантів у дозах, необхідних для розкислення кореневмісного шару ґрунту. На солонцюватих ґрунтах (каштанові і світло каштанові) слід вносити гіпс.
Для ефективної боротьби з бур'янами в перші роки експлуатації плантації слід застосовувати мульчування ґрунту соломою або тирсою, агроволокно, або ж механічне знищення з використанням мульчувачів рослинних решток.
На важких глинистих ґрунтах (вміст глини ≥ 50%) при закладанні плантацій потрібно проводити щілювання культиваторами-щілювачами на глибину 45−50 см з інтервалом 140 см. При утворенні ґрунтової кірки необхідно проводити міжрядні розпушування.
Обробка живців верби перед садінням добривами на основі гуматів і позакореневе підживлення ними в перший рік вегетації дозволяють покращити приживання й адаптацію рослин до несприятливих умов вирощування.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 19:

Short title in English	Growing switchgrass on marginal lands in Ukraine
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Switchgrass is well adapted to the main agro-ecological zones of Ukraine. Therefore it can be grown on such types of marginal land as acidic, saline, chemically contaminated, with low organic matter content, stony, with unfavourable soil texture, steep slopes. In the first vegetation year, the crop suffers greatly from weeds. Therefore, it is recommended to sow switchgrass together with a marker crop (white mustard, 1−2 kg/ha) followed by loosening after the emergence of seedlings of the marker crop and, if necessary, 2−3 loosening after the emergence of switchgrass plants. Appropriate herbicides should also be used if the crops are severely affected by dicotyledonous weeds. In early August, in order to increase tillering and rooting of plants, mowing the plants to a height of 5−7 cm is recommended. In the second and subsequent years of vegetation, the crop itself effectively fights weeds providing that plant density is, at least, 200 plants/m^2. On acidic and saline soils, pre-planting application of lime or gypsum in the doses necessary for deoxidation of the root layer of the soil is highly recommended, as the soil pH < 5.5 sharply increases the availability of aluminum and manganese to plants. These elements are easily accumulated by the plants, which impairs the quality of biofuels. Switchgrass is a quite new crop to Ukraine; therefore it has no specific pests and diseases.

Short title in native language	Вирощування світчграсу на маргінальних землях в Україні
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Просо прутоподібне добре адаптоване до основних агроекологічних зон України, тому його можна вирощувати на таких типах маргінальних ділянок як кислі, засолені, хімічно забруднені, бідні на органічну речовину, кам'янисті, та з несприятливою текстурою ґрунту, розташовані на крутих схилах. У перший рік вегетації культура досить сильно страждає від бур'янів, а тому виправданою є сівба з маячною культурою (гірчиця біла 1−2кг/га) з наступним розпушуванням міжрядь після появи сходів маячної культури і, за потреби, 2−3 посходовими розпушуваннями міжрядь. За значного забур'янення дводольними видами бур'янів доцільно також застосовувати відповідні гербіциди. В першій декаді серпня, задля збільшення кущення й укорінення рослин, практикуються підкошування вегетативної маси проса прутоподібного на висоту 5−7 см. На 2-й і наступні роки вегетації культура сама ефективно бореться з бур'янами за умов густоти не менше 200 стебел на м2. На кислих і засолених ґрунтах, перед закладанням плантації, варто застосовувати вапняні або гіпсові меліоранти в дозах, необхідних для розкислення кореневмісного шару ґрунту. Адже за зниження pH нижче 5,5 різко підвищується доступність рослинам алюмінію та марганцю. А ці елементи легко поглинаються і накопичуються в рослині, а потім – опиняються в твердому біопаливі, чим погіршують його якісні характеристики. Завдяки тому що просо прутоподібне культура досить нова для України специфічних хвороб та шкідників немає.

Practice "abstract" 20:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in English

Growing hemp on marginal lands in Ukraine

Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English*

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

In Ukraine, the optimal conditions for growing hemp are provided in the Forest-Steppe zone, where the average annual rainfall ranges from 540 to 650 mm. High temperatures of the Steppe zone, insufficient temperatures, and excessive rainfall of Polissia zone are unfavourable for hemp. It can be grown on marginal land with acidity, chemical contamination, and low organic matter content. If soil pH < 5.5, it is highly recommended to apply lime or gypsum in the doses necessary for deoxidation of the root layer of the soil.

Fibre in hemp is accumulated in the bark of the stem. That is why the value of hemp biomass directly depends on the thickness and height of stems: the larger the stem, the higher the yield, the more fibre and cellulose it contains. Therefore, the optimal plant density (40−45 plants/m^2) is key for the formation of a good yield.

Ploughing and seedbed preparation to a depth of 6−8 cm with cultivator ensure better results than mini-till. Both mechanical (pre-emergence harrowing on 3rd – 4th day + post-emergence harrowing, if needed) and chemical (Dual Gold 1.6 l/ha, applied before emergence) weed control methods ensure good yield results.

The high efficiency of growing hemp will be ensured with a wide-row planting on the background of fertilizers N120P90K90 (kg a.i./ha), which can ensure a stem yield of 4.02 t/ha and seed yield of 0.91 t/ha. This is a fairly high seed yield obtained on acid soils with low organic matter content due to the use of a balanced composition of nutrients.

Due to the immunity of hemp (to diseases and pests), it can withstand even the conditions of monocropping. When growing hemp to obtain green fibre, harvesting is recommended in the stage of technical maturity in order to perform timely ploughing for the following year.

Short title in native language	Вирощування конопель на маргінальних землях в Україні

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

В Україні, оптимальні умови для росту конопель існують в Лісостеповому регіоні країни, де середня кількість опадів за рік становить від 540 до 650 мм. Високі температури у Степовому регіоні, недостатня сума температур і надмірна кількість опадів у Поліссі несприятливі для культури. Коноплі можна вирощувати на таких типах маргінальних ґрунтів як кислі, хімічно забруднені, бідні на органічну речовину. У разі коли pH ґрунту нижче 5.5, перед закладанням плантації, варто застосовувати вапняні або гіпсові меліоранти в дозах.
Волокно в коноплях знаходиться у корі стебла тому цінність біомаси безпосередньо залежить від товщини й висоти стебла: чим крупніше стебло тим вища врожайність, тим більше в ньому волокна, а відповідно й целюлози. Тому для формування гарного врожаю слід забезпечити оптимальну густоту стеблостою 40−45 шт./м2.
Оранка й передпосівна підготовка на глибину 6−8 см забезпечує кращі результати, ніж мінімальний обробіток ґрунту. Однаково ефективні як механічні (досходове боронування на 3–4 день + післясходове у разі потреби) так і хімічні (Дуал Голд 1,6 л/га, досходове застосування) методи боротьби з бур'янами.
Доведена висока ефективність вирощування конопель широкорядним способом на фоні удобрення N120P90K90 (кг д.р./га), що може забезпечити урожай стебел 4,02 т/га і насіння 0,91 т/га. Це досить висока продуктивність, отримана на малозабезпечених кислих ґрунтах завдяки застосуванню збалансованого складу елементів живлення.
Завдяки імунітету (до хвороб і шкідників) рослини конопель добре витримують умови монокультури. При вирощуванні конопель на зеленець-волокно, збирання рекомендовано проводити у фазі технічної стиглості конопель з метою проведення своєчасної оранки під посів наступного року.

Practice "abstract" 21:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	No-till covercrop in Miscanthus x giganteus establishment year, France
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Miscanthus x giganteus (MxG) is a perennial plant that has seen a strong development in France over the last 15 years. It's benefits are multiple, but can be summarised as: low inputs and high yields. Miscanthus does not require herbicide, except during its first year. A trial was developed to see if a cover crop could further reduce herbicide use by suppressing winter weeds without affecting miscanthus growth. To do this, 6 differents mixes of covercrops were sown in a 5 month old MxG plantation measuring up to 150cm in september 2019. A no-till disc drill was used to sow. MxG stems were slightly affected, but straightened back up after sowing. The results: Clover was too slow to establish due to a dry september and was not able to suppress ray grass. The covercrop mixtures including flax showed very good results. Also daikon radish, mustard and phacelia proved to establish quick enough to suppress winter weeds in a sufficient manner. However, daikon radish overgrew MxG in spring time and should be destroyed (FACA roller) before next year. Lastly, biodiversity increased; a lot of insects and mammals were observed. To conclude: Covercrops can be an efficient way to manage weeds in a first year MxG planting, depending on weather conditions during sowing.
Short title in native language	Couvert végétal dans un miscanthus de premiere année

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

Le Miscanthus x giganteus (MxG) est une plante vivace qui connaît un fort développement en France depuis 15 ans. Ses avantages sont multiples, mais peuvent se résumer ainsi : faibles intrants et rendements élevés. Le miscanthus ne nécessite pas d'herbicide, sauf pendant sa première année. Nous avons développé un essai pour voir si une couvert végétale pouvait réduire davantage l'utilisation d'herbicides en supprimant les mauvaises herbes d'hiver sans affecter la croissance du miscanthus. Pour ce faire, 6 mélanges différents de cultures de couverture ont été semés dans une plantation MxG âgée de 5 mois mesurant jusqu'à 150cm en septembre 2019. Nous avons utilisé un semoir à disques pour semer. Les tiges MxG ont été légèrement affectées, mais se sont redressées après le semis. Les résultats : Le trèfle a été trop lent à s'établir en raison d'un mois de septembre sec et n'a pas pu supprimer le raygrass venu de la bordure. Les mélanges de cultures de couverture comprenant du lin ont donné de très bons résultats. Le radis daikon, la moutarde et la phacélie se sont également avérés s'établir assez rapidement pour supprimer les mauvaises herbes d'hiver de manière suffisante. Cependant, le radis daikon a envahi MxG au printemps et devrait être détruit (rouleau FACA) avant le printemps prochaine. Enfin, la biodiversité a augmenté ; beaucoup d'insectes et de mammifères ont été observés. Pour conclure : les cultures de couverture peuvent être un moyen efficace dans la gestion des mauvaises herbes dans une plantation MxG de première année, en fonction des conditions météorologiques lors du semis.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 22:

Short title in English	Miscanthus cultivation on marginal soils in France with low inputs

Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English*

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

The Loire river valley in France has very sandy soils that are often abandoned when irrigation is not possible. Miscanthus x giganteus (MxG) is a drought restistant plant that creates possibilities due to its perennial character, which allows it to establish over time and seek water where annuals cannot grow. No inputs are requiered. No fertilizers, and no herbicides after year 1. For MxG to be a success, establishment is crucial. Therefore, a trial was developed to see if MxG could be established in these sandy soils without irrigation, fertilizer, pesticides and herbicides in Mezieres lez Cléry on 1 hectare of sandy soil. 50% was rainfed, 50% irrigated. 50% of the weeds were mechanically destroyed, 50% chemically destroyed. No pesticides were used against wireworms (MxG's only establishment predator), and half of the fields had potatoes added to the interrow to distract wireworms from attacking. After maintaining these conditions over 2 years, the following results were found: The wireworm population was not strong enough to show a significant difference. The MxG establishment rates in irrigated, herbicide were highest (67,5%) and lowest in the rainfed, mechanically weeded part (42,5%). However, irrigation in the first year of MxG establishment, can compensate the dry out effect of mechanical weeding in the sandy soil (52% est.), 50 % establishment is the minimum to have 10,000 plant/ha. This trial shows that MxG can be established in sandy soils. No herbicide, no fertilizers, and only mechanical weeding in the first year is needed to establish MxG on these marginal soils. Also, instead of using a row crop cultivator, a sprint tine harrow should be used: it reduces water evaporation and is still efficient enough to destroy weeds when they're small.

Short title in native language	Culture du miscanthus sur des sols marginaux en France avec de faibles intrants
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	La vallée de la Loire en France a des sols sablonneux qui sont abandonnés lorsque l'irrigation n'est pas possible. Le Miscanthus x giganteus (MxG) est une plante plus résistante à la sécheresse qui crée des possibilités grâce à son caractère pérenne qui lui permet de s'établir dans le temps et de chercher l'eau là où les annuelles ne peuvent pas pousser. Aucun intrant n'est nécessaire. Pas d'engrais, pas d'herbicides après la première année. Pour MxG l'établissement est crucial. Donc nous avons développé un essai pour voir si nous pouvons établir MxG dans ces sols sablonneux sans irrigation, engrais, pesticides et herbicides à Mezieres lez Cléry sur 1 hectare. 50 % était en pluvial, 50 % en irrigué. 50 % des mauvaises herbes étaient détruites mécaniquement, 50 % seraient détruites chimiquement. Aucun pesticide n'a été utilisé contre le taupin et dans la moitié des champs, des pommes de terre ont été ajoutées dans l'inter-rang comme appât. Après avoir maintenu ces conditions pendant 2 ans, voici les résultats: La population de taupins n'était pas assez forte pour montrer une différence significative. Les taux de survie de MxG en irrigué, herbicide étaient les plus élevés (67,5%) et les plus bas dans la partie pluviale, désherbée mécaniquement (42,5%). Cependant l'irrigation dans la première année d'établissement de MxG, peut compenser l'effet de dessèchement du désherbage mécanique dans le sol sablonneux (52% est.). 50 % de survie est le minimum pour avoir 10,000 plantes/ha. Ces essais montrent que nous pouvons établir MxG dans des sols sablonneux sans intrants. Au lieu d'utiliser un cultivateur en ligne, utiliser une herse étrille, qui réduit l'évaporation de l'eau et est efficace pour détruire les mauvaises herbes lorsqu'elles sont petites.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 23:

Short title in English	Boosting miscanthus on marginal land in France
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Miscanthus x giganteus (MxG) is a perennial plant that has seen a strong development in France over the last 15 years. It has been implanted in France on all latitudes, and adapts well to different soil and climate conditions. However, on marginal lands, rare cases of lowering yields were observed. This trial was created to define the factors that can cause this phenomenon. To do so, soil and plant matter analyses were done to expose any deficiencies. The apparently missing elements were then added by the means of fertilizers. In 2019 Urea was applied on 2 10x10m squares. In 2020 N, P, K, Mg and Zn were applied in strips, next to a control strip. The results show that Miscanthus x Giganteus responded very well to N-rich fertilizers. A dark green colour was observed on the leaves, as well as an increase in stem height by 29,4%. What was most interesting, is that the effects were again clearly visible in the second year, without receiving a second application of N. This led to conclude that in some cases, a one-time N-rich fertilizers application can boost Miscanthus yield to increase to regular standards again.
Short title in native language	Renforcer un Miscanthus sur terre marginale

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Le Miscanthus x giganteus (MxG) est une plante vivace qui connaît un fort développement en France depuis 15 ans. Implanté en France sous toutes les latitudes, il s'adapte bien aux différentes conditions pédoclimatiques. Cependant, sur les terres marginales, nous avons observé des cas rares de diminution des rendements. L'essai que nous avons développé a été créé pour définir les facteurs qui peuvent provoquer ce phénomène. Pour ce faire, des analyses de sol et de matière végétale ont été effectuées pour mettre en évidence les éventuelles carences. Les éléments apparemment manquants ont ensuite été ajoutés au moyen d'engrais. En 2019, l'urée a été appliquée sur 2 carrés de 10x10m. En 2020, N, P, K, Mg et Zn ont été appliqués en bandes, à côté d'une bande de contrôle. Les résultats montrent que Miscanthus x Giganteus a très bien réagi aux engrais riches en N. Une coloration vert foncé a été observée sur les feuilles, ainsi qu'une augmentation de la hauteur de la tige de 29,4%. Ce qui était le plus intéressant, c'est que les effets étaient à nouveau clairement visibles la 2ème année, sans recevoir une 2ème application de N. Ceci nous amène à conclure que dans certains cas, une application unique d'engrais riches en N peut relancer un Miscanthus et obtenir des rendements habituels.

Practice "abstract" 24:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in English	Castor experimental field in Volos, Greece
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	In 2021 an experimental field in Volos, Greece, was established to test the effects of three terminating products: Glyphosate GLY 6 l ha^{-1} applied 20 days before harvesting; DEF Spotlight© BASF (carfentrazone-ethyl) 6 l ha^{-1} 20 days before harvesting and Diquat at 5 l ha^{-1} 10 days before harvesting. Residual moisture, seed loss and effects on the direct combine harvesting were recorded and compared with Control plants. Seeds of dwarf cultivar C 1012 were provided by KAIIMA, they were sown in April 2021 on a marginal field and the same day a fertilization with 270 kg ha^{-1} of fertilizer NPK 21-17-3 was carried out. Row spacing was 50 cm x 75 cm and weed management was performed mechanically after germination. The combine harvester used was a New Holland mod. CX 780 equipped with a New Holland cereal header Type 17V 5.10 m wide. All other factors, as fan speed, upper sieve and lower sieve clearance of the combine harvester were kept constant, namely: 800 r.p.m., 17 mm and 10 mm opening, respectively. The working speed of the machinery averaged at 2.3 km/h. The effects on seeds loss were assessed as well as the quality of collected seeds. According to the results, DIQ showed a significantly lower moisture content of capsules (7.32%) in comparison to the other treatments, while for plant moisture the lowest values were achieved by both DIQ (62.38%) and GLY (59.12%). Focusing on seed loss, DIQ showed the lowest value for seed loss for natural dehiscence (3.28%) and a very low value of seed loss related to the cleaning shoe of the combine harvester (0.41%).
Short title in native language	Campo sperimentale di ricino a Volos, Grecia

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

Nel 2021 è stato creato un campo sperimentale a Volos, in Grecia, per testare gli effetti di tre prodotti terminanti: Glifosate GLY 6 l ha^{-1} applicato 20 giorni prima del raccolto; DEF SpotlightBASF 6 l ha^{-1} 20 giorni prima del raccolto e Diquat a 5 l ha^{-1} 10 giorni prima del raccolto. L'umidità residua, la perdita di semi e gli effetti sulla raccolta diretta della mietitrebbia sono stati registrati e confrontati con le piante di controllo. I semi della cultivar nana C1012 sono stati forniti da KAIIMA, sono stati seminati in aprile 2021 su un campo marginale e lo stesso giorno è stata effettuata una concimazione con 270kg ha^{-1} di fertilizzante NPK 21-17-3. La spaziatura delle file era di 50x75cm e la gestione delle infestanti è stata eseguita meccanicamente dopo la germinazione. La mietitrebbia utilizzata era una New Holland mod. CX780 equipaggiata con una testata per cereali New Holland tipo 17V larga 5,10m. Tutti gli altri fattori, come la velocità della ventola, la distanza dal setaccio superiore e inferiore della mietitrebbia sono stati mantenuti costanti, vale a dire: 800r.p.m., 17mm e 1 mm di apertura, rispettivamente. La velocità di lavoro della macchina è stata in media di 2,3km/h. Sono stati valutati gli effetti sulla perdita di semi e la qualità dei semi raccolti. Secondo i risultati, DIQ ha mostrato un contenuto di umidità delle capsule significativamente più basso(7,32%) rispetto agli altri trattamenti, mentre per l'umidità della pianta i valori più bassi sono stati raggiunti sia da DIQ(62,38%) che da GLY(59,12%). Concentrandosi sulla perdita di semi, DIQ ha mostrato il valore più basso di perdita di semi per deiscenza naturale(3,28%) e un valore molto basso di perdita di semi legato alla scarpa di pulizia della mietitrebbia(0,41%).

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 25:

Short title in English	Castor experimental field in Greece
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	In 2021 an experimental field in Xanthi, Greece, was established to test the performance of direct combining harvesting castor beans (Ricinus communis L.) grown on marginal land. Seeds of dwarf cultivar C 1012 were provided by KAIIMA, they were sown in April 2021 and on the same day a first fertilization with 270 kg ha^{-1} of fertilizer NPK 21-17-3 was carried out. Row spacing was 50 cm x 100 cm Weed management was performed by applying 4.0 kg ha^{-1} of Stomp (BASF, Ludwigshafen, Germany) after emergence. The crop was terminated 10 days before harvesting via the application of 6.0 l ha^{-1} of Reglone 20 SL (Syngenta, Basel, Switzerland). Before harvesting plants measured 78 cm in height on average, the potential seed yield (PSY) was 2 t d.m. ha^{-1} , seed and plant moisture were 4.1 % and 80.7% on average respectively. The mechanical harvesting was performed with Combine harvester New Holland CX8060 equipped with cereal header and a sunflower header. The average working speed of the combine harvester was 2.3 km h-1, corresponding to an Effective Field Capacity of 1.03 ha h-1, with a fuel consumption of 21.27 l h-1.Seeds loss and performance and were evaluated in both cases. Seed loss due to the impact accounted for 14% and 8% in dry matter of PSY in cereal and sunflower header, respectively. On the other hand, the two headers did not affect the seed loss due to the cleaning system which was estimated ranging between 7 and 8% of PSY.
Short title in native language	Campo sperimentale di ricino in Grecia

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

Nel 2021 è stato istituito un campo sperimentale a Xanthi, in Grecia, per testare le prestazioni della raccolta diretta dei semi di ricino (Ricinus communis L.) coltivati su terreni marginali. I semi della cultivar nana C 1012 sono stati forniti da KAIIMA, sono stati seminati nell'aprile 2021 e lo stesso giorno è stata effettuata una prima concimazione con 270 kg ha^{-1} di fertilizzante NPK 21-17-3. La distanza tra le file era di 50 cm x 100 cm La gestione delle infestanti è stata eseguita applicando 4,0 kg ha^{-1} di Stomp (BASF, Ludwigshafen, Germania) dopo l'emergenza. La coltura è stata interrotta 10 giorni prima della raccolta mediante l'applicazione di 6,0 l ha^{-1} di Reglone 20 SL (Syngenta, Basilea, Svizzera). Prima della raccolta, le piante misuravano in media 78 cm di altezza, la resa potenziale in semi (PSY) era di 2 t d.m. ha-1, l'umidità del seme e della pianta era rispettivamente del 4,1% e dell'80,7%. La raccolta meccanica è stata eseguita con mietitrebbia New Holland CX8060 dotata di testata cereali e testata girasole. La velocità media di lavoro della mietitrebbia è stata di 2,3 km h^{-1}, corrispondente ad una capacità effettiva di campo di 1,03 ha h^{-1}, con un consumo di carburante di 21,27 l h-1. Perdita di semi e prestazioni valutate in entrambi i casi. La perdita di semi a causa dell'impatto ha rappresentato rispettivamente il 14% e l'8% sulla sostanza secca di PSY nella testata di cereali e girasole. Le due testate, invece, non hanno influito sulla perdita di seme dovuta al sistema di pulizia che è stata stimata compresa tra il 7 e l'8% di PSY.

Practice "abstract" 26:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Wild Sugar Cane on marginal lands affected by drought in southern Italy
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Mediterranean climates are characterized by long periods of drought during summer and short dry periods from autumn to spring, what limits plant CO2 assimilation and biomass production to a great extent. More limiting scenarios are forecasted due to climate change in the coming years in the Mediterranean basin. Under these circumstances, plants with excellent adaptation are needed. Perennial crops, and grasses in particular, have proved to be more efficient than annual crops for biomass production for several environmental and economic reasons. The Joint Research Centre (JRC) has set thresholds to define marginal lands in terms of biophysical constraints. In this case, climate limitation given by the ratio between precipitations and potential evapotranspiration (P/ET) was focused. Areas with P/ET ≤0.60 are classified as affected by dryness. The study follows up a long-term plantation of the C4 perennial grass wild sugarcane (Saccharum spontaneum ssp. aegypticum) under different water regimes in a semi-arid environment. The species were established at the experimental farm of the University of Catania in 2005 by using rhizome cuttings. Biomass dry matter yield was significantly affected by irrigation treatment and meteorological conditions of the growing season (mainly precipitation amount and distribution) with yield values ranging between 29.9 and 37.1 t/ha in full-irrigation, between 24.5 and 32.0 t/ha in half-irrigation and between 19.1 and 27.4 t/ha in rainfed conditions. Wild Sugar Cane is well adapted to environments dominated by dryness, and even after 10 years the biomass yield remain quite stable and at very high levels. However, agronomic, energetic, environmental and economic issues need further research.

Short title in native language	La canna d'Egitto in terreni marginali siccitosi
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	I climi mediterranei sono caratterizzati da lunghi periodi di siccità durante l'estate e brevi periodi di siccità dall'autunno alla primavera, il che limita in larga misura l'assimilazione della CO2 e la produzione di biomassa. Scenari più limitanti sono previsti a causa del cambiamento climatico. In queste circostanze, sono necessarie specie in grado di ottimizzare le risorse naturali. Le colture perenni e in particolare le graminacee hanno dimostrato di essere più efficienti delle colture annuali per la produzione di biomassa per diverse ragioni agronomiche ed ambientali. Il JRC ha stabilito una serie di soglie per definire le terre marginali in termini di vincoli biofisici. Il nostro studio focalizza sulla limitazione climatica data dal rapporto tra precipitazioni ed evapotraspirazione potenziale (P/ET ≤0,60). Il presente studio riporta una piantagione di lungo termine della canna d'Egitto (Saccharum spontaneum ssp. aegypticum) in diversi regimi idrici in un ambiente mediterraneo semi-arido. La resa della biomassa è stata significativamente influenzata dal trattamento di irrigazione e dalle condizioni meteorologiche della stagione di crescita (principalmente dalla quantità e distribuzione delle precipitazioni) con valori di resa compresi tra 29,9 e 37,1 t/ha in irrigazione completa, tra 24,5 e 32,0 t/ha in irrigazione ridotta e tra 19,1 e 27,4 t/ha condizioni idriche naturali. La specie si adatta bene agli ambienti dominati dall'aridità, e anche dopo 10 anni dalla piantagione la resa della biomassa rimane abbastanza stabile. Tuttavia, ulteriori ricerche conseguite per altre graminacee perenni (ad esempio, A. donax, Miscanthus spp. P. virgatum, P. arundicnacea, ecc.), devono essere affrontate.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 27:

Short title in English	Camelina slope harvesting in Italy
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Field survey was carried out on marginal soil (steep soil of 15%) to evaluate seed yield of the spring camelina cultivar Alba, supplied by Camelina Company (Spain), and to assess seed loss during direct mechanical harvesting. A large plot trial was established in January 2021 on a surface of about 1000 m^2 at the experimental farm of Bologna University in Ozzano (Bologna). The experimental field is characterized by a slope of about 15% The agronomic management was defined as low input organic. Harvesting was performed with a New Holland TC 5080 self-levelling combine harvester with 6 m working width and conventional cleaning shoe. Seed yield of camelina cultivar Alba reached on average 1.52 t d.m. ha^{-1}. Results of the work performance analysis showed that seed loss was substantially lower than what found in current literature for flat land, i.e. 0.53 %, mostly as a consequence of the lower working speed. Therefore, it is possible to harvest camelina via self-levelling combine harvester also in steep slope conditions, confirming the suitability of such crop to grow on marginal lands.

Short title in native language	Raccolta delle piste di camelina in Italia
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	È stata condotta un'indagine di campo su terreno marginale (terreno ripido del 15%) per valutare la resa in seme della cultivar di camelina Alba, fornita da Camelina Company (Spagna), e per valutare la perdita di seme durante la raccolta meccanica diretta. Un grande appezzamento di prova è stato istituito nel gennaio 2021 su una superficie di circa 1000 m^2 presso l'azienda agricola sperimentale dell'Università di Bologna a Ozzano (Bologna). Il campo sperimentale è caratterizzato da una pendenza di circa il 15% La gestione agronomica è stata definita biologica a basso input. La raccolta è stata eseguita con una mietitrebbia autolivellante New Holland TC 5080 con larghezza di lavoro di 6 m e pattino di pulizia convenzionale. La resa in semi della cultivar di camelina Alba ha raggiunto in media 1,52 t d.m. ha^{-1}. I risultati dell'analisi delle prestazioni lavorative hanno mostrato che la perdita di semi è stata sostanzialmente inferiore a quella riscontrata nella letteratura attuale per i terreni pianeggianti, ovvero 0,53%, principalmente come conseguenza della minore velocità di lavoro. Pertanto, è possibile raccogliere la camelina tramite mietitrebbia autolivellante anche in condizioni di forte pendenza, a conferma dell'idoneità di tale coltura a crescere su terreni marginali.

Practice "abstract" 28:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in English	Arundo and Miscanthus on marginal land affected by dryness in fertilized and unfertilized conditions in southern Italy
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Perennial, non-food grasses have been proposed as the most efficient species for biomass production due to their agronomic, environmental and social benefits. Species characterized by high water use efficiency and low nitrogen requirement, well adapted to use natural resources of a specific environment, can be recommended as ideal crops. Along with irrigation and water savings, nitrogen requirement is a significant issue in intensive agriculture and has a great effect over the energetic balance of crops. Therefore, low input cropping systems could directly mitigate greenhouse gas emissions. In this case long-term plantations of two perennial grasses (Arundo donax and Miscanthus x giganteus), grown in rainfed conditions under two nitrogen regimes, were compared in an environment affected by dryness (according to the thresholds set by the Joint Research Centre (JRC) in terms of ratio between precipitations and potential evapotranspiration (P/ET ≤0.60)). Miscanthus x giganteus and Arundo donax were transplanted in summer 1993 and in spring 1997, respectively. In 2015 (22-year for Miscanthus and 18-year for Arundo), Arundo and Miscanthus (fertilized with 80 kg N ha^{-1}) showed similar yields (11.9 and 10.4 t/ha), while Arundo unfertilized (N0) produced 10 t/ha against 5.3 t/ha of Miscanthus N0. In 2016 (23-year for Miscanthus and 19-year for Arundo) Arundo and Miscanthus N0 produced 10.6 and 6.2 t/ha, while Arundo and Miscanthus N80 attained 15.3 and 8.7 t/ha. In 2017 (24-year for Miscanthus and 20-year for Arundo) a similar trend was observed, Arundo N80 showed the highest yield (14.9 t/ha) followed by Miscanthus N80 (9.7 t/ha), Arundo N0 (8.4 t/ha) and Miscanthus N0 (5.9 t/ha).

Short title in native language	Arundo e Miscanthus in terreni marginali siccitosi in condizioni concimate e non-concimate
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Le graminacee perenni, non alimentari, sono state proposte come le specie più efficienti per la produzione di biomassa grazie all'elevata efficienza dell'uso delle risorse naturali. Le specie caratterizzate da un'elevata efficienza d'uso dell'acqua e un basso fabbisogno di azoto, possono essere raccomandate come colture ideali. Accanto al risparmio di acqua, il fabbisogno di azoto è un problema significativo nell'agricoltura intensiva e influisce notevolmente sull'equilibrio energetico delle colture. Nel presente studio sono state confrontate coltivazioni a lungo termine di due graminacee perenni (Arundo donax e Miscanthus x giganteus) coltivate in condizioni di idriche naturali in due regimi di concimazione azota in un ambiente affetto da siccità (secondo le soglie stabilite dal JRC in termini di rapporto tra precipitazioni ed evapotraspirazione potenziale (P/ET ≤0,60)). Miscanthus e Arundo sono stati trapiantati nell'estate del 1993 e nella primavera del 1997, rispettivamente. Nel 2015 (22 anni per Miscanthus e 18 anni per Arundo), Arundo e Miscanthus (concimati con 80 kg/ha di N) hanno mostrato rese simili (11,9 e 10,4 t/ha), mentre Arundo non concimato (N0) ha prodotto 10 t/ha contro 5,3 t/ha di Miscanthus N0. Nel 2016, Arundo e Miscanthus N0 hanno prodotto 10,6 e 6,2 t/ha, mentre Arundo e Miscanthus N80 hanno ottenuto 15,3 e 8,7 t/ha. Nel 2017 è stata osservata una tendenza simile, Arundo N80 ha mostrato la resa più elevata (14,9 t/ha) seguito da Miscanthus N80 (9,7 t/ha), Arundo N0 (8,4 t/ha) e Miscanthus N0 (5,9 t/ha).

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 29:

Short title in English

Recultivation of peat mining area in Latvia

Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English*

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

An experimental tree plantation was established in peat post-mining area in Latvia. The upper layer of the remaining soil consists of acidic (pHCaCl2 ~3.5) moderately decomposed raised bog peat and is above 50 cm in thickness. Such soil is rich in organic matter and N but lacks essential plant-available nutrients. Therefore, in addition to control plots, wood ash treatment was applied in doses of 5, 10 and 15 t ha^{-1} in three replications. Wood-ash chemical content: K 24.7, Mg 18.2, Ca 120.4, P 6.6 g kg-1. In each replication poplar (Populus tremula) (clone Vesten), birch (Betula pendula), pine (Pinus Syvestris) and alder (Alnus Glutinosa) were planted (1055 trees per hectare). Five years after establishment, survival rate of poplar was the lowest of all species – 0% in control plots, 27, 62 and 57% survival in plots amended with wood ash in doses 5, 10 and 15 t ha^{-1} respectively. On average, after four years, poplar was 112, 331, 452 and 452 cm high under control and 5, 10 and 15 t ha^{-1} wood ash treatments. The results highlight the high nutritional and pH requirements of poplar. Fertilisation and liming is essential to ensure survival of poplar stands in poor post-mining areas, and application of 10 t ha^{-1} wood ash dose is sufficient. The initial growth of pine is rather slow, however it exhibited >98% survival regardless of treatment, thus, proving to be a promising species in poor post-mining conditions. Initially 5 t ha^{-1} treatment was enough to ensure adequate growth and survival, but after five years pine, birch and alder showed best growth parameters (180, 367 and 476 cm, respectively) under 15 t ha^{-1} wood ash treatment compared to control (100, 78 and 154 cm, respectively). The site was established as LIFE Restore project (LIFE14 CCM/LV/001103) demo site.

Short title in native language	Kūdras ieguves vietas rekultivācija
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Eksperimentāls kokaugu stādījums ierīkots bijušajā kūdras ieguves teritorijā. Augsnes virsējās kārtas (>50 cm) veido skāba (pHCaCl2 ~3.5), daļēji sadalījusies augstā purva kūdra. Šādas augsnes ir bagātas ar organiskajām vielām un slāpekli, bet tām trūkst citu svarīgu augiem pieejamo barības elementu. Tādēļ, papildus kontroles variantam, augsne ielabota ar trīs devām koksnes pelnu – 5, 10 un 15 t ha^{-1}. Koksnes pelnu sastāvs: K 24.7, Mg 18.2, Ca 120.4, P 6.6 g kg-1. Visi varianti ierīkoti trīs atkārtojumos, un katrā iestādītas papeles (Populus tremula) (klons Vesten), bērzi (Betula pendula), melnalkšņi (Alnus Glutinosa) un priedes (Pinus Sylvestris) (1055 koki ha^{-1}). Pēc pieciem augšanas gadiem papeles uzrādīja vissliktāko saglabāšanos – 0% kontroles variantā, 27, 62 un 57% variantos, kas ielaboti attiecīgi ar 5, 10 un 15 t ha^{-1} koksnes pelniem. Vidējie papeļu augstumi pēc četriem augšanas gadiem bija 112, 331, 452 un 452 cm kontroles un ar 5, 10 un 15 t ha^{-1} pelnu ielabotajos variantos. Šie rezultāti norāda uz papeļu jutību pret barības vielu trūkumu un augsnes pH. Augsnes ielabošana ir vitāli nepieciešama, lai nodrošinātu papeles izdzīvošanu nabadzīgās augsnēs. Ielabošana ar 10 t ha^{-1} koksnes pelniem ir pietiekama. Kaut arī sākotnējā priedes augšanas gaita ir salīdzinoši lēna, tā ir piemērota audzēšanai nabadzīgos apstākļos, jo visos variantos priežu izdzīvotība bija >98%. Sākotnēji pietiek ar 5 t ha^{-1} koksnes pelnu devu, lai nodrošinātu koku augšanu, tomēr pēc pieciem gadiem vislabākie rādītāji priedei, bērzam un melnalksnim bija izmantojot 15 t ha^{-1} koksnes pelnu devu (attiecīgi 180, 367 un 476 cm) salīdzinājumā ar kontroli (attiecīgi 100, 78 un 154 cm). Stādījums ierīkots LIFE Restore projekta ietvaros (LIFE14 CCM/LV/001103).

Practice "abstract" 30:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Elaboration of innovative White Willow agroforesty systems on marginal mineral soils improved by wood ash and less demanded peat fractions amendments in Latvia
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	The use of industrial by-products as fertilizers helps to reduce the cost of soil improvement and complies with the basic principles of the circular economy. Wood-ash is abundant with potassium and phosphorus which is available to plants. Less demanded peat fractions can be used to diminish the lack of nitrogen and organic matter in poor mineral soils. In addition, in acid soils, wood-ash also acts as a liming agent reducing pH and enhancing nutrient availability to plants. Growing traditional crops in marginal areas is not an economically viable practise, hence, more acceptable is to choose crops with high ecological plasticity. Willow genus and clones are easy to vegetative propagated and used both as a wood resource and as a source of nectar and pollen during flowering. A total of 21 clones including White Willow cuttings and female and male juvenile fast-growing clones were used in study. If male clones are planted, the plantation does not produce seeds and there is no risk of willow seeds spreading from the plantation in the adjacent areas. A mixture of different fractions of peat (0-7; 5-10; 7-20; 20-40 mm) and wood-ash (10; 20; 30% of the fertilizer mixture) was added to the substrate to determine the most efficient mixture for cuttings. During study, several S. alba clones that grow well in poor mineral soils (0218B, 0214W, LVX1, Platonis) were selected. Clone Platonis was selected due to the good morphological traits of the male mother plant (CPVO No. A20210392). Elaboration of innovative White Willow – perennial grass agroforestry systems on marginal mineral soils improved by wood ash and less demanded peat fractions amendments (ERAF Nr.1.1.1.1/19/A/112).

Short title in native language	Inovatīvu Baltā vītola agromežsaimniecības sistēmu ierīkošana ar koksnes pelnu un mazāk pieprasīto kūdras frakciju maisījumiem ielabotās marginālās minerālaugsnēs
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Rūpniecības blakusproduktu izmantošana kā mēslojums palīdz samazināt augsnes ielabošanas izmaksas, kā arī atbilst aprites ekonomikas pamatprincipiem. Koksnes pelni ir bagāti ar augiem pieejamu K un P. Nabadzīgās minerālās augsnēs trūkstošo slāpekli un organiskās vielas var pievienot izmantojot mazāk pieprasītās kūdras frakcijas. Turklāt skābās augsnēs koksnes pelni darbojas arī kā kaļķošanas līdzeklis, optimālāka vides reakcija ir saistīta ar augsnē esošo barības vielu uzņemšanu. Tradicionālo lauksaimniecības kultūru audzēšana marginālos apgabalos nav ekonomiski dzīvotspējīga, alternatīva ir pieticīgas kultūras ar augstu ekoloģisko plastiskums. Vītolu ģints sugas un kloni ir viegli veģetatīvi pavairojami un izmantojami gan kā koksnes resurss, gan ziedēšanas laikā kā nektāraugs un putekšņu avots. Šajā pētījumā kā pētāmo objektu izmantoja vietējās sugas Baltā vītola spraudeņus, tā sievišķos un vīrišķos juvenīli ātraudzīgus klonus, kopā 21 klonu. Ja stāda vīrišķos klonu – audze neveido sēklas un nepastāv risks, ka piegulošajās platībās izplatīsies kārklu sēklas no stādījuma. Substrātam pievienoja dažādu frakciju kūdras (0-7; 5-10; 7-20; 20-40 mm) un koksnes pelnu koncentrācijas (10; 20; 30 % no mēslojuma maisījuma) maisījumu, lai noteiktu efektīvāko maisījumu spraudeņu audzēšanai. Pētījumā atlasīti vairāki S. alba kloni, kas labi aug nabadzīgā mineralaugsnē (0218B, 0214W, LVX1, Platonis). Klons Platonis atlasīts vīrišķā mātesauga labo īpašību dēļ (CPVO Nr. A20210392). (ERAF Nr.1.1.1.1/19/A/112). Inovatīvu Baltā vītola - daudzgadīgo zālaugu agromežsaimniecības sistēmu ierīkošana ar koksnes pelnu un mazāk pieprasīto kūdras frakciju maisījumiem ielabotās marginālās minerālaugsnēs (ERAF Nr.1.1.1.1/19/A/112).

Practice "abstract" 31:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in English	Willow and poplar cultivation on sandy and heavy soil sites in Poland
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Poplar and willow are species grown as short rotation coppices (SRC). These plants are grown mainly on marginal or contaminated soils of poor quality, less suitable for the cultivation of food or feed crops. The aim of the study, located in north-eastern Poland, was to compare the yield of willow and poplar cultivation on sandy and heavy clay soil. The crops were planted in 2018 and the results are from two years of experiment (2019 and 2020).The results show that the survival of both species was satisfactory on light soil (81.3%) and very low on heavy soil (44.4% on average). This low survival rate was the result of unfavorable weather conditions, especially the lack of precipitation in the first year after the cuttings were planted. The yield of fresh biomass of two-year-old poplar plants, was 14.5 t/ha on average and was significantly higher by approx. 2 t/ha than for willow. In turn, the yield of fresh biomass obtained from light soil (22.9 t/ha on average) was over 5 times higher than that obtained from heavy soil. A significant influence of the type of soil on the amount of dry biomass yield was found. The yield of poplar and willow on sandy soil was 5.13 and 5.14 t/ha/year d.m., respectively. On the other hand, on heavy soil, the yield of dry biomass was 6 times lower and amounted to 1.12 and 0.67 t/ha/year d.m, respectively. The correlation analysis showed that the dry matter yield was significantly influenced by plant density, survival, plant height and shoot diameter. In conclusion, willow and poplar can be grown on light soil, achieving satisfactory yield, but it is not recommended to cultivate them on heavy clay soil, because such a site does not provide the appropriate conditions for the cultivation of these species.
Short title in native language	Uprawa wierzby i topoli na glebie piaszczystej i ciężkiej glebie ilastej

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

Topola i wierzba są gatunkami uprawianymi w krótkich rotacjach (SRC). Rośliny te są uprawiane głównie na słabej jakości glebach marginalnych czy skażonych, mniej przydatnych do uprawy roślin żywnościowych czy paszowych. Celem badań, zlokalizowanych w północno-wschodniej Polsce, było porównanie plonowania uprawy wierzby i topoli na sandy i heavy clay soil. Rośliny był sadzone w roku 2018, a wynki pochodzą z dwóch lat doświadczeń (2019 i 2020). Wyniki wskazują, że przeżywalność obu gatunków była zadowalająca na glebie lekkiej (81.3%) i bardzo niska na glebie ciężkiej (średnio 44.4%). Ta niska przeżywalność była wynikiem niekorzystnych warunków meteorologicznych, a szczególnie braku opadów w pierwszym roku po wysadzeniu zrzezów.
Plon świeżej biomasy dwuletnich roślin topoli, średnio 14.5 t/ha był istotnie wyższy o ok. 2 t/ha niż u wierzby. Z kolei plon świeżej biomasy uzyskany z gleby lekkiej (średnio 22.9 t/ha) był aż ponad 5-krotnie wyższy w porównaniu do tego uzyskanego z gleby ciężkiej. Stwierdzono istotny wpływ rodzaju gleby na wysokość plonu suchej biomasy, ponieważ na sandy soil plon topoli i wierzby wyniósł odpowiednio 5.13 i 5.14 t/ha/rok d.m. Natomiast na glebie ciężkiej plon suchej biomasy był 6-krotnie niższy i wynosił odpowiednio 1.12 i 0.67 t/ha/d.m. Analiza korelacji wykazała, że na plon suchej masy istotnie wpływały obsada roślin, przeżywalność oraz wysokość roślin i średnica pędów.
Podsumowując wierzba i topola mogą być uprawiane na glebie lekkiej, osiągając zadowalające plony, natomiast nie zaleca się ich uprawy na ciężkiej glebie ilastej, gdyż takie stanowisko nie zapewnia odpowiednich warunków do uprawy tych gatunków.

Practice "abstract" 32:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Short Rotation Coppices cultivation on sandy soil with different soil enrichment method in Poland
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Poplar, Willow and Black locust are Short Rotation Coppices (SRC) species. Their plantations are established mainly on poor quality marginal or contaminated soils. The aim of this research, located in North-Eastern Poland, was to determine the impact of soil enrichment method on survivability, productivity and energy value of a yield of three plant species cultivated in four-year harvest cycle on sandy soil. This sandy soil was characterized by unfavourable air and water conditions. Such conditions caused in periods of no precipitation permanent water shortage for plants. The highest average yield of dry biomass, in four-year rotation, was found for Willow, 33.36 t/ha. Poplar yielded 0.5 t/ha lower and Black Locust almost three times lower. The highest yield in the whole experiment was obtained for Poplar fertilized with lignin and mineral fertilizers (41.96 t/ha). A similar yield was obtained for Willow fertilized with lignin, mycorrhiza and mineral fertilizers (41.20 t/ha) and fertilized with lignin and mineral fertilizers (39.32 t/ha). The use of lignin in combination with mineral fertilizers resulted in an increase in the yield by 8-14% compared to mineral fertilizers alone for Willow and Poplar and in a nearly twofold increase for Black Locust. The energy value of the yield ranged from 28.6 to 176.7 GJ/ha, respectively, for Black Locust grown on the control plot and for Poplar grown on the plot with mineral fertilization and lignin used in combination. Thus, real possibilities of increasing the biomass and energy yield of SRC on sandy soils have been found, including marginal ones, by appropriate selection of woody species and soil enrichment. These results should be verified in subsequent harvesting cycles.

Short title in native language	Zaganiki uprawiane w krótkich rotacjach na glebie lekkiej wraz z różnymi metodami wzbogacenia gleby w Polsce
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Topola, wierzba i robinia akacjowa to gatunki uprawiane w krótkich rotacjach (SRC). Ich plantacje prowadzone są głównie na glebach marginalnych lub skażonych i niskiej jakości. Celem tych badań, zlokalizowanych w północno-wschodniej Polsce, było określenie wpływu metod wzbogacania gleby na przeżywalność, produkcyjność i wartość energetyczną plonu trzech gatunków roślin uprawianych w czteroletnim cyklu zbiorów na glebie piaszczystej. Gleba ta charakteryzowała się niekorzystnymi warunkami powietrzno-wodnymi. Takie warunki powodowały w okresach braku opadów stały niedobór wody dla roślin. Najwyższy plon suchej biomasy, w czteroletniej rotacji, stwierdzono dla wierzby (33,36 t/ha). Topola dała 0,5 t/ha mniejszy, a robinia prawie trzy razy mniejszy plon. Najwyższy plon uzyskano dla topoli nawożonej ligniną i nawozami mineralnymi (41,96 t/ha). Podobny plon uzyskano dla wierzby nawożonej ligniną, mikoryzą i nawozami mineralnymi (41,20 t/ha) i nawożonej ligniną i nawozami mineralnymi (39,32 t/ha). Zastosowanie ligniny w połączeniu z nawozami mineralnymi spowodowało wzrost plonu wierzby i topoli o 8-14% w porównaniu do samego stosowania nawozów mineralnych oraz prawie dwukrotny wzrost dla robinii. Wartość energetyczna plonu wahała się od 28,6 do 176,7 GJ/ha, odpowiednio dla robinii uprawianej w kotroli i topoli uprawianej na poletku z łącznym nawożeniem mineralnym i ligniną. Wyniki te pokazują realne możliwości zwiększenia plonu biomasy i wydajności energetycznej SRC na glebach piaszczystych, w tym na marginalnych, poprzez odpowiedni dobór gatunków i metod wzbogacanie gleby. Wyniki te należy zweryfikować w kolejnych cyklach zbiorów.

Practice "abstract" 33:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in English

Camelina cultivation on sandy and heavy soil sites in Poland

Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English*

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

Camelina is an oil plant that was known in Europe already in the Bronze Age. The yield of camelina seeds is 1.0-3.0 t/ha, and the oil content is 30-49% d.m. The aim of this study, located in north-eastern Poland, was to compare the yield of camelina in two soil sites.
The site in the village of Leginy was located on heavy soil made of clay. This soil belongs to nutrient and potentially fertile soils. The site in the village of Fingaty was located on light soil made of sand. Such soils are poor in nutrients, permanently too dry, hence the fertilization gives a slight increase in yields. The trial was run in years 2018-2020.
Camelina seed yield on sandy soil was 0.38 t/ha d.m. and ranged from 0.18 to 0.53 t/ha d.m. It was noticed that despite good emergence on sandy soil, in the end the yield was lower than on heavy clay soil. The reasons for this were, among others, unfavorable distribution of precipitation but also low water capillary action of the soil. The average seed yield on clay soil was 0.75 t/ha d.m. and ranged from 0.50 to 0.99 t/ha d.m. in 2018 and 2020, respectively.
The seed quality analysis carried out in 2019 showed that larger seeds were obtained on heavy soil than on light soil. Also, the fat and protein contents were higher on heavy soil (41.85 and 26.87% d.m., respectively) than on light soil (40.70 and 23.91% d.m., respectively). On the other hand, the soil position did not affect the composition of fatty acids.
Therefore, it can be concluded that heavy clay soil is better suited for the cultivation of camelina than sandy soil, which due to low capillary action is more susceptible to lack of water during drought. This results in a lower yield and poorer quality of the camelina seeds.

Short title in native language	Uprawa lnianki na glebie piaszczystej i ciężkiej glebie ilastej

Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).

This summary should at least contain the following information:
- Main **results/outcomes** of the activity (expected or final)
- The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?

This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

Camelina jest rośliną oleistą, która w Europie była znana już w epoce brązu. Plony nasion lnianki wynoszą 1.0-3.0 t/ha, a zawartość oleju 30-49% s.m. Celem niniejszych badań, zlokalizowanych w północno-wschodniej Polsce, było porównanie plonowania lnianki na dwóch stanowiskach glebowych. Stanowisko we wsi Leginy zlokalizowane było na ciężkiej glebie ilastej. Ta gleba należy do gleb zasobnych i potencjalnie żyznych. Działka we wsi Fingaty zlokalizowana była się na lekkiej glebie piaszczystej. Gleby takie są ubogie w składniki pokarmowe, zwykle zbyt suche, stąd nawożenie daje nieznaczny wzrost plonów. Badanie prowadzono w latach 2018-2020.Plon nasion lnianki na glebie lekkiej wyniósł 0.38 t/ha s.m. i wahał się od 0.18 do 0.53 t/ha s.m. Zauważono, że pomimo dobrych wschodów na glebie piaszczystej, w końcowym efekcie uzyskiwano niższe plony niż na glebie ciężkiej ilastej. Powodem tego były m. in. niekorzystny rozkład opadów ale również niska pojemność wodna gleby. Średni plon nasion na glebie ilastej wyniósł 0.75 t/ha s.m. i wahał się od 0.50 do 0.99 t/ha s.m. odpowiednio w roku 2018 i 2020. Przeprowadzone w 2019 roku badania jakości nasion wykazały, że większe nasiona uzyskiwano na glebie ciężkiej niż na lekkiej. Również zawartość tłuszczu i białka była wyższa na glebie ciężkiej (odpowiednio 41.85 i 26.87% s.m.) niż na lekkiej (odpowiednio 40.70 i 23.91% s.m.). Natomiast stanowisko glebowe nie wpływało na różnice w składzie kwasów tłuszczowych.
Można zatem stwierdzić, że gleba ilasta ciężka lepiej nadaje się pod uprawę lnianki siewnej niż gleba piaszczysta, która z powodu niskiej pojemności wodnej jest bardziej podatna na brak wody w okresie suszy. Skutkuje to niższym plonem oraz gorszymi cechami nasion lnianki.

Practice "abstract" 34:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Cultivation of fiber hemp on land degraded by open cast mining of lignite in Poland
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	The study comparing fibrous hemp Bialobrzeskie cultivation in two nitrogen fertilization schemes – mineral (calcium nitrate: 0.90,180 kg/ha) and organic (cattle manure: 0, 15, 30 t/ha) was conducted on former site of lignite mining in MAGIC project. As a result of mining activity the soil was removed and loam was deposited resulting in very low carbon and poor structure causing high compaction in arable layer. This causes difficult air penetration in soil, water stagnation in wet periods, rock-like hardness in dry periods and in consequence late start of tillage in spring and short time when conditions allow for tillage. The best hemp straw yield response was observed at moderate manure dose (15 t/ha) especially in 2020 (8.57 t/ha) while yields at 0 and 30 t/ha were by ca 60% lower. In 2019 much lower yields were noted (1.29, 2.86 and 2.76 t/ha at manure doses 0, 15 and 30 t, respectively) and only yield obtained at no manure combination was significantly lower. The straw yield obtained under mineral N fertilization was less differentiated upon doses compared to manure. In 2020 hemp responded with gradually growing yields of straw on increasing N doses – 5.47,6.39 and 7.7 t/ha, while in 2019, the yields were approximately 5-fold lower and with almost no difference to the N dose used – 1.29, 1.47 and 1.38 t/ha. Fibre concentration obtained on mineral fertilization were generally higher as compared to those obtained at manure, however the loss of yield could not be compensated by higher fibre concentrations. Given these results, it is recommended to apply cattle manure on such marginal soils also because it contributes to accumulation of organic matter which is in high deficiency on such sites.

Short title in native language	Uprawa konopi włóknistych na terenach zdegradowanych przez odkrywkową eksploatację węgla brunatnego w Polsce
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Badania porównujące uprawę konopi włóknistych w dwóch schematach nawożenia – azotem mineralnym (saletra wapniowa: 0,90 180 kg/ha) i organicznym (obornik bydlęcy: 0,15, 30 t/ha) przeprowadzono w ramach projektu Magic na byłym obrzarze wydobycia węgla brunatnego. W wyniku działalności górniczej usunięto glebe, a następnie zdeponowano ił, co spowodowało bardzo niską zawartość węgla i słabą strukturę powodującą duże zagęszczenie warstwy ornej. Utrudnia to penetrację powietrza do gleby, stagnację wody w okresach mokrych, twardość skały w okresach suchych, a w konsekwencji późne rozpoczęcie uprawy na wiosnę i krótki czas, gdy warunki na nią pozwalają. Najlepszą reakcję plonowania słomy zaobserwowano przy umiarkowanej dawce obornika (15 t/ha), zwłaszcza w roku 2020 (8,57t/ha), natomiast plony przy 0 i 30 t/ha były o ok. 60% niższe. W 2019 r. odnotowano znacznie niższe plony (1,29, 2,86 i 2,76t/ha przy dawkach obornika odpowiednio 0,15 i 30t) i tylko plon uzyskany przy braku kombinacji obornikowej był istotnie niższy. Plon słomy uzyskany przy nawożeniu mineralnym N był mniej zróżnicowany przez zastosowane dawki w porównaniu z obornikiem. W 2020 r. konopie reagowały stopniowo rosnącymi plonami słomy na wzrastające dawki N – 5,47,6,39 i 7,7 t/ha, natomiast w 2019 r. plony były ok. 5-krotnie niższe i prawie bez różnicy w stosunku do zastosowanej dawki N – 1,29, 1,47 oraz 1,38 t/ha. Całkowita zawartość włókna uzyskana przy nawożeniu mineralnym była generalnie wyższa niż przy nawożeniu obornikiem jednak spadek plonu nie był przez nią rekompensowany. Biorąc pod uwagę te wyniki, na takich marginalnych glebach zaleca się stosowanie obornika bydlęcego, również dlatego, że przyczynia się on do akumulacji materii organicznej, której na takich stanowiskach występuje duży niedobór.

Practice "abstract" 35:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Phytomanagement of contaminated sites
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Phytomanagement is a new technology in which industrial non-food cash crops are used to reduce and control risks arising from soil contamination. Simultaneously, a profitable and sustainable use of contaminated sites is assured by producing marketable biomass. Several recent studies focus on fast growing, high yielding and high value non-food crops, that could be used as a feedstock for bioenergy and bioproducts (e.g. construction biomaterials, bio-lubricants, bioplastics, pulp for paper, biopolymers, biochemicals, biofuels, biochar, etc). Crops suitable to be used for phytomanagement should have the following characteristics: (i) tolerance to high levels of soil contaminants, (ii) ability to uptake the contaminants and/or stabilize them in soil fractions in relatively high levels, iii) ability to degrade organic pollutants, (iv) rapid growth rates and high biomass yield (v) widespread highly branched root system, (vi) low input requirements and easy harvest ability, (vii) non consumable by humans and animals. Promising candidates are miscanthus, industrial hemp, fiber sorghum, castor bean, safflower, cardoon, giant reed, kenaf, switchgrass, poplar, willow, etc. The exploitation of contaminated lands could open new economic opportunities for local farmers and rural communities by increasing the availability of domestic raw materials for use in new emerging markets.

Short title in native language	Αξιοποίηση ρυπασμένων εδαφών με την καλλιέργεια βιομηχανικών φυτών
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Η Φυτοδιαχείριση (Phytomenagement) είναι μια νέα τεχνολογία, στην οποία χρησιμοποιούνται βιομηχανικές μη τροφικές καλλιέργειες για τη μείωση και τον έλεγχο των κινδύνων που προκύπτουν από την ρύπανση του εδάφους. Ταυτόχρονα πραγματοποιείται οικονομική αξιοποίηση των ρυπασμένων περιοχών με την παραγωγή εμπορεύσιμης βιομάζας. Αρκετές μη τροφικές καλλιέργειες με γρήγορη ανάπτυξη, υψηλή απόδοση και μεγάλο οικονομικό ενδιαφέρον μπορούν να καλλιεργηθούν σε ρυπασμένες περιοχές και να αποδώσουν βιομάζα χρήσιμη για την παραγωγή βιοενέργειας και βιοπροϊόντων (π.χ. κατασκευαστικά υλικά, βιολιπαντικά, βιοπλαστικά, πολτό για χαρτί, βιοπολυμερή, βιοχημικά κλπ). Οι καλλιέργειες που είναι κατάλληλες για φυτοδιαχείριση θα πρέπει να έχουν τα ακόλουθα χαρακτηριστικά: (i) αντοχή σε υψηλές συγκεντρώσεις ρύπων στο έδαφος, (ii) ικανότητα απορρόφησης των ρύπων ή/και σταθεροποίησής τους στο έδαφος σε σχετικά υψηλά επίπεδα, iii) ικανότητα διάσπασης των οργανικών ρύπων, (iv) ταχείς ρυθμούς ανάπτυξης και υψηλή απόδοση βιομάζας (v) μεγάλο και ευρέως διακλαδισμένο ριζικό σύστημα, (vi) χαμηλές απαιτήσεις εισροών και εύκολη συγκομιδή, (vii) όλα τα φυτικά τμήματα να μην είναι βρώσιμα από τον άνθρωπο και τα ζώα. Παραδείγματα τέτοιων καλλιεργειών είναι: ο μίσχανθος, η βιομηχανική κάνναβη, το κλωστικό σόργο, η ρετσινολαδιά, η ατρακτυλίδα, το καλάμι, το κενάφ, οι λεύκες, η ιτιά κ.λπ. Η εκμετάλλευση των ρυπασμένων εκτάσεων θα δημιουργήσει νέες οικονομικές ευκαιρίες για τους τοπικούς αγρότες και τις αγροτικές κοινότητες αυξάνοντας τη διαθεσιμότητα εγχώριων πρώτων υλών και τη δυνατότητα προώθησής τους σε νέες αναδυόμενες αγορές.

Practice "abstract" 36:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Kenaf cultivation in contaminated sites.
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Kenaf is an annual fiber crop having great potential for fiber, energy, and feedstock. Its stem fibers are an excellent source for textile, paper pulp, and cordage industries, for building materials, for biofuel production, etc. Kenaf young plants can be used in livestock feeding, due to their palatability and high protein content. A quite new application of this crop is its use as food additive, while its leaves can also be used as hot beverage. However, it is well known that food consumption is identified as the major pathway of human exposure to contaminants. Thus, it is important to investigate the possible bioaccumulation of several contaminants in the aerial biomass of kenaf. A pot experiment was conducted using a soil heavily contaminated with cadmium (Cd: 132.5 mg/kg), lead (Pb: 25875.7 mg/kg), zinc (Zn: 16821.6 mg/kg), antimony (Sb: 369.6 mg/kg) and arsenic (As: 3430.7 mg/kg). The soil was mixed with uncontaminated soil in percentages of 0% (control), 10%, 50% and 100 % respectively. Each soil mixture was used to fill three pots and five kenaf seeds were sown in each pot. The results showed that -in all treatments- plant growth was not affected, indicating the tolerance of this crop to contaminants. The concentrations of heavy metals and metalloids measured in kenaf aerial biomass were higher than in the control plants but within the normal limits, apart from Cd, Pb and Sb. Cadmium concentration was up to 11.0 mg/kg, lead was up to 59.18 mg/kg and antimony was up to 3.4 mg/kg. Especially Cd contents in plants were 55-fold higher than in the control plants. In conclusion, this work indicate that kenaf grown on soils bearing Cd, Pb and Sb could be dangerous as a carrier of these trace elements in the food chain.

Short title in native language	Καλλιέργεια του κενάφ σε ρυπασμένα εδάφη.
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Το κενάφ είναι ένα ετήσιο κλωστικό φυτό χρήσιμο για τις βιομηχανίες κλωστοϋφαντουργίας, την παραγωγή χαρτοπολτού και σχοινιών, για την κατασκευή οικοδομικών υλικών, την παραγωγή βιοκαυσίμων κ.λπ. Τα νεαρά φυτά κενάφ μπορούν να χρησιμοποιηθούν σαν ζωοτροφή λόγω της γευστικότητας και της υψηλής περιεκτικότητάς τους σε πρωτεΐνες. Επίσης χρησιμοποιείται ως πρόσθετο τροφίμων, ενώ τα φύλλα του μπορούν να χρησιμοποιηθούν και ως ζεστό ρόφημα. Δεδομένου ότι η κατανάλωση τροφίμων είναι η κύρια πηγή έκθεσης των ανθρώπων σε επικίνδυνους ρυπαντές, είναι σημαντικό να διερευνηθεί η δυνατότητα του φυτού αυτού να συσσωρεύει ρύπους στη βιομάζα του. Για το σκοπό αυτό πραγματοποιήθηκε ένα πείραμα σε γλάστρες χρησιμοποιώντας έδαφος ρυπασμένο με κάδμιο (Cd: 132,5 mg/kg), μόλυβδο (Pb: 25875,7 mg/kg), ψευδάργυρο (Zn: 16821,6 mg/kg), αντιμόνιο (Sb: 369,6 mg/kg) και αρσενικό (As: 3430,7 mg/kg). Το έδαφος αυτό αναμίχθηκε με καθαρό σε ποσοστά 0% (μάρτυρας), 10%, 50% και 100% αντίστοιχα. Κάθε μίγμα εδάφους χρησιμοποιήθηκε για να γεμίσει τρεις γλάστρες και σε κάθε γλάστρα σπάρθηκαν πέντε σπόροι κενάφ. Τα αποτελέσματα έδειξαν ότι η ανάπτυξη των φυτών δεν επηρεάστηκε. Οι συγκεντρώσεις των βαρέων μετάλλων και των μεταλλοειδών που μετρήθηκαν στην αέρια βιομάζα του κενάφ ήταν εντός των φυσιολογικών ορίων, εκτός από το Cd, Pb και Sb. Η συγκέντρωση του Cd ήταν 11,0 mg/kg, του Pb ήταν 59,18 mg/kg και του Sb ήταν 3,4 mg/kg. Ειδικότερα η περιεκτικότητα των φυτών σε Cd ήταν 55 φορές υψηλότερη από αυτήν των φυτών που αναπτύχτηκαν σε καθαρό έδαφος. Επομένως χρειάζεται ιδιαίτερη προσοχή όταν το κενάφ καλλιεργείται σε εδάφη με αυξημένες συγκεντρώσεις Cd, Pb και Sb γιατί μπορεί να μεταφέρει αυτούς τους ρύπους στην τροφική αλυσίδα.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 37:

Short title in English	Cultivation of industrial crops on heavy metal contaminated lands
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Under the frame of MAGIC project, fifteen industrial crops have been tested for their ability to be cultivated in soils contaminated with cadmium (Cd), nickel (Ni), lead (Pb) and zinc (Zn). The tested crops are: biomass sorghum, camelina, cardoon, castor bean, crambe, Ethiopian mustard, giant reed, hemp, lupin, miscanthus x giganteus, pennycress, safflower, switchgrass, tall wheatgrass, and wild sugarcane. All plants were grown to relatively low contamination levels, namely: Cd in 0, 4, 8 mg/kg, Ni in 0, 110, 220 mg/kg, and both Pb and Zn in 0, 450, 900 mg/kg. The results showed that the most toxic heavy metal was zinc since its high soil concentration was lethal -at least for one year- to eight crops, namely to: biomass sorghum, camelina, castor bean, hemp, lupin, pennycress, switchgrass and tall wheatgrass. In addition, the low Zn treatment was lethal to four crops, namely to: camelina, hemp, lupin, and pennycress. Second on the row of toxicity was nickel, as in its high treatment all crops were dried or did not germinate at all in four crops: camelina, hemp, lupin, and pennycress. Cadmium was the third less toxic element: camelina's yield was reduced under the high soil concentration, while low tolerance was observed in tall wheatgrass and moderate tolerance was recorded in giant reed, miscanthus x giganteus, castor bean and crambe. Under low Cd treatment, the crops Ethiopian mustard and tall wheatgrass showed low tolerance. Finally, lead was the less toxic element since it was not lethal to any of the tested crops. In addition, its high soil concentration reduce by 50%-75% the yield of only three crops i.e. of Ethiopian mustard, giant reed and tall wheatgrass.

Short title in native language	Καλλιέργεια βιομηχανικών φυτών σε εδάφη ρυπασμένα με βαριά μέταλλα
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Στο πλαίσιο του προγράμματος MAGIC διερευνήθηκε η δυνατότητα δεκαπέντε βιομηχανικών φυτών να καλλιεργηθούν σε εδάφη ρυπασμένα με σχετικά χαμηλές συγκεντρώσεις καδμίου(Cd: 0, 4, 8 mg/kg), νικελίου (Ni: 0, 110, 220 mg/kg), μολύβδου (Pb: 0, 450, 900 mg/kg) και ψευδαργύρου (Zn: 0, 450, 900 mg/kg). Τα φυτά αυτά είναι: το σόργο, η καμελίνα, η αγριαγκινάρα, η ρετσινολαδιά, η κράμβη, η ελαιοκράμβη Αιθιοπίας, το καλάμι, η κάνναβη, το λούπινο, ο μίσχανθος, το pennycress (Thlaspi arvense L.), η ατρακτυλίδα, το πάνικον το ραβδωτό (switchgrass, είδος κεχριού), το tall wheatgrass (Agropyron elongatum L.) και το wild sugarcane (Saccharum spontaneum L.). Τα αποτελέσματα έδειξαν ότι το πιο τοξικό μέταλλο είναι ο ψευδάργυρος δεδομένου ότι στις υψηλές συγκεντρώσεις του ξεράθηκαν όλα τα φυτά των ειδών: σόργο, καμελίνα, ρετσινολαδιά, κάνναβη, λούπινο, pennycress, πάνικο και tall wheatgrass. Οι χαμηλές συγκεντρώσεις ψευδαργύρου ήταν καταστροφικές για τέσσερα είδη: καμελίνα, κάνναβη, λούπινο και pennycress. Δεύτερο σε τοξικότητα ήταν το νικέλιο. Στις υψηλές συγκεντρώσεις του τα φυτά ξεράθηκαν -ή δεν βλάστησαν καθόλου ο σπόροι- στα είδη: καμελίνα, κάνναβη, λούπινο και pennycress. Το κάδμιο έρχεται τρίτο σε σειρά τοξικότητας: στις υψηλές συγκεντρώσεις του μειώθηκε σημαντικά η παραγωγή της καμελίνας και του tall wheatgrass, ενώ μικρότερη μείωση παρατηρήθηκε στα είδη: καλάμι, μίσχανθο, ρετσινολαδιά και κράμβη. Οι χαμηλές συγκεντρώσεις καδμίου ήταν τοξικές μόνο για τα είδη ελαιοκράμβη Αιθιοπίας και tall wheatgrass. Τέλος ο μόλυβδος ήταν το λιγότερο τοξικό μέταλλο. Μόνο στις υψηλές συγκεντρώσεις του παρατηρήθηκε μείωση της παραγωγής σε τρία είδη: στην ελαιοκράμβη Αιθιοπίας, στο καλάμι και στο tall wheatgrass.

Practice "abstract" 38:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Biofertilisation as a tool to improve crop biomass production on marginal lands
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Biofertilisation of soils with earthworms is a means proposed to improve poor soil characteristics. Earthworm activities may increase crop yield by increasing nutrient availability, improving soil structure and promoting C and N cycles. Relating MAGIC project, it was proposed to apply biofertilisation to a marginal land exhibiting a combined marginality factors as unfavourable soil texture and trace element contamination. A sandy textured soil located in Paris was used, multicontaminated after 100 years of raw wastewater spreading. The aim was to make the proof of concept both ex situ in controlled conditions and in situ in natural conditions, with the tested factor being the absence or presence of earthworms. The ex-situ experiments involved a two months post experiment with Lolium perenne and the ubiquist endogeic earthworm Aporrectodea caliginosa. Results confirmed that even in marginal soils, earthworms improve biomass production, but also reduce trace element uptake by plants while increasing trace elements in soil solution. The field trial involved switchgrass and miscanthus established in June 2019 by seeds and rhizomes respectively. Earthworms were introduced manually in selected blocs of around 1 m^2 surrounded by a geotextile (both endogeic species Aporrectodea caliginosa, and anecic species Lumbricus terrestris). Contrarily to miscanthus, switchgrass could not compete with the weeds. After two years, biomass yield of miscanthus in the presence of earthworms was significantly higher compared to the plots without earthworms. But in the absence of irrigation the unstable soil moisture induced a low mean yield of miscanthus around 2 t/ha in 2021. Increasing soil fauna activity reveals a way to counteract soil marginality.

Short title in native language	Utilisation de la biofertilisation pour améliorer la production de biomasse sur les terres marginales
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	La biofertilisation des sols par inoculation de vers de terre est un moyen souvent proposé pour améliorer des caractéristiques défavorables aux cultures. En effet, les activités des vers de terre peuvent améliorer les rendements des cultures en augmentant la disponibilité des nutriments, en améliorant la structure des sols ou d'une façon générale en stimulant les cycles du carbone et de l'azote. Concernant projet MAGIC, nous avons appliqué la biofertilisation à un sol marginal combinant deux facteurs de marginalité une texture défavorable et une contamination. Nous avons utilisé un site localisé dans la banlieue parisienne (France) avec une texture sableuse et multi-contaminé sur le long terme par 100 ans d'irrigation avec des eaux usées brutes. Notre objectif était de faire une preuve de concept à la fois ex-situ en conditions contrôlées et in situ en conditions de terrain, le facteur à tester étant l'absence ou la présence de vers de terre inoculés. L'expérimentation ex-situ a mis en jeu une exposition en pots de deux mois de Lolium perenne et de l'espèce de ver de terre endogé ubiquiste Aporrectodea caliginosa. Les résultats ont confirmé que même en conditions de sols marginaux, les vers de terre améliorent la production de biomasse, mais aussi diminuent la bioaccumulation des éléments trace par les plantes même si une augmentation des éléments trace en solution est observée. L'essai sur le terrain a porté sur le switchgrass et le miscanthus, mis en place en juin 2019 à partir de graines ou de rhizomes respectivement. Les vers de terre (à la fois endogés Aporrectodea caliginosa, et aneciques Lumbricus terrestris) ont été introduits manuellement dans des blocs spécifiques de 1m^2 entourés de géotextile. Contrairement au miscanthus, le switchgrass n'a pas pu pousser en raison des mauvaises herbes. Après deux ans, le rendement en biomasse de miscanthus en présence de vers de terre était significativement plus important comparé aux blocs sans vers de terre. Mais en absence d'irrigation, l'humidité instable du sol sableux a induit en moyenne un faible taux de rendement du miscanthus d'environ 2t/ha en 2021. L'étude de terrain in situ a confirmé les résultats ex situ. Augmenter l'activité de la faune du sol est un moyen de contrer la marginalité du sol pour les cultures.

Practice "abstract" 39:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Low-input agricultural practices for industrial crops on marginal land
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	The identification of the most suitable industrial crops that can be cultivated in the European "prevalent marginal agro-ecological zones" (MAEZ), as well as of the "marginal agricultural land low-input systems" (MALLIS) for growing these crops were among the main issues addressed by MAGIC. In addition to the economic and environmental aspects, the research was also based on the current knowledge on best low-input agricultural practices for food crop production on good soils. It sought to optimize the use of on-farm resources and minimize off-farm inputs, which translates into having a more 'closed' production cycle and requires more advanced agronomic skills. As a conclusion, the selection of suitable industrial crops was found to be the most important component in the development of MALLIS, because all other measures (tillage, fertilization, weeding, irrigation, etc.) very much depend on the site-specific performance of the crop. The expected overall performance of the crops was analysed by means of a multi-criteria analysis. Some examples of the conclusions are: -in Mediterranean climate conditions and soils with unfavourable texture and stoniness tall wheatgrass can be cultivated using practices of minimum/no tillage. Also, Siberian elm could be cultivated in rainfed; -in Atlantic climate conditions and soils contaminated by wastewater the lignocellulosic crops such as miscanthus can be cultivated with minimum/no tillage and bio-fertilisation; -in Continental climate conditions and soils with hard clay and limited soil drainage there can be cultivated crops such as tall wheatgrass, willow, hemp, poplar or reed canary grass with minimum/no tillage, reduced fertilization and weed control practices.

Practice "abstract" 40:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Good Practices in MAGIC
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Marginal land is largely attributed to agricultural fields which have been abandoned due to biophysical and/ or socio-economic restrictions. This has become a major problem in Europe with several environmental, socioeconomic and landscape implications, including higher risk of fires, loss of biodiversity, water scarcity, etc., which reduce the health and quality of life of rural communities. Recently, the European Commission Joint Research Centre (JRC) applied the LUISA Territorial Modelling Platform to generate projections of agricultural land abandonment in the EU in the period 2015-2030. The resulted potential risk map of agricultural land abandonment in the EU in 2030 produced with this modelling framework indicates that 11% of EU's agricultural land will be under high (19.6 million ha, 10.7%) and very high (800.000 ha, 0.4%) potential risk of abandonment. The aim of identifying Good Practices in the MAGIC project is to understand the context of restoring marginal land for cropping, the state and prospects for industrial crops, the conditions framing their cultivation and the supply chains as well as their operational capacities across time and development stages. The work performed analysed practices which rehabilitate the biophysical constraints related to the soil and water conditions of the land while improving environmental, economic and societal performance and operational aspects of the value chain. These practices can guide policy in integrating industrial crops cultivated in marginal lands as raw materials in bio-based value chains. The 'Good Practice' when assessed scores highest on the specific indicators compared to other practices in the region.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 41:

Short title in English	Analysis of Good Practices in MAGIC
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	The performance of twelve cases of Good industrial crop Practices on biophysically marginal lands has been examined in this report around (i) stages of the value chain, focusing on land use and biomass production, and (ii) competitive priorities at different phases of development. The methodological approach provides a conceptual link of Value Chain Analysis (VCA), and a two-dimensional perspective (the key attributes of the value chain in the form of competitive priorities (CP) and their performance at different stages of development) to investigate a set of Good Practice cases growing industrial crops on marginal lands. A set of indicators has been employed, assessing the performance of the studied Good Practice cases at the land use and biomass production phases. The results of this study show how industrial crops on land with low soil fertility, high salinity, sandy soils, unfavourable texture and stoniness, pollution, etc. can improve to end biophysical and socioeconomic challenges by providing outlets for rural communities to support feedstock supply to bio-based sectors. The most common marginal land challenges that industrial crop cultivation helped to surmount include (i) presentation of low-input practices to restore land with low fertility, soil contamination, adverse texture, stoniness, drought, etc. (ii) Increased transparency in the establishment of low indirect land use biomass crops and (iii) created new income opportunities for farmers in rural areas with a high percentage of marginality.

Practice "abstract" 42:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Key findings and transferability in MAGIC
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	This report has studied the essential characteristics of selected industrial crops and the challenges of marginality ameliorated with their cultivation. The review includes the level of potential transferability of lessons learned by key attribute biophysical-environmental, economic, and social attributes and stage of development to other European regions. The results extracted from the twelve Best Practice cases across Europe of industrial crops grown on land with biophysical marginalities are (i) the cultivation of lignocellulosic perennial species facilitates improvements on contaminated land. (ii) Regions surrounded by primary activities were more likely to undertake industrial crops on marginal lands. (iii) Minimal farmer interaction with the research community. (iv) Availability of public and private funds with simplified rules and procedures. (v) Good relationship between farmers and regional government. (vi) Availability of well-trained farmers and good interactions with research institutions. (vii) Increased public knowledge on reclamation of marginal lands with industrial crops for bio-based products. (viii) Restoring marginal lands with low-input practices to maintain low GHG emission levels can be complicated, as in most cases significant inputs are required to make the land productive. (ix) Establishment of perennial plants through an arid and dry climate, with no irrigation available during the first year. (x) Farmers were doubtful about the long-term economic viability of industrial crops on marginal land. (xi) The small scale of farming implies a level of training, networking and complex interactions that are time consuming and delay value chain integration in farming systems.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 43:

Short title in English	Conversion of vegetable oils through metathesis chemistry
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Metathesis is a chemical reaction which involves the double bonds of the fatty acid chains. With a homogeneous catalyst the double bond react with a short olefin (which can be ethylene, or 1-butene for example) and produce a shorter fatty acid (10 and 12 carbons chains) and an olefin (10 or 12 carbon chains). The shorter fatty acids can substitute the acids from palm kernel and coconut oils, while the olefins can be used for synthetic lubricants (PAO) for example. The most appropiate oils for this process should have a high ratio of Oleic to Linoleic acid (high MonoUnsaturated/PolyUnsaturated fatty acids ratio). Currently this chemistry is practiced by Elevance-Wilmar in Indonesia on Palm oil. However other high oleic oils such as High Oleic Sunflower and High Oleic Safflower are also appropriate, provided that their cost is limited. The challenge with this chemistry is that it generates a lot of coproducts for which a value has to be identified. Ethylene would be the best reagent to generate the highest value from the products, but it is also a poison for most of the catalysts. This is the reason why the process implemented by Elevance uses 1-butene. High oleic oils, reacting with ethylene would generate alpha-olefins and C10 unsaturated fatty acid ester. Although the olefins would have a direct market in lubricants, cosmetics, surfactants, the C10 unsaturated fatty acid still has to find its market, and in the worst case could be a substitute for the imported medium chain fatty acids present in tropical oils. The economic analysis shows that large plant would have to be built to cover the cost, and that initially incentives to the large fuel/petrochemical markets would be necessary, before addressing the specialties.

Short title in native language	Conversion d'huiles végétales par métathèse
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	La métathèse est une réaction chimique qui implique les doubles liaisons des chaînes d'acides gras. Avec un catalyseur homogène, la double liaison réagit avec une oléfine courte (qui peut être l'éthylène, ou le 1-butène par exemple) et produit un acide gras plus court (chaînes de 10 ou 12 carbones) et une oléfine (10 ou 12 carbones). Les acides gras plus courts peuvent remplacer les acides des huiles de palmiste et de noix de coco, tandis que les oléfines peuvent être utilisées pour les lubrifiants synthétiques (PAO) par exemple. Si les oléfines auraient un marché direct dans les lubrifiants, les cosmétiques, les tensioactifs, l'acide gras insaturé en C10 doit encore trouver son marché. Les huiles les plus appropriées pour ce processus devraient avoir un rapport élevé d'acides gras monoinsaturés/polyinsaturés. Actuellement cette chimie est pratiquée par Elevance-Wilmar en Indonésie sur l'huile de palme. Cependant, d'autres huiles à haute teneur en acide oléique telles que le tournesol à haute teneur en acide oléique et le carthame à haute teneur en acide oléique sont également appropriées, à condition que leur coût soit limité. L'enjeu de cette chimie est qu'elle génère beaucoup de coproduits pour lesquels une valeur doit être identifiée. L'éthylène serait le meilleur réactif pour générer la valeur la plus élevée des produits, mais c'est aussi un poison pour la plupart des catalyseurs. C'est la raison pour laquelle le procédé mis en place par Elevance utilise du 1-butène. L'analyse économique montre qu'il faudrait construire de grandes usines pour couvrir les coûts, et que dans un premier temps des incitations aux grands marchés du carburant/pétrochimie seraient nécessaires, avant d'aborder les spécialités.

Practice "abstract" 44:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Conversion of vegetable oils to azelaic acid and pelargonic acid
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	The most interesiting vegetable oils for the chemical conversion to azelaic acid (a C9 diacid) and pelargonic acid (a C9 fatty acid) are the oils rich in oleic acid (C18:1). In order, to have a high purity and high value of the final products, the amount of linoleic acid (C18:2) and Linolenic (C18:3) should be minimal. Azelaic acid has market applications in polymers, lubricants, plasticizers... while pelargonic acid has also applications as herbicide, lubricants... There are two main processes in use today: the ozonolysis practiced by Emery Oleochemicals in the US and Croda Sipo in China, and the oxidative cleavage practiced by Matrica in Italy. The oxidative cleavage requires the use of hydrogen peroxide and air as oxidants. Although Palm oil is rather cheap and has a high ratio of Oleic/linoleic acids, it is not the most appropriate oil for that chemistry, because a lot of coproducts, such as saturated fatty acids which cannot react in the process do not generate much value. This oil would require a much bigger plant, which would compensate for the cheaper oil. Instead appropriate oils for that chemistry include High Oleic Sunflower OIl, but also High Oleic Safflower oil, for example. An econmic analysis, of the process allows us to estimate that an increase of 1% of oleic acid content in the oil, could justify a maximum 3% increase in the oil value, based on a difference between High Oleic Safflower (82% Oleic) and High Oleic Sunflower (85% Oleic).

Short title in native language	Conversion d'huiles végétales en acide azélaique et en acide pélargonique
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Les huiles végétales les plus intéressantes pour la conversion chimique en acide azélaïque (un diacide en C9) et en acide pélargonique (un acide gras en C9) sont les huiles riches en acide oléique (C18:1). Afin d'avoir une pureté élevée et une valeur élevée des produits finaux, la quantité d'acide linoléique (C18:2) et linolénique (C18:3) doit être minimale. L'acide azélaïque a des applications de marché dans les polymères, lubrifiants, plastifiants... tandis que l'acide pélargonique a aussi des applications comme herbicide, lubrifiants... Il existe aujourd'hui deux procédés principaux : l'ozonolyse pratiquée par Emery Oleochemicals aux USA et Croda Sipo en Chine , et la coupure oxydante pratiquée par Matrica en Italie. La coupure oxydante nécessite l'utilisation de peroxyde d'hydrogène et d'air comme oxydants. Bien que l'huile de palme soit plutôt bon marché et ait un ratio élevé d'acides oléique/linoléique, ce n'est pas l'huile la plus appropriée pour cette chimie, car de nombreux coproduits, tels que les acides gras saturés qui ne peuvent pas réagir dans le processus, ne génèrent pas beaucoup de valeur. Cette huile nécessiterait une usine beaucoup plus grande, ce qui compenserait l'huile moins chère. Au lieu de cela, les huiles appropriées pour cette chimie comprennent l'huile de tournesol à haute teneur en acide oléique, mais aussi l'huile de carthame à haute teneur en acide oléique, par exemple. Une analyse économique du procédé nous permet d'estimer qu'une augmentation de 1% de la teneur en acide oléique dans l'huile, pourrait justifier une augmentation maximale de 3 % de la valeur de l'huile, sur la base d'une différence entre le Carthame Haut Oléique (82% Oleic) et Tournesol à haute teneur en acide oléique (85% d'acide oléique).

Practice "abstract" 45:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Conversion of vegetable oils to sebacic acid (c10 diacid)
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Castor Oil, extracted from the seeds of "Ricinus communis" is the only oil today used to produce sebacic acid, a C10 linear diacid. Castor can be cultivaed in Europe, as an annual crop, provided that it is mechanized. Sebacic acid is used for the synthesis of polymers (polyamides, polyesters…), lubricants, plasticizers. Although 80% of the world production of Castor is made in India, most of the sebacic acid is currently produced in China through the "Alkaline Cleavage process". There is also some production in India, and more recently in Oman. Alternative processes to make sebacic acid, include the fermentation of petrosourced C10 paraffin (Cathay Indsutrial Biotech) and the fermentation of the C10 fatty acid present in Coconut and Palm Kernel oils (in the past Verdezyne intended to produce it). The Alkaline cleavage process is a reaction in sodium hydroxyde, in which only the Ricinoleic acid (C18:1,OH) chain - present at 85% in castor oil - will react in successive reaction steps leading to the diacid and to 2-Octanol as major products. Only Castor oil contains ricinoleic acid in high quantity and can lead to sebacic acid. However, Lesquerella which is a desertic crop, contains an other hydroxyfatty acid (lesquerolic acid) C20:1,OH, which would lead to the C12 diacid when using the same chemistry; and a micro-organism: claviceps purpurea, also accumulates ricinoleic acid in significant quantities. The process requires the following steps: hydrolysis of the oil; alkaline cleavage; separation of 2-octanol; acidification to separate the unreacted acids; further acidification to recover the diacid. It also generates a large amount of sodium sulfate.

Short title in native language	Conversion d'huile végétale en acide sébacique (diacide à 10 atomes de carbone)
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	L'huile de ricin, extraite des graines de "Ricinus communis" est la seule huile aujourd'hui utilisée pour produire de l'acide sébacique, un diacide linéaire en C10. Le ricin peut être cultivé en Europe, comme culture annuelle, à condition qu'elle soit mécanisée. L'acide sébacique est utilisé pour la synthèse de polymères (polyamides, polyesters…), lubrifiants, plastifiants. Bien que 80% de la production mondiale de ricin soit localisée en Inde, la majeure partie de l'acide sébacique est actuellement produite en Chine par le biais du «procédé de clivage alcalin». Il y a aussi une petite production en Inde, et plus récemment au Sultanat d'Oman. Des procédés alternatifs pour fabriquer de l'acide sébacique, comprennent la fermentation de la paraffine C10 pétro-sourcée (Cathay Indsutrial Biotech) et la fermentation de l'acide gras C10 présent dans les huiles de noix de coco et de palmiste (Verdezyne avait l'intention de le produire). Le procédé de clivage alcalin est une réaction dans l'hydroxyde de sodium, dans laquelle seule la chaîne acide ricinoléique (C18:1,OH) - présente à 85% dans l'huile de ricin - réagira par étapes successives de réaction conduisant au diacide et au 2-octanol comme principaux produits. Seule l'huile de ricin contient de l'acide ricinoléique en grande quantité et peut conduire à de l'acide sébacique. Cependant, Lesquerella qui est une culture désertique, contientl'acide lesquérolique C20:1,OH, qui conduirait au diacide C12 en utilisant la même chimie ; et un micro-organisme : le claviceps purpurea, accumule également l'acide ricinoléique en quantités importantes. Le procédé nécessite les étapes suivantes: hydrolyse; clivage alcalin; séparation du 2-octanol; acidification pour séparer les acides n'ayant pas réagi ; acidification supplémentaire pour récupérer le diacide. Il génère également une grande quantité de sulfate de sodium.

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Practice "abstract" 46:

Short title in English	Potential biomass supply from marginal lands
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	With the aim of increasing bioenergy production and food security, as well as benefiting the environment and ecosystems, the MAGIC project has evaluated and mapped out the potential of marginal lands to supply biomass in two regions of the EU: Soria in Spain and Brittany in France. The productivity of energy crops on such lands has been modelled for these regions, factoring in biophysical constraints to crop growth. On the one hand, the Soria region currently has a potential of 376,500 ha of marginal lands suitable for energy crops such as tall wheatgrass and Siberian elm. On the other hand, Brittany has a potential of 57,544 ha of marginal lands suitable for miscanthus, a perennial grass. Marginal lands make up 3% and 37% of current cropland area in Brittany and Soria, respectively, pointing at contrasted local configurations. Overall, marginal lands could supply 1,431 kton of biomass dry matter per year in Soria, and 1,582 kton in Brittany, respectively. Researchers from the MAGIC project also evaluated the potential of sourcing biomass from agricultural and forest residues, pointing to a similar amount (1,574 kton) in Soria and a much larger one in Brittany (at 5,637 kton per year). Thus, residues could complement the supply of biomass processing facilities and mitigate the risks of biomass shortages. These quantifications provide data for the development of industrial, lignocellulosic crops in Brittany and Soria, and the methodology used in this research could be generalized to other contexts. Such approaches can support the design of efficient biomass utilization value-chains in locations with different feedstock availability, thus lowering the overall risks of investing in bioenergy/biorefinery projects.

Practice "abstract" 47:

Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.

Short title in English	Identification of arable marginal lands under rainfed conditions for bioenergy purposes in Spain
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	CEDER- CIEMAT has identified those areas in Spain where food crops are not economically profitable, but energy crops could be cultivated. In this work, it has estimated the profit margin of wheat and barley, the spatial location of cultivation areas and the biophysical limitations. Almost 10 million hectares in Spain present biophysical and/or economic constraints in rainfed arable areas. The results showed an average potential of 83.33 GJ per ha using triticale (x Triticosecale) and 174.85 GJ per ha, using cardoon (Cynara cardunculus L). in these lands. These numbers represent between 3%-5% of the primary energy needs in Spain, which can optimise rural development, promote the bioeconomy, and achieve environmental objectives. Furthermore, the economic balance of rainfed wheat and barley indicates that yields of less than 1.5 t per ha make cultivation of the land unprofitable for farmers using traditional management, so that these areas are considered marginal. This directly links economic restraints and biophysical limitations. Finally, a change in seedbed preparation or sown crops could improve marginal areas. The systematics developed in this study can be used to identify marginal lands and their limiting factors. It could be reproduced in other EU countries with the same challenges, mainly in the Mediterranean basin.

Practice "abstract" 48:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Value chain for multifunctional refining of industrial hemp in Denmark
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Thanks to EU H2020 projects exchange, MAGIC partners had the opportunity to retrieve information from COOPID project about a value chain for multifunctional refining of industrial hemp in Denmark, with several phases and associated businesses. Hemp is an excellent crop to have in rotation in Denmark. As a late sown crop, it gives time to handle weeds mechanically early in spring. It is also good for under sowing with nitrogen-fixing crops, such as yellow clover or yellow trefoil. After harvest, the stubble with the yellow clover and some waste seeds, is an ideal forage for wildlife, including insects, birds, and deer. Finola is a variety of hemp that has been ploughed and fertilized with 100 kg N/ha embedded slurry. Typically, it can be harvested between 1 and 1.5 tonnes of seeds per ha. Harvesting is done by a traditional combined harvester with only minor modifications. It does not need herbicides or pesticides, and only needs a small amount of fertilizer, making it very suitable for unfertile land. Hemp has no insect pests, although there may be minor fungal attacks. It is appreciable how the hemp fibres are turned into sustainable products, replacing fossil fuel-based materials. There are four steps for treatment of recycled or biobased materials, such as hemp. The cleaned seeds can be de-hulled, toasted or transformed into flour. The hemp flour is sold to another company, and it's processed into meat replacement products based on 100% plant protein. The hulls are sold to make pet-food or fibre-rich full-flour. The dried hemp straw, consist of skews and fibres destined to clothing processes. The shives can be used for construction materials and the hempcrete can replace the concrete.

Short title in native language	Kūdras ieguves vietas rekultivācija
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	Eksperimentāls kokaugu stādījums ierīkots bijušajā kūdras ieguves teritorijā. Augsnes virsējās kārtas (>50 cm) veido skāba (pHCaCl2 ~3.5), daļēji sadalījusies augstā purva kūdra. Šādas augsnes ir bagātas ar organiskajām vielām un slāpekli, bet tām trūkst citu svarīgu augiem pieejamo barības elementu. Tādēļ, papildus kontroles variantam, augsne ielabota ar trīs devām koksnes pelnu – 5, 10 un 15 t ha^{-1} Koksnes pelnu sastāvs: K 24.7, Mg 18.2, Ca 120.4, P 6.6 g kg-1. Visi varianti ierīkoti trīs atkārtojumos, un katrā iestādītas papeles (Populus tremula) (klons Vesten), bērzi (Betula pendula), melnalkšņi (Alnus Glutinosa) un priedes (Pinus Sylvestris) (1055 koki ha^{-1}). Pēc pieciem augšanas gadiem papeles uzrādīja vissliktāko saglabāšanos – 0% kontroles variantā, 27, 62 un 57% variantos, kas ielaboti attiecīgi ar 5, 10 un 15 t ha^{-1} koksnes pelniem. Vidējie papeļu augstumi pēc četriem augšanas gadiem bija 112, 331, 452 un 452 cm kontroles un ar 5, 10 un 15 t ha^{-1} pelnu ielabotajos variantos. Šie rezultāti norāda uz papeļu jutību pret barības vielu trūkumu un augsnes pH. Augsnes ielabošana ir vitāli nepieciešama, lai nodrošinātu papeles izdzīvošanu nabadzīgās augsnēs. Ielabošana ar 10 t ha^{-1} koksnes pelniem ir pietiekama. Kaut arī sākotnējā priedes augšanas gaita ir salīdzinoši lēna, tā ir piemērota audzēšanai nabadzīgos apstākļos, jo visos variantos priežu izdzīvotība bija >98%. Sākotnēji pietiek ar 5 t ha^{-1} koksnes pelnu devu, lai nodrošinātu koku augšanu, tomēr pēc pieciem gadiem vislabākie rādītāji priedei, bērzam un melnalksnim bija izmantojot 15 t ha^{-1} koksnes pelnu devu (attiecīgi 180, 367 un 476 cm) salīdzinājumā ar kontroli (attiecīgi 100, 78 un 154 cm). Stādījums ierīkots LIFE Restore projekta ietvaros (LIFE14 CCM/LV/001103).

Practice "abstract" 49:	*Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.*
Short title in English	Combating desertification in the Mediterranean – key findings of the MediOpuntia project
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). *Do not complete if the summary below is completed in English* This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	MediOpuntia is a project whose purpose is to promote the establishment of Opuntia spp. in dry marginal lands of the Mediterranean adopting efficient water management systems. O. ficus-indica was planted under different irrigation applications to understand the effect of severe water deficit on crop development: (I1) 12 L/plant/week regardless soil water content in effective root zone (554 m3·yr-1); (I2) received water only when soil water content (SWC) dropped under 85% of soil available water (AW) (16.6 m3·yr-1); (I3) received water each time SWC dropped below 70% of AW (12.5 m3·yr-1). The results revealed higher fruit yield under I1 (340 kg· ha^{-1}) than I2 and I3 (226-227 kg· ha^{-1}). Yet, water productivity was the lowest in I1 (0.62 kg·m-3), the highest in I3 (18.1 kg·m-3), and in between in I2 (13.6 kg·m-3). No significant difference was found in soil water content and canopy cover, among the applied irrigation scheduling. It is recommended to irrigate the crop following the intermittent I3 irrigation system. Although fruit yield was reduced by 34%, the water applied in I3 represented only 2.25% of the water applied in I1, providing savings of 97.75%. Considering that several regions of the Mediterranean have limited water resources, this solution contributes to improve the sustainability of the Opuntia spp. production in arid marginal lands, contributing positively to achieve food security. In the framework of the project, a prototype was developed by CREA-IT for the application of subsurface water retention technology (SWRT) in the experimental fields. This technology increases water holding capacity in the root zones in permeable sandy soil which will impact positively agriculture production in marginal arid soils.

Short title in native language	Combate à desertificação no Mediterrâneo - principais conclusões do projeto MediOpuntia
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: − Main **results/outcomes** of the activity (expected or final) − The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.	O projeto MediOpuntia tem por objetivo o cultivo de Opuntia spp. em terras áridas do Mediterrâneo, adotando sistemas eficientes de gestão da água. O O. ficus-indica foi plantado sob diferentes regimes de irrigação para estudar o efeito do déficit hídrico no desenvolvimento da cultura: (I1) 12 L / planta / semana, independentemente do teor de água no solo na rizosfera (554 m3·ano-1); (I2) e (I3) recebeu água quando o conteúdo de água no solo foi inferior a 85% e a 70% da água disponível no solo (16,6 m3·ano-1 e 12,5 m3·ano-1, respetivamente). Os resultados revelaram maior produção de frutos em I1 (340 kg· ha^{-1}) do que em I2 e I3 (226-227 kg· ha^{-1}). No entanto, a produtividade da água foi a mais baixa em I1 (0,62 kg·m-3), a mais alta em I3 (18,1 kg·m-3) e intermédia em I2 (13,6 kg·m-3). Não se verificaram diferenças significativas no teor de água do solo e cobertura do solo, entre os regimes de irrigação aplicados. Recomenda-se a rega seguindo o sistema de irrigação intermitente I3. Embora a produção de frutos tenha sido 34% inferior, o uso de água em I3 representou apenas 2,25% dos recursos aplicados em I1, proporcionando uma economia de 97,75%. Considerando que várias regiões do Mediterrâneo apresentam recursos hídricos limitados, esta solução contribui para melhorar a sustentabilidade da produção de Opuntia spp. em terras áridas, contribuindo positivamente para a segurança alimentar. No âmbito do projeto, um protótipo foi desenvolvido pelo CREA-IT para a aplicação da tecnologia de retenção de água subterrânea em campos experimentais. Esta tecnologia aumenta a capacidade de retenção de água, na rizosfera, em solo arenoso permeável, o que terá um impacto positivo na produção agrícola em solos áridos.