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INDEX

AREA 1 – ENERGETIC INSTALLATIONS 16

Full Solar Charging Station for EV
J.M. Suárez Muñoz, A. Pérez Cagigas , A. Ortiz Juárez, E. Carranza Cueva, S. Tamayo Pacheco 17
Definition of construction cost structure for energy rehabilitation of buildings
C.Fé, E.Gómez, J.Solís, P. González, M. Marrero, A. Ramírez, J.L. Molina, R. Salmerón, S. Álvarez 18
Solar Roadsides
J.M. Suárez Muñoz, R. Pascual Juez 19
Thermodynamic validation of near-optimal reactive distillation column designs
I. F. Gomes, R. M. Filipe, A. Q. Novais 20
HVAC System Energy Optimization of an Industrial
A. Guedes, L. Oliveira , I. Sarmento, J. Rocha 21
Energy Optimization of the Climate Control of a Pottery
A. Guedes, A. Silva, H. Barros 22
Energy Recovery in Water Cycle using Picoturbine Systems. Autoconsumption Aplications. 3 Cases of Study
A. Cortés Marco, J. Pérez-García, J.A. Imbernón Manresa, S. Nevado Santos 23
Extremadura Climate Zoning for application in Energy Certification Procedures
F. López Rodríguez, A. Ruiz Celma, F. Cuadros Blázquez, F. Del Moral García, B. Nieto-Sandoval García, E. Pulido Granado 24
Evaluation of the performance of a domestic pellet boiler burning EU certified and non-certified commercial pine pellets
T. Ferreira, J.M. Paiva, C. Pinho 25
Basic Desing of a Three Pressures Steam Cycle in HRSG for CCPP
S.G. Orille, M. R. Guerrero 26
Computational Intelligence techniques for maximum energy efficiency of cogeneration processes
S. Seijo, I. del Campo, J. Echanobe, J. García, E. Suso, T.Atienza 27
ADVANCED USE OF POD AS INSPECTION TECHNIQUE FOR A SIROCCO DOUBLE ASPIRATING CENTRIFUGAL FAN
Laura Delgado, Jesús M. Fernández Oro, Sandra Velarde-Suárez, David Rodríguez, José González 28
Energetic efficiency in buildings: the use of a solar system for water heating associated with a heat exchanger..
R. Barbosa Pontes , Prof. MSc. P. Roberto dos Santos 29
An analysis of strongly swirling flow in a model vortex chamber
S. Shtork, I. Litvinov, P. Kuibin , E. Fernandes 30

AREA 2 – RENEWABLE ENERGIES 31

Design and analysis of buoy geometries for a wave energy converter
Pedro Beirão , Candida Malca 32
Feasibility Study of Offshore Wind Farms Installation within the Greek Exclusive Economic Zone
Emmanouil I. Konstantinidis, Dimitris G. Kompolias, Pantelis N. Botsaris 33
Maximum efficiency of a solar gas turbine power plant
S. Sánchez- Orgaz, A. Medina, A. Calvo Hernández 34
Artificial roughness arrangement effects on heat transfer and flow developments – case of solar air collectors
O. Mahfoud, A. Moummi, N. Moummi 35
Characterization of new developed catalyst for natural gas and biogas steam reforming reaction
G. Monteleone, M.C. Annesini, A. Giaconia, L. Turchetti 36
Energetic applications of tobacco plant
A. González-González, F. Cuadros, F. Cuadros-Salcedo 37
Renewable Energies. CIPFP Vicente Blasco Ibáñez - Valencia
Antonio Blanco Solsona 38
SILOXANES REMOVAL FROM BIOGAS BY HIGH SURFACE AREA ADSORBENTS
P.Gislon, S.Galli, G.Monteleone 39

Optimization of CFD methodologies for the aerodynamic study of wind turbine airfoils
Sandra Velarde-Suárez, Esther Castiñeira-Martínez, Jesús M. Fernández Oro, Katia M. Argüelles Díaz, José González 40
Adaptive Monitoring of µg Activity through Intelligent Smart Meter Deployments in Smart Grids.
F. Prieto-Castrillo, J. Domínguez-Bravo, M. Rubio del Solar, M. Botón-Fernández, ... 41
STUDY OF THE VIABILITY OF INSTALLATION FOR SOLAR SWIMMING POOL TO PRODUCT ELECTRIC ENERGY
José Roberto Abbud Jorge 42
Time Delay Algorithms for Wind Turbine Yaw Control System
A. G. Kavaz, B. Barutcu 43
Stabilize Fluctuating Power from Renewable Energies Exploited with Advanced Technologies
T. Kanemoto , S. Okamoto and Y. Usui 44
Daylight in window design: optimization of proportion and position under overcast sky conditions.
Ignacio Acosta, Miguel Ángel Campano, Carmen Muñoz 45
MODELLING OF ELECTRICAL SELF CONSUMPTION FACILITIES FOR POWER OPTIMIZATION PROFITABILITY.
Diego Carmona Fernández, Luis Alberto Horrillo Horrillo, Awf Al-KassirAbdulla..... 46
Potential of Jerusalem artichoke as an energetic crop: tuber yield and above-ground biomass in different sampling dates
M. A. Rodrigues, I. Q. Ferreira, M. Arrobas, V. Cadavez..... 47
Studies on nitrogen rates, sowing dates and cultivar of rapeseed in North-eastern Portugal
M. Ângelo Rodrigues, Lino Maia, Rodrigo Rocha, Isabel Q. Ferreira, Margarida Arrobas, Arlindo Almeida..... 48
Estimation of temperature and enthalpy of the flue gases in the combustion of biomass in a conical reactor of spouted bed
A. Pablos , JF. Saldarriaga , M. Amutio, R. Aguado, M. Olazar 49
Assessment of Several Weeds for Biogas Production
J.L. Guil-Laynez, A. Guil-Laynez, J.L. Guil-Guerrero 50
A study of combustion and emissions of experimental pellets in a small-scale stove
J.I. Arranz, T. Miranda, I. Montero, F. Sepúlveda, S. Nogales 51
Biogas Production from Greenhouse By-products
A. Guil-Laynez, J.L. Guil-Laynez, J.L. Guil-Guerrero 52
Nutritional Assessment of Greenhouse By-products for Biogas Production
A. Guil-Laynez, J.L. Guil-Laynez, J.L. Guil-Guerrero 53
Nutritional Assessment of Fishing By-products for Biogas Production
J.L. Guil-Laynez, A. Guil-Laynez, J.L. Guil-Guerrero 54
The use of ultrasonication in biomass and its effect on thermogravimetric and emission profiles
M. T. Miranda, S. Nogales-Delgado, S. Román, I. Montero, J.I. Arranz, C.V. Rojas 55
Slow pyrolysis of woody biomass waste: Influence of raw material on pyrolysis products
A. Lopez-Urionabarrenechea*, I. de Marco, A. Adrados, J. Solar, B.M. Caballero, J.F. Cambra. 56
Steam Gasification of Crude Glycerin in a Packed Bed Reactor
P. Barata, A.S. Veríssimo and M. Costa..... 57
Potential of Producing Bio-oils through Fast Pyrolysis from Agricultural Residues
R. Maximino, R. Neto, M. Costa 58
Life Cycle Assessment of Residual Forestry Biomass Chips at Power Plant: a Portuguese case study
José V. Ferreira, Helder Viana, Bruno Esteves, Luísa P. Cruz Lopes, Idalina Domingos 59
Wind speed profile model based a new artificial neural network
Nawal Cheggaga, & Fatiha Youcef Ettoumi 60
Autochthon microalgae cultivation technology for biomass feedstock production
J.F. González , B. Cuello, M. Calderón, A.J. Calderón, J. González 61
Synthesis of biodiesel from animal fats by acid catalysis in subcritical methanol conditions
J. M. Encinar , J.F. González, N. Sánchez , J. Soria 62
Complete optimization of castor oil transesterification to obtain biodiesel: A response surface methodology approach
J. M. Encinar, J.F. González, N. Sánchez, R. Sánchez..... 63
Use of Biogas and Sludge of UASB Reactors as Renewable Energy Source in Waste Water Treatment Plants
J. A. Conesa, A. Pereira, C.A.L. Chernicharo 64
Corn Stover Thermal Decomposition in Pyrolytic and Oxidant Atmosphere
J. A. Conesa, A. Urueña..... 65

Potential of Jerusalem artichoke as an energetic crop: tuber yield and above-ground biomass in different sampling dates

M. A. Rodrigues [1,2], I. Q. Ferreira [2], M. Arrobas [1,2], V. Cadavez [1,2]

[1] Mountain Research Centre – [2] Polytechnic Institute of Bragança.
Phone: 00351 273303237; e-mail: angelor@ipb.pt

1. Introduction – Jerusalem artichoke (Helianthus tuberosus) is a species of the Asteraceae family that has been grown for its edible tubers. It is also used as an ornamental in several parts of the world. Previous studies have revealed that Jerusalem artichoke can be grown in Portugal, producing high tuber yields when the crop is regularly watered and moderately fertilized with nitrogen [1]. In recent years there has been an increasing interest on this species, since it can be grown as an energetic crop for bioethanol production because it commonly accumulates high levels of carbohydrates in the tubers [2]. Furthermore, the high amount of above-ground phytomass yielded may be used in the near future in the production of lignocellulosic bioethanol. This study was conducted with the aim of assessing the potential of Jerusalem artichoke to accumulate aerial phytomass and tubers in two dates of the growing cycle: at full bloom, when the accumulation of dry matter in aerial biomass reaches the higher level; and at the end of the growing cycle when almost all the photoassmilates were translocate to the tubers.

2. Experimental – A field trial was carried out in Bragança (41º48' N; 6º44' W), NE Portugal, in a Eutric Cambissol. The experimental design included four nitrogen rates (0, 40, 80 and 160 kg N ha^{-1}), since N is one of the major ecological factors determining the partition of photoassimilates between the aerial biomass and storage organs. The planting density was 2 plants m^{-2} and the crop was sprinkle-irrigated throughout the growing season. During the growing season the nutritional status of the crop was monitored by determining the chlorophyll content of leaves using the portable SPAD-502 chlorophyll meter and the standard leaf analysis procedure. SPAD readings were taken in the youngest fully developed leaves of the upper part of the plant. The leaves collected for laboratory analysis were also taken up from the same position in the plant. At full bloom samples of 1 m^2 were cut to determine the dry matter content in the above-ground biomasss. At harvest, tuber dry matter yields were determined in the plants in which the above-ground biomass was cut at flowering and in those in which the above-ground biomass was maintained until the end of the growing season.

3. Results and Discussion – The production of aerial phytomass at full bloom varied significantly ($P<0.05$) between N rates, reaching a maximum value of fresh tissues of 26.9 Mg ha-1 when 80 kg N ha-1 were applied. In the plants where the above-ground biomass was cut at full bloom, interrupting the translocation of photoassimilates to the storage organs, fresh tuber yields also showed significant differences between N fertilization rates, reaching a maximum of 10.4 Mg ha-1 when 80 kg N ha-1 were applied. When the aerial biomass was left until the end of the growing season, fresh tuber yield reached a maximum of 24.4 Mg ha-1 in the plots where 160 kg N ha-1 were applied. Seed yields were lower than those found in previous studies with this crop in similar agro-ecological conditions [1]. The plant suffered a severe attack of Sclerotinia following flowering that restricted the photosynthetic capacity of the plants and which impaired the translocation of assimilates to the tubers. Despite being considered a hard crop [3], the introduction of this species into intensive cropping, with sprinkler irrigation and fertilization, seems to make it vulnerable to some diseases which will require monitoring and control.

4. Conclusions – The cut of the above-ground biomass at flowering stage resulted in a tuber weight loss at harvest of 60%. Thus, the best option on how to manage the crop will depend on the value of the aerial phytomass and tubers as raw materials for bioenergetic purposes. The profitable cultivation of Jerusalem artichoke seems possible in the conditions of this experiment. However, monitoring pest and disease will be needed to safeguard the expression of the full potential of the crop to produce and store biomass.

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