Renewable Energy Research Institute
Department of Agroforestry Technology and Science and Genetics
CASTILLA LA MANCHA UNIVERSITY

VALUE FOR CULTIVATION AND USE TESTING OF THE CLONE IN VITRO 112® (VCU)

Hibrid Paulownia Elongate x Paulownia Forunei

Technical Report (June 2013)

Environmental and Forest Resources Department. Campus Universitario s/n, CP 02071 Albacete, Spain

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Environmental and Forest Resources Department. Campus Universitario s/n, CP 02071 Albacete, Spain

1.- BACKGROUND AND OBJECTIVES.

The concentration of carbon dioxide (CO_2) in the Earth's atmosphere is rising rapidly due to emissions from human activities and atmospheric CO_2 concentration is now higher than at any time in the past 400000 years. Consequently, average temperature is expected to increase between 2 and 4ºC over the next century in the Mediterranean basin and precipitation is expected to decrease in summer and autumn, but to increase in winter, resulting in higher intensity precipitation events. Thus, climate change is one of the major challenges for society in the coming decades since it is expected to drastically modify developing conditions for many flora and fauna species. On this context, National and International Organizations have developed different strategies with the aim of promoting the substitution of fossil fuels for renewable energy sources, which is closely connected with the possibility of using additional trees as carbon sinks. The use of short rotation forestry plantations is a promising tool for reducing atmospheric carbon dioxide concentration through fossil fuel substitution and new opportunities to finance wood energy, agro-forestry projects and plantations for biomass production have appeared. Short rotation forestry plantations represent an ideal tool to maximize yields and sequester CO_2 and these land uses have been introduced with the aim of producing biomass for energy and industry both in the USA and in Europe over the past two decades. The most common species utilized for such plantations in temperate climates belong to the genera *Populus* and *Salix* and in a few cases species of the genera *Betula*, *Alnus*, *Robinia* and *Nothofagus* are also utilized.

Besides minimising or avoiding the utilisation of fossil energy, the enhanced use of tree crop is considered to contribute highly to the reduction of the CO_2 emissions into the atmosphere and to the protection of fossil resources. Therefore, short rotation forestry plantations are considered to be environmentally friendly, help diversify farm income, and can play a major role in the mitigation of green house gases and the adaptation of agriculture to changing environmental conditions.

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Paulownia ssp is an extremely fast-growing deciduous tree species with vegetative propagation and high tolerance to natural conditions. This tree is original of China and its natural distribution ranges from tropical through to cool temperate climates, on sites with average rainfall ranging from 500 mm to over 2000 mm per annum. Paulownia occurs from just above sea level up to an altitude of 2400 meters and it could be considered as a low demand water plant, in spite of not growing in barren zones.

Figure 1. Paulownia clone In Vitro 112® plantation of two months for wood production located in Valencia (Spain).

On this context and in order to propose the Paulownia clone In Vitro 112® for Cultivation and Use Testing of Plant Varieties (VCU), the current document is elaborated and presented. The objectives of Value for Cultivation and Use Testing of Plant Varieties (VCU) is to establish in respect of a variety: differences of productivity, biological characteristics, quality of the obtained produce, chemical and technological characteristics from the standard variety,

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resistance to pests and diseases, as well as other commercially important characteristics, growing suitability under different agro-climatic conditions.

The present report has been elaborated with data obtained from the Castilla La Mancha University research project number PBI06-0161: Forestación de zonas semi-áridas de Castilla La Mancha con especies del género Paulownia spp (funded by the Castilla La Mancha Government between 2008 and 2010). Also, information from recently developed research studies and independent company reports has been used.

2.- MAIN CHARACTERISTICS OF PAULOWNIA CLONE IN VITRO 112®.

2.1.- General characteristics

Paulownia (a tree known as the Princess Tree or Phoenix Tree) is a hardwood tree with the fastest growth in the world. If grown in proper conditions, it can reach a height up to 20 m in 3 years and also can be harvested for timber production. At least six species of Paulownia are known today: *P. Elongate, P. Fargesii, P. Forunei, P. Giabrata, P. Taiwaniana, P. Tomentosa*: also known as Kiri. The Paulownia Clone in Vitro 112® tree was selected by In VItro SL from Sant Feliu de Llobregat, Barcelona, Spain, (identification nursery number ES-09-08-0016). They are cloned, hybrid trees. The main characteristics of the trees are that they are able to resist in extreme temperatures, from -25 to + 45 degrees Celsius and can be harvested for the best quality timber. Once planted, it can be harvested at least three times. These trees plays a very important role in providing timber for furniture industry, fire wood and have many other purposes.

One of the most versatile wood plants available, Paulownia Clone in Vitro 112®, gained tremendous popularity in the world (i.e. Europe, South America), where its cultivation is booming, especially for the furniture production, plywood and biomass. Known in the timber and furniture industry as “aluminium timber”, Paulownia Clone in Vitro 112® is 30% lighter than any comparable hard wood. Paulownia Clone in Vitro 112® is resistant to contortion, resistant to shrinkage

(no splits) and is generally resistant to deformation. It is beautiful, clean and smooth. It has no nodes. Its fine-grained properties make the Paulownia Clone in Vitro 112® wood exceptionally suitable for boats, pallets, household furniture, plywood and prefabricated panels. The plants were given international recognition, with European quality certificate and also International trading license.

Figure 2. Picture from Paulownia clone in vitro 112® stem of four years then to be harvested. Plantation for wood production.

The tree regenerates naturally from existing root systems, earning a well-deserved nickname Phoenix Tree. This means you can harvest between minimum 3 and a maximum of 5 generations without the need of replanting. Its leaves grow fast and have an immense capacity to absorb carbon dioxide.

Its deep root system cleans the degraded soil surfaces. Its deep roots allow also to improve soil quality and to maintain underground water. Paulownia Clone in Vitro 112® is new species created, tested and recognized

internationally by experts in the field, can not be multiplied; therefore it is not an invasive species, no matter where it is cultivated in the world.

The main product gained out of the Paulownia Clone in Vitro 112® tree is wood. Because of its resistance and because it is light weighted, the Paulownia Clone in Vitro 112® wood is suitable for furniture and upholstery inside of trailers, aircrafts and light boats. It is also suitable for obtaining wood pulp, fibber, paper and laminated beams. The wood is semiprecious, has a very light colour, it is very resistant. Comparing it with metals, Paulownia Clone in Vitro 112® can be referred to as the “aluminium” of the utility woods. 1 cubic meter of the Paulownia wood weighs about 310 kg. It is one of the most intensively processed products, one of the most stable, doesn’t bend, deform or crack.

Figure 3. Picture from Paulownia clone in Vitro 112® cloning work at the laboratory.

The wood is easily processed, has a high smoothness and allows performing a large variety of finished products. Can be painted, varnished or can be added glue to it. Not easily inflammable and it is water resistant. Its texture and colour are similar to the ash tree. Because of the easy processing it is prefect for preparation of boards and cladding. Has a high capacity of isolating heat and/or cold. It is excellent in constructions as cladding and interior - exterior isolation.

Figure 4. Manufactured wood from Paulownia clone in vitro 112®.

The trees can be cut down after 4 years for the wood production, and after 1 or 2 years for the production of pillars. For woody biomass production, trees can be cut down each 2 or 3 years. Are easily peeled (20 % easier than in case of other trees). Easily adapts to the climate and soils. The Paulownia Clone in Vitro 112® has a high degree of usage because the trees can be cut down at

every three years, and used for obtaining energy or in woodworking shops. It is a good forestry curtain for protection, the trees are very adequate for shade. These trees tolerate all soil types. Fluid requirements are 750 mm3 / year. The nitrogen consumption of the adult trees is estimated to 350 UF of nitrogen. The roots are vertical, reaching up to 9 m. The width of the canopy can easily overcome 10m; this is why it is not recommended to plant Paulownia or any other trees with rich canopy near walls, constructions, water pipes or electric cables. The leaves are large, especially in the first year of growth, having over 60 cm, which represents a great ecological help in the war against air pollution. The leaves are useful as fodder or as fertilizer, due to its high nitrogen content. Estimated absorption for 1 ha of Paulownia is 1200 t / ha / year.

Figure 5. Picture from Paulownia clone in vitro 112® leaves. Four months plantation.

Paulownia honey has a remarkable taste; it is flavoured, has a light colour and can be compared only with the acacia honey, having the same qualities. The Paulownia honey is also used as medicine helps cure bronchitis and other

respiratory diseases and also helps improving digestion. These properties of the Paulownia honey are due to the biologically active flower substances, which are used in food products. Honey production per ha is around 700 kg.

Figure 6. Picture from Paulownia clone in vitro 112® seeds.

In relation to soil, Paulownia Clone in Vitro 112® normally lives in soils with pH values between 5,5 and 8,7. According with different studies (see point 6.- additional studies related with paulownia clone in vitro 112® plantations), paulownia plantation generates better soil status than the maize crop (intensive use of the soil). In spite of the higher soil organic matter content found in the paulownia plantation and the maize crop, the presence of heavy metals and machinery operations decline the physical and chemical soil properties, creating an unfavourable environment for soil microbes, as their lower activity levels reflected. Thus, paulownia plantation is not the worst soil use of the four compared in this study although machinery operation should be avoided in the paulownia plantation development in order to not decline the soil condition as usually happens in cropped soil.

Figure 7. Picture from Paulownia clone in vitro 112® flowers.

Figure 8. Picture of harvest operations from Paulownia clone in vitro 112® Plantation of five years. Plantation for wood production.

2.1.- Characteristics included in the international union for the protection of new varieties of plants (UPOV).

According to field observations of about 10 years and following the UPOV classification parameters, the Paulownia characteristics are:

- Commercial name: Clone in Vitro 112
- Botanical name of taxon: *Paulownia elongata* S. Y. Hu x *Paulownia Fortunei* (Seem.) Hemsl.
- Plant, spring sprouting: early to medium.
- Petiole, length: long.
- Petiole, colour of upper side: medium red.
- Petiole, angle between petiole and stem: large.
- Leaf blade, width: broad.
- Leaf blade, doming between veins: strong.
- Leaf blade, expression of pair of lobes: weak.
- Leaf blade, shape of tip: short acuminate.
- Leaf blade, hairiness of lower side: medium green.
- Stem, colour in upper third of sunny side: grey brown.

3.- GROWTH RATE DESCRIPTION OF PAULOWNIA CLONE IN VITRO 112®.

Different factors have to be considered for the growth rate description. For example, growth rate and productivity are influenced by soil characteristics, water quality and quantity, climatic characteristics of each site. The plantations management plans are normally divided according to two options: 1) wood production and 2) woody biomass production. For wood productions, Paulownia Clone in Vitro 112® trees are harvested with eight/nine years old generating 1 cubic meter. For woody biomass production, trees are harvested each two or

three years, generating 30-50 Ton by hectare each year. The clone in Vitro 112® planting density is 5x5 meters spacing for woof production and 3x2 meters spacing fbiomass production.

In order to correctly describe growth rate description, tested data from experimental plantation are provided as follow. Paulownia trees clone In Vitro 112® were planted in Valencia, Tarragona, Girona and Sevilla (Spain). The following pictures are from a Paulownia clone in Vitro 112® plantation fro woody biomass production located in Tarragona (Spain). The plantation was established in June-2012.

Figure 9. First day Paulownia clone in vitro 112® Plantation in Tarragona (June-2012)

Figure 10. First day Paulownia clone in vitro 112® Plantation in Tarragona (June-2012). Detail of protection to avoid plant damage and predation.

Figure 11. Paulownia clone in vitro 112® plantation of four months for woody biomass production (october-2012).

Figure 12. Detail of the re-sprouting Paulownia clone in vitro 112® plantation (April-2013).

Figure 13. New respouting before technical cut in April 2013.

The following pictures are from a Paulownia clone in Vitro 112® plantation fro woody biomass production located in Sevilla (Spain). The plantation was established in June-2012.

Figure 14. Four months Paulownia clone in vitro 112® plantation located in Sevilla (octubre-2012).

Figure 15. Four months Paulownia clone in vitro 112® plantation located in Sevilla (octubre-2012).

Pictures from Paulownia planation located in Valencia:

Figure 16. First day. Paulownia clone in vitro 112®**.** Trees were planted in 5, may 2009.

Figure 17. One month later. Paulownia clone in vitro 112® trees need develop a root system first.

Figure 18. Paulownia clone in vitro 112®**.** Picture taken 27-9-2009. Five months after planting.

Figure 19. Paulownia clone in vitro 112®**.** Evolution year by year of the trees. Pictures were taken between september and october. Left picture correspond with year 2010, 18 months after planting. Picture in the middle correspond to year 2011 and right one, correspond to 2012.

Some trees were cut off in march 2012 to evaluate clon Invitro 112® timber. See rings, 3 year old and 36 cm in diameter. Picture detail of almost 1 year regrowth, exactly 7 month regrowth. Still have to get thick during two moths more.

Figure 20. Paulownia clone in vitro 112® three years old and 36 cm in diameter.

Following pictures are from the same tree. Mesures was taken at chest height and at the base of tree. Both pictures of the left were taken in 2011. Mesures are, 20 cm DAP and 30 cm diameter at the base. The right pictures were taken 1 year later, in 2012. Mesures are, 28 cm DAP and 37 cm diameter at the base.

Figure 21. Paulownia clone in vitro 112®**.** Pictures from the same tree (see mesureament detail)

Figure 22. Paulownia clone in vitro 112®**.** Pictures from the same tree (see mesureament detail)

Picture 23. Paulownia clone in vitro 112®**.** Four year old tree, 42 cm in diameter at the stump. Same paulownia tree that figure 22

Picture 24. Paulownia clone in vitro 112®**.** Four year old tree, 42 cm in diameter at the stump. Same paulownia tree that figure 13.

Picture 25. Paulownia clone in vitro 112®**.** Harvesting process. Trees were planted in 2009 and harvested in 2013.

Picture 26. Paulownia clone in vitro 112®**.** Manufacturing process.

Picture 27. Paulownia clone in vitro 112® final product. (unfinished boards for surfing).

Picture 28. Paulownia clone in vitro 112® final product. (boards for surfing).

Picture 29. Detail of Paulownia clone in vitro 112® final product.

The following pictures are from a wood production plantation located in Gerona (Spain).

Picture 30. Paulownia clone in vitro 112® plantation of about 5 years old and located in Gerona (Spain).

Picture 31. Paulownia clone in vitro 112® plantation of about 5 years old and located in Gerona (Spain).

Picture 32. Paulownia clone in vitro 112® plantation of about 5 years old and located in Gerona (Spain). Plantation for wood production.

Them the trees were cut down as is showed in the next pictures:

Picture 33. Piece of wood from Paulownia clone in vitro 112® then to be cut down. Plantation for wood production.

Figure 34. Picture of harvest operations from Paulownia clone in vitro 112® Plantation of five years. Plantation for wood production.

Picture 35. Piece of wood from Paulownia clone in vitro 112® then to be cut down.

Picture 36. Detail of Paulownia clone in vitro 112® chips.

Then to cut the trees, a vigorous re-sporuting is generated as is showed in the next pictures:

Picture 37. Detail of the resprouting of Paulownia clone in vitro 112®. 15 days since the tree was cut down.

Picture 38. Detail of the resprouting of Paulownia clone in vitro 112®. 30 days since the tree was cut down.

Pictures from Valencia plantations:

Picture 39. Paulownia clone in vitro 112® tree planted in 09 May-2009.

Picture 40. Pictures from the same plantation that picture 39. Eleven years months from initial plantation time (left picture) and seventeen months old from initial plantation time (right picture)

Picture 41. Paulownia clone in vitro 112 tree planted in 09 May-2009. Picture taken eighteen months later

Picture 42. Paulownia clone in vitro 112 tree planted in 09 May-2009. Picture taken eighteen months later

Picture 43. Paulownia clone in vitro 112® tree planted in 17 May-2007.

Picture 44. Paulownia clone in vitro 112 tree planted in 17 May-2007. Picture taken 3 years later

Picture 44. Paulownia clone in vitro 112® tree planted in 02 April-2006.

Picture 45. Technical cut in February 2007 of Paulownia clone in vitro 112® tree planted in 02 April-2006.

Picture 46. Pictures from the same plantation that picture 44. Three years old from initial plantation time (left picture) and four years old from initial plantation time (right picture)

Picture 47. Pictures from the same plantation that picture 44 (52,2 cm at breast height and three years old)

Picture 48. Pictures from the same plantation that picture 44 (60 cm at breast height and four years old)

For more detail about growth rate description of the Paulownia clone in Vitro 112®, see point 6.- additional studies related with paulownia clone in vitro 112® plantations. According with to the Castilla La Mancha University study, paulownia clone in Vitro 112® is a fast-growing species. Different paulownia varieties were tested on this study (i.e. cotevisa) and paulownia clone in Vitro 112® always presented better growing rates than the other variety.

4.- ECONOMIC ANALYSIS FOR WOOD AND WOODY BIOMASS PRODUCTION FROM PAULOWNIA CLONE IN VITRO 112® PLANTATIONS.

Different factors have to be considered when doing Economic analyses. For example, soil characteristics, plant spacing, water quality and quantity, climatic characteristics of each site, etc., influence growth rate and productivity. For example, 1 meter cubic was generated in Gerona plantations after 10 years. Also woody biomass production (3x2 plantation spacing) is influenced by location (Extremadura (Spain) 50 Ton by hectare each year; Valencia (Spain) 40 Ton by hectare each year; Toledo (Spain) 30 Ton by hectare each year.

Here some simulations depending on plantations conditions (irrigated system and plot rent) are presented for Paulownia clone in Vitro 112® plantation located in Spain. Wood price used in the economic simulations is 200 euros/m3. For woody biomass price, 78 euros/ton has been used in the economic simulations.

CULTIVO ENERGÉTICO DE PAULOWNIAS (50 ha.) CORTES CADA 2 AÑOS — Cálculos para 1 Ha.

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20	Año 21	Año 22
Inversión parcial riego	0																						
Arrendamiento	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planta	6.640	0																					
Plantación	580	0																					
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Cosechado y astillado		0	960		960		960		960		960	0	960	0	960	0	960	0	960	0	960	0	960
Total costes	**7.520**	**320**	**1.280**	**320**	**1.280**	**320**	**1.280**	**320**	**1.280**	**320**	**1.280**	**320**	**1.280**	**320**	**1.280**	**320**	**1.280**	**320**	**1.280**	**320**	**1.280**	**320**	**1280**
Ingresos	**0**	**0**	**12.480**	**0**	**12.480**	**0**	**12.480**	**0**	**12.480**	**0**	**12.480**	**0**	**12.480**	**0**	**12.480**	**0**	**12.480**	**0**	**12.480**	**0**	**12.480**	**0**	**12460**
Resultado	7.520	320	11.200	320	11.200	320	11.200	320	11.200	320	11.200	320	11.200	320	11.200	320	11.200	320	11.200	320	11.200	320	11200
Resultado acumulado	7.520	7.840	3.360	3.040	14.240	13.920	25.120	24.800	36.000	35.680	46.880	46.560	57.760	57.440	68.640	68.320	79.520	79.200	90.400	90.080	101.280	100.960	112.160

PARÁMETROS CONSIDERADOS			
Inversión parcial en riego por el proyecto	0	TIR	55,7%
Arrendamiento por hectárea	0	VAN	€ 59.273,80
Marco de plantación 3x2, unidades por hectárea	1.660	5%	
Precio planta por unidad	4,0		
Plantación	560	SUPUESTO 1 SIN INVERSIÓN EN SISTEMS DE RIEGO	
Mantenimiento y riego	320	SIN ARRENDAMIENTO	
Cosechado y astillado por tonelada	12		
Rendimiento (t/ha/año) al 30% de humedad	40		
Turno de años por cosecha	2		
Precio astillas por t., al 30% humedad, sin transporte	78		

Simulation 1: Economic analysis for plantation without irrigation system and without plot rent. Objective: Woody biomass production. Two years old plantation.

CULTIVO ENERGETICO DE PAULOWNIAS (50 ha.) CORTES CADA 2 AÑOS

Cálculos para 1 ha.

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20	Año 21	Año 22
Inversión parcial riego	------																						
Arrendamiento	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Planta	6.640	0																					
Plantación	560	0																					
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Cosechado y astillado		0	960		960		960		960		960	0	960	0	960	0	960	0	960	0	960	0	960
Total costes	8.120	920	1.880	920	1.880	920	1.880	920	1.880	920	1.880	920	1.880	920	1.880	920	1.880	920	1.880	920	1.880	920	1880
Ingresos	0	0	6.240	0	6.240	0	6.240	0	6.240	0	6.240	0	6.240	0	6.240	0	6.240	0	6.240	0	6.240	0	6240
Resultado	8.120	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4360
Resultado acumulado	8.120	9.040	4.680	5.600	1.240	2.160	2.200	1.280	5.640	4.720	9.080	8.160	12.520	11.600	15.960	15.040	19.400	18.480	22.840	21.920	26.280	25.360	29.720

PARAMETROS CONSIDERADOS			
Inversión parcial en riego por el proyecto	------	TIR	18,0%
Arrendamiento por hectárea	600	VAN	€ 13.021,71
Marco de plantación 3x2, unidades por hectárea	1.660	5%	
Precio planta por unidad	4,0	SUPUESTO 2 : SIN INVERSION E. EN SISTEMA DE RIEGO	
Plantación	560	CON ARRENDAMIENTO	
Mantenimiento y riego	320		
Cosechado y astillado por tonelada	12		
Rendimiento (tha/año) al 30% de humedad	40		
Turno de años por cosecha	2		
Precio astillas por t. al 30% humedad, sin transporte	78		

Simulation 2: Economic analysis for plantation without irrigation system and with plot rent. Objective: Woody biomass production. Two years old plantation.

CULTIVO ENERGÉTICO DE PAULOWNIAS (50 ha.) CORTES CADA 2 AÑOS

Cálculos para 1 ha

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20	Año 21	Año 22
Inversión parcial riego	1300																						
Arrendamiento	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Planta	6.640	0																					
Plantación	580	0																					
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Cosechado y astillado		0	960		960		960		960		960	0	960	0	960	0	960	0	960	0	960	0	960
Total costes	**9.420**	**920**	**1.880**	**920**	**1.880**	**920**	**1.880**	**920**	**1.880**	**920**	**1.880**	**920**	**1.880**	**920**	**1.880**	**920**	**1.880**	**920**	**1.880**	**920**	**1.880**	**920**	**1880**
Ingresos	**0**	**0**	**6.240**	**0**	**6.240**	**0**	**6.240**	**0**	**6.240**	**0**	**6.240**	**0**	**6.240**	**0**	**6.240**	**0**	**6.240**	**0**	**6.240**	**0**	**6.240**	**0**	**6240**
Resultado	9.420	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4.360	920	4360
Resultado acumulado	9.420	10.340	5.980	6.900	2.540	3.460	900	20	4.340	3.420	7.780	6.860	11.220	10.300	14.660	13.740	18.100	17.180	21.540	20.620	24.980	24.060	28.420

PARÁMETROS CONSIDERADOS

Inversión parcial en riego por el proyecto	1.300
Arrendamiento por hectárea	600
Marco de plantación 3x2, unidades por hectárea	1.660
Precio planta por unidad	4,0
Plantación	580
Mantenimiento y riego	320
Cosechado y astillado por tonelada	12
Rendimiento (t/ha/año) al 30% de humedad	40
Turno de años por cosecha	2
Precio astillas por t. al 30% humedad, sin transporte	78

TIR 16%

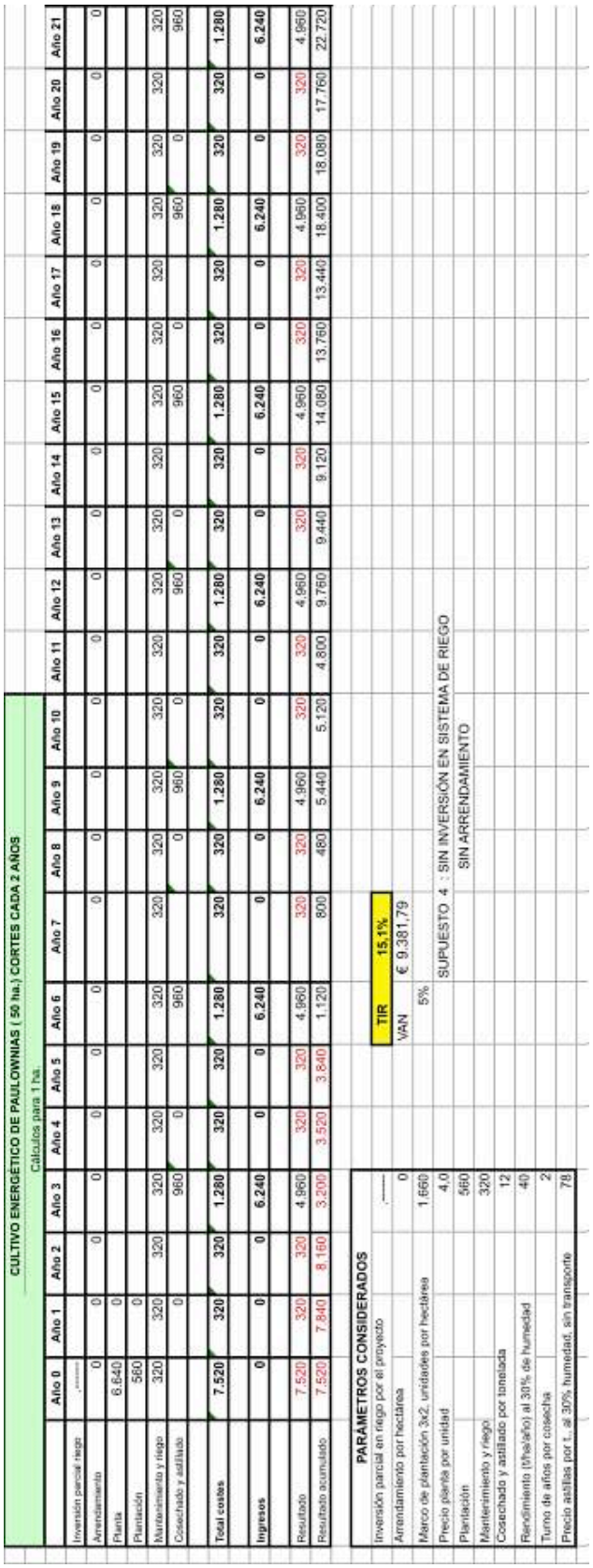
VAN € 11.783,61

5%

SUPUESTO 3 : CON INVERSIÓN EN SISTEMA DE RIEGO

CON ARRENDAMIENTO

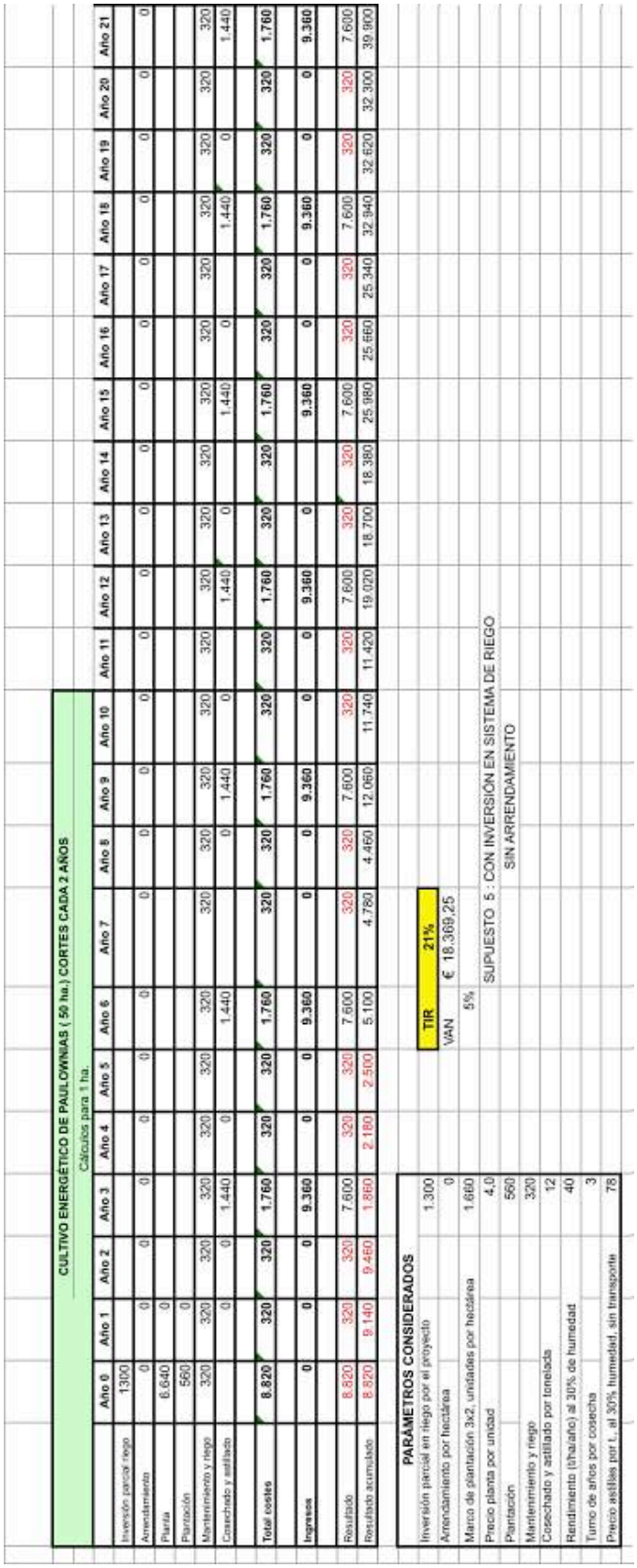
Simulation 3: Economic analysis for plantation with irrigation system and with plot rent. Objective: Woody biomass production. Two years old plantation.



CULTIVO ENERGÉTICO DE PAULOWNIAS (50 ha.) CORTES CADA 2 AÑOS Calculos para 1 ha.	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20	Año 21
Inversión parcial riego	,-----																					
Arrendamiento	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planta	6.640	0																				
Plantación	560	0																				
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Cosechado y astillado		0		960	0		960		0	960	0		960	0		960	0		960	0		960
Total costes	**7.520**	**320**	**320**	**1.280**	**320**	**320**	**1.280**	**320**	**320**	**1.280**	**320**	**320**	**1.280**	**320**	**320**	**1.280**	**320**	**320**	**1.280**	**320**	**320**	**1.280**
Ingresos	**0**	**0**	**0**	**6.240**	**0**	**0**	**6.240**	**0**	**0**	**6.240**	**0**	**0**	**6.240**	**0**	**0**	**6.240**	**0**	**0**	**6.240**	**0**	**0**	**6.240**
Resultado	7.520	320	320	4.960	320	320	4.960	320	320	4.960	320	320	4.960	320	320	4.960	320	320	4.960	320	320	4.960
Resultado acumulado	7.520	7.840	8.160	3.200	3.520	3.840	1.120	800	480	5.440	5.120	4.800	9.760	9.440	9.120	14.080	13.760	13.440	18.400	18.080	17.760	22.720

PARÁMETROS CONSIDERADOS			
Inversión parcial en riego por el proyecto	,-----	TIR	15,1%
Arrendamiento por hectárea	0	VAN	€ 9.381,79
Marco de plantación 3x2, unidades por hectárea	1.660	5%	
Precio planta por unidad	4,0	SUPUESTO 4 : SIN INVERSIÓN EN SISTEMA DE RIEGO	
Plantación	560	SIN ARRENDAMIENTO	
Mantenimiento y riego	320		
Cosechado y astillado por tonelada	12		
Rendimiento (t/ha/año) al 30% de humedad	40		
Turno de años por cosecha	2		
Precio astillas por t. al 30% humedad, sin transporte	78		

Simulation 4: Economic analysis for plantation without irrigation system and without plot rent. Objective: Woody biomass production. Three years old plantation.



CULTIVO ENERGÉTICO DE PAULOWNIAS (50 ha.) CORTES CADA 2 AÑOS

Cálculos para 1 ha.

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20	Año 21
Inversión parcial riego	1300																					
Amendamiento	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planta	6.640	0																				
Plantación	560	0																				
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Cosechado y astillado		0	0	1.440	0		1.440		0	1.440	0		1.440	0		1.440	0		1.440	0		1.440
Total costes	8.820	320	320	1.760	320	320	1.760	320	320	1.760	320	320	1.760	320	320	1.760	320	320	1.760	320	320	1.760
Ingresos	0	0	0	9.360	0	0	9.360	0	0	9.360	0	0	9.360	0	0	9.360	0	0	9.360	0	0	9.360
Resultado	8.820	320	320	7.600	320	320	7.600	320	320	7.600	320	320	7.600	320	320	7.600	320	320	7.600	320	320	7.600
Resultado acumulado	8.820	8.140	9.460	1.860	2.180	2.500	5.100	4.780	4.460	12.060	11.740	11.420	19.020	18.700	18.380	25.980	25.660	25.340	32.940	32.620	32.300	39.900

PARAMETROS CONSIDERADOS	
Inversión parcial en riego por el proyecto	1.300
Amendamiento por hectárea	0
Marco de plantación 3x2, unidades por hectárea	1.660
Precio planta por unidad	4,0
Plantación	560
Mantenimiento y riego	320
Cosechado y astillado por tonelada	12
Rendimiento (t/ha/año) al 30% de humedad	40
Turno de años por cosecha	3
Precio astillas por t., al 30% humedad, sin transporte	78

TIR	21%
VAN	€ 18.369,25
	5%

SUPUESTO 5 : CON INVERSIÓN EN SISTEMA DE RIEGO
SIN ARRENDAMIENTO

Simulation 5: Economic analysis for plantation with irrigation system and without plot rent.

Objective: Woody biomass production. Three years old plantation.

CULTIVO ENERGÉTICO DE PAULOWNIAS (50 ha.) CORTES CADA 3 AÑOS

Cálculos para 1 ha.

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20	Año 21
Inversión parcial riego	1300																					
Arrendamiento	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Planta	6.640	0																				
Plantación	560	0																				
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Cosechado y astillado		0		1.440	0		1.440		0	1.440	0		1.440	0		1.440	0		1.440			1.440
Total costes	**9.420**	**920**	**920**	**2.360**	**920**	**920**	**2.360**	**920**	**920**	**2.360**	**920**	**920**	**2.360**	**920**	**920**	**2.360**	**920**	**920**	**2.360**	**920**	**920**	**2.360**
Ingresos	**0**	**0**	**0**	**9.360**	**0**	**0**	**9.360**	**0**	**0**	**9.360**	**0**	**0**	**9.360**	**0**	**0**	**9.360**	**0**	**0**	**9.360**	**0**	**0**	**9.360**
Resultado	9.420	920	920	7.000	920	920	7.000	920	920	7.000	920	920	7.000	920	920	7.000	920	920	7.000	920	920	7.000
Resultado acumulado	9.420	10.340	11.260	4.260	5.180	6.100	900	20	940	6.060	5.140	4.220	11.220	10.300	9.380	16.380	15.460	14.540	21.540	20.620	19.700	26.700

PARÁMETROS CONSIDERADOS	
Inversión parcial en riego por el proyecto	1.300
Arrendamiento por hectárea	600
Marco de plantación 3x2, unidades por hectárea	1.660
Precio planta por unidad	4,0
Plantación	560
Mantenimiento y riego	320
Cosechado y astillado por tonelada	12
Rendimiento (t/ha/año) al 30% de humedad	40
Turno de años por cosecha	3
Precio astillas por t., al 30% humedad, sin transpc	78

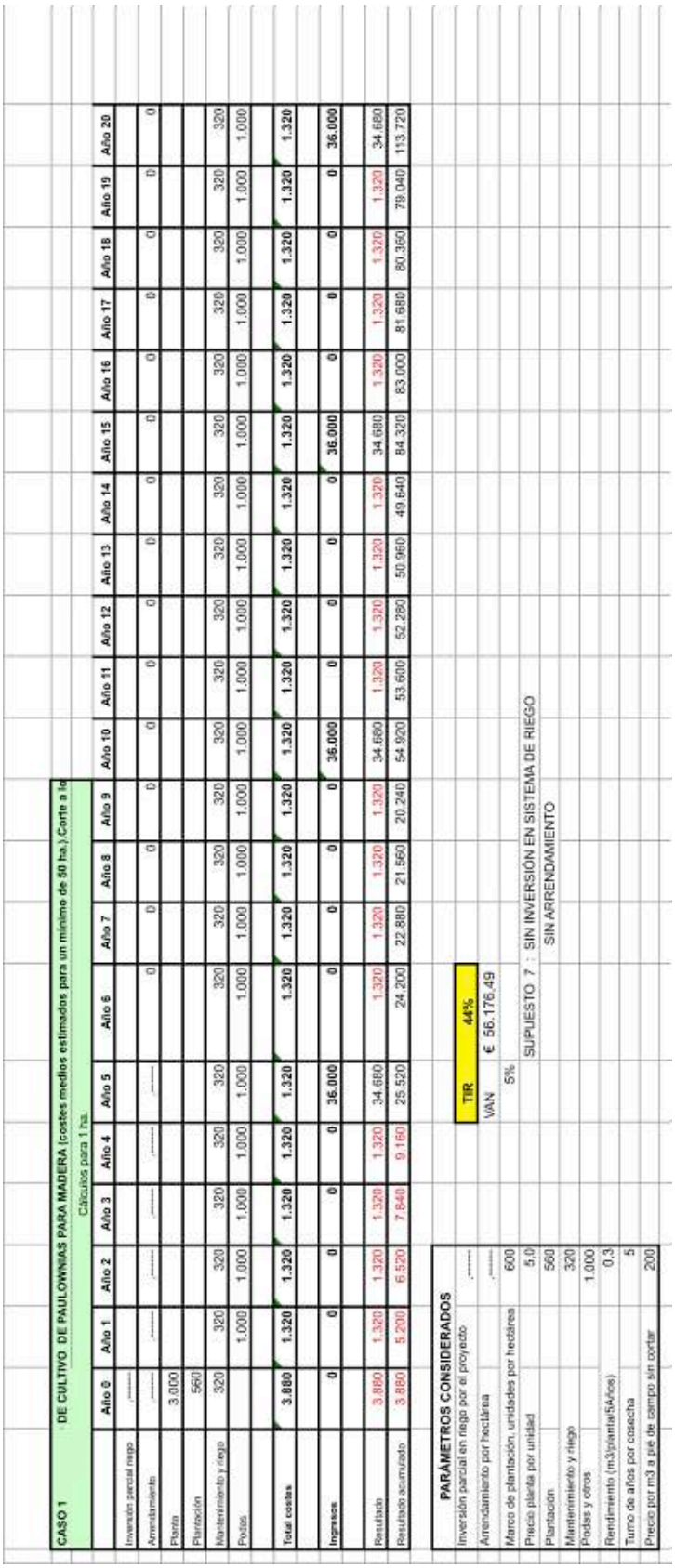
TIR 14%

VAN € 10.471,44

5%

SUPUESTO 6 : CON INVERSIÓN EN SISTEMA DE RIEGO
CON ARRENDAMIENTO

Simulation 6: Economic analysis for plantation with irrigation system and with plot rent. Objective: Woody biomass production. Three years old plantation.



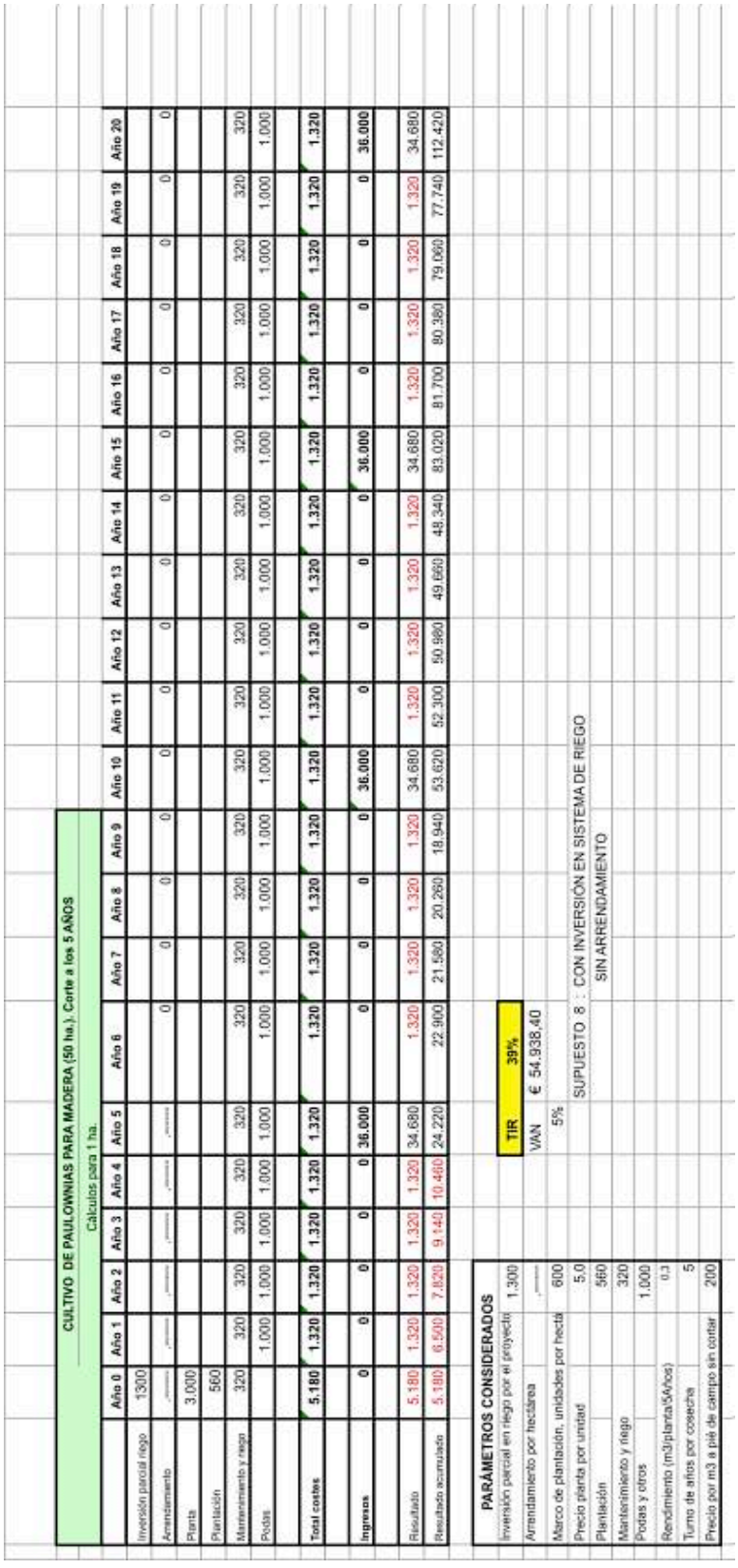
CASO 1	DE CULTIVO DE PAULOWNIAS PARA MADERA (costes medios estimados para un mínimo de 50 ha.).Corte a 16																			
	Cálculos para 1 ha																			
	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20
Inversión parcial riego	,------																				
Arrendamiento	,------	,------	,------	,------	,------	,------	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planta	3.000																				
Plantación	560																				
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Podas		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total costes	**3.880**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**
Ingresos	**0**	**0**	**0**	**0**	**0**	**36.000**	**0**	**0**	**0**	**0**	**36.000**	**0**	**0**	**0**	**0**	**36.000**	**0**	**0**	**0**	**0**	**36.000**
Resultado	3.880	1.320	1.320	1.320	1.320	34.680	1.320	1.320	1.320	1.320	34.680	1.320	1.320	1.320	1.320	34.680	1.320	1.320	1.320	1.320	34.680
Resultado acumulado	3.880	5.200	6.520	7.840	9.160	25.520	24.200	22.880	21.560	20.240	54.920	53.600	52.280	50.960	49.640	84.320	83.000	81.680	80.360	79.040	113.720

PARÁMETROS CONSIDERADOS	
Inversión parcial en riego por el proyecto	,------
Arrendamiento por hectárea	,------
Marco de plantación, unidades por hectárea	600
Precio planta por unidad	5,0
Plantación	560
Mantenimiento y riego	320
Podas y otros	1.000
Rendimiento (m3/planta/5Años)	0,3
Turno de años por cosecha	5
Precio por m3 a pie de campo sin cortar	200

TIR	44%
VAN	€ 56.176,49
	5%

SUPUESTO ? : SIN INVERSIÓN EN SISTEMA DE RIEGO
SIN ARRENDAMIENTO

Simulation 7: Economic analysis for plantation without irrigation system and without plot rent. Objective: Wood production. Five years old plantation.



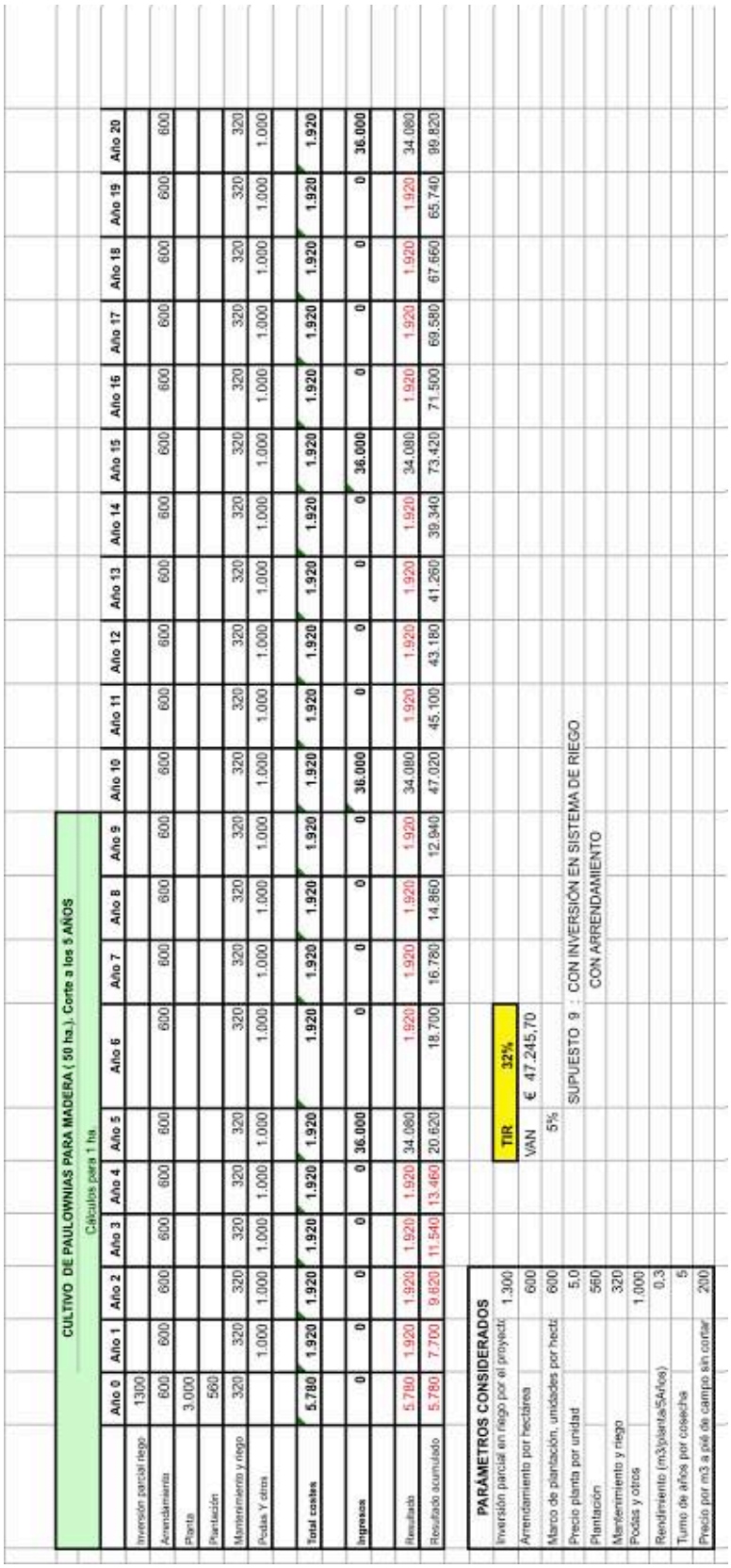
CULTIVO DE PAULOWNIAS PARA MADERA (50 ha.). Corte a los 5 AÑOS

Cálculos para 1 ha.

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20
Inversión parcial riego	1300																				
Arrendamiento	,-----	,-----	,-----	,-----	,-----	,-----	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planta	3.000																				
Plantación	560																				
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Podas		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total costes	**5.180**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**
Ingresos	**0**	**0**	**0**	**0**	**0**	**36.000**	**0**	**0**	**0**	**0**	**36.000**	**0**	**0**	**0**	**0**	**36.000**	**0**	**0**	**0**	**0**	**36.000**
Resultado	5.180	1.320	1.320	1.320	1.320	34.680	1.320	1.320	1.320	1.320	34.680	1.320	1.320	1.320	1.320	34.680	1.320	1.320	1.320	1.320	34.680
Resultado acumulado	5.180	6.500	7.820	9.140	10.460	24.220	22.900	21.580	20.260	18.940	53.620	52.300	50.980	49.660	48.340	83.020	81.700	80.380	79.060	77.740	112.420

PARÁMETROS CONSIDERADOS			
Inversión parcial en riego por el proyecto	1.300	TIR	39%
Arrendamiento por hectárea	,-----	VAN	€ 54.938,40
Marco de plantación, unidades por hectá	600		5%
Precio planta por unidad	5,0	SUPUESTO 8 : CON INVERSIÓN EN SISTEMA DE RIEGO	
Plantación	560	SIN ARRENDAMIENTO	
Mantenimiento y riego	320		
Podas y otros	1.000		
Rendimiento (m3/planta/5Años)	0,3		
Turno de años por cosecha	5		
Precio por m3 a pié de campo sin cortar	200		

Simulation 8: Economic analysis for plantation with irrigation system and without plot rent. Objective: Wood production. Five years old plantation.



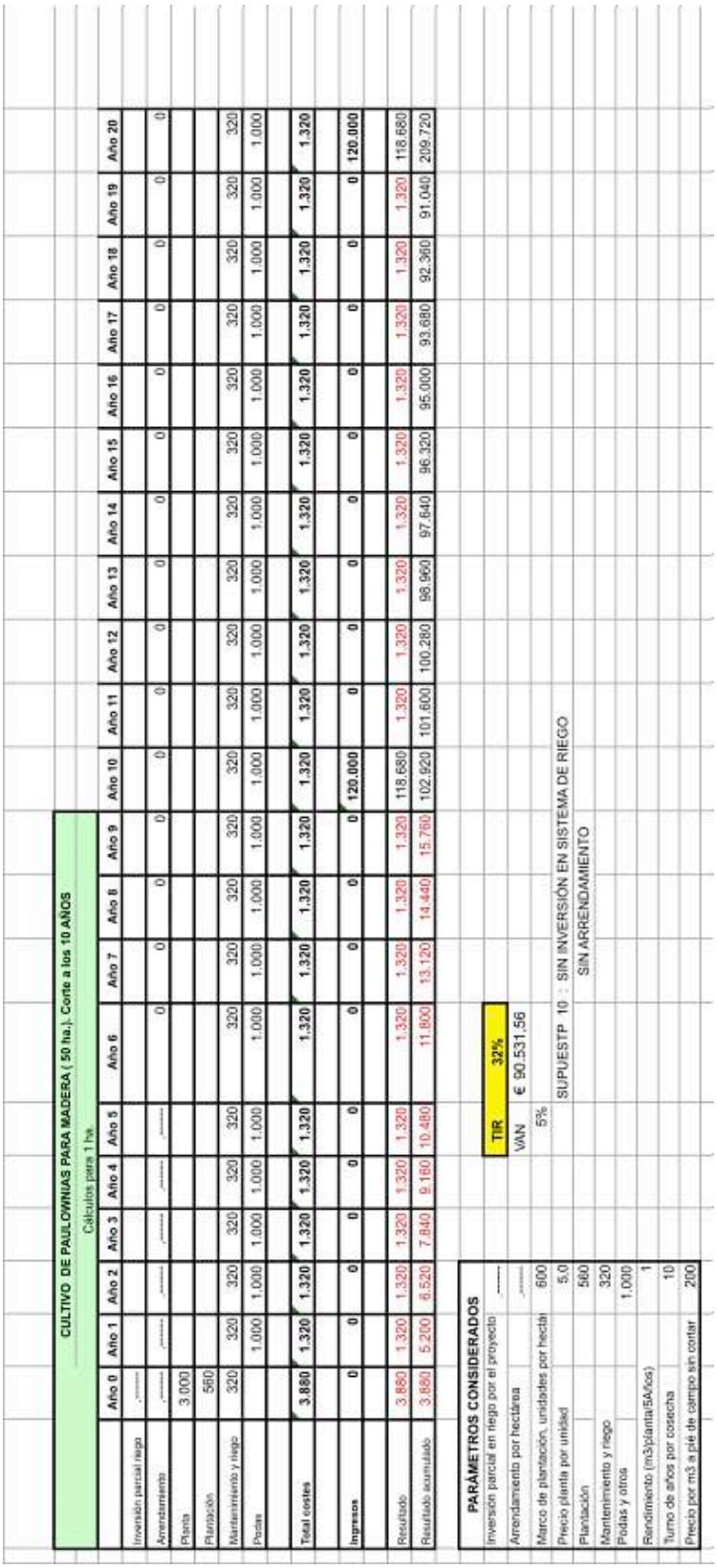
CULTIVO DE PAULOWNIAS PARA MADERA (50 ha.), Corte a los 5 AÑOS

Cálculos para 1 ha

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20
Inversión parcial riego	1300																				
Arrendamiento	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Planta	3.000																				
Plantación	560																				
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Podas Y otros		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total costes	**5.780**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**
Ingresos	**0**	**0**	**0**	**0**	**0**	**36.000**	**0**	**0**	**0**	**0**	**36.000**	**0**	**0**	**0**	**0**	**36.000**	**0**	**0**	**0**	**0**	**36.000**
Resultado	5.780	1.920	1.920	1.920	1.920	34.080	1.920	1.920	1.920	1.920	34.080	1.920	1.920	1.920	1.920	34.080	1.920	1.920	1.920	1.920	34.080
Resultado acumulado	5.780	7.700	9.620	11.540	13.460	20.620	18.700	16.780	14.860	12.940	47.020	45.100	43.180	41.260	39.340	73.420	71.500	69.580	67.660	65.740	99.820

PARAMETROS CONSIDERADOS			
Inversión parcial sin riego por el proyecto	1.300	TIR	32%
Arrendamiento por hectárea	600	VAN	€ 47.245,70
Marco de plantación, unidades por hectá	600	5%	
Precio planta por unidad	5,0	SUPUESTO 9 : CON INVERSIÓN EN SISTEMA DE RIEGO	
Plantación	560	CON ARRENDAMIENTO	
Mantenimiento y riego	320		
Podas y otros	1.000		
Rendimiento (m3/planta/5Años)	0,3		
Turno de años por cosecha	5		
Precio por m3 a pié de campo sin contar	200		

Simulation 9: Economic analysis for plantation with irrigation system and with plot rent. Objective: Wood production. Five years old plantation.



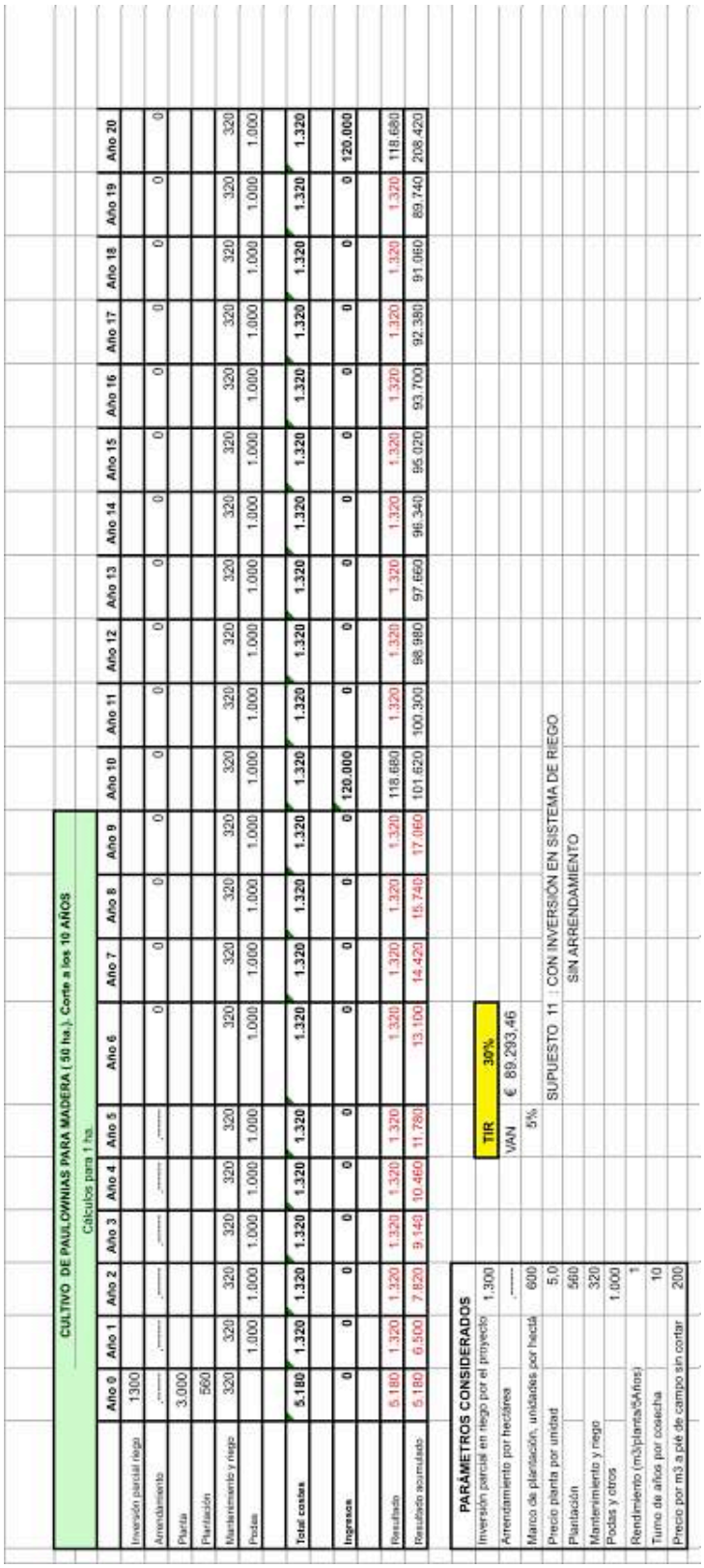
CULTIVO DE PAULOWNIAS PARA MADERA (50 ha.). Corte a los 10 AÑOS

Cálculos para 1 ha.

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20
Inversión parcial riego	------																				
Arrendamiento	------	------	------	------	------	------	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planta	3.000																				
Plantación	560																				
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Podas		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total costes	**3.880**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**
Ingresos	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**120.000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**120.000**
Resultado	3.880	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	118.680	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	118.680
Resultado acumulado	3.880	5.200	6.520	7.840	9.160	10.480	11.800	13.120	14.440	15.760	102.920	101.600	100.280	98.960	97.640	96.320	95.000	93.680	92.360	91.040	209.720

PARÁMETROS CONSIDERADOS			
Inversión parcial en riego por el proyecto	------	TIR	32%
Arrendamiento por hectárea	------	VAN	€ 90.531,56
Marco de plantación, unidades por hectá	600		5%
Precio planta por unidad	5,0	SUPUESTP 10 : SIN INVERSIÓN EN SISTEMA DE RIEGO	
Plantación	560	SIN ARRENDAMIENTO	
Mantenimiento y riego	320		
Podas y otros	1.000		
Rendimiento (m3/planta/5Años)	1		
Turno de años por cosecha	10		
Precio por m3 a pié de campo sin contar	200		

Simulation 10: Economic analysis for plantation without irrigation system and without plot rent. Objective: Wood production. Ten years old plantation.

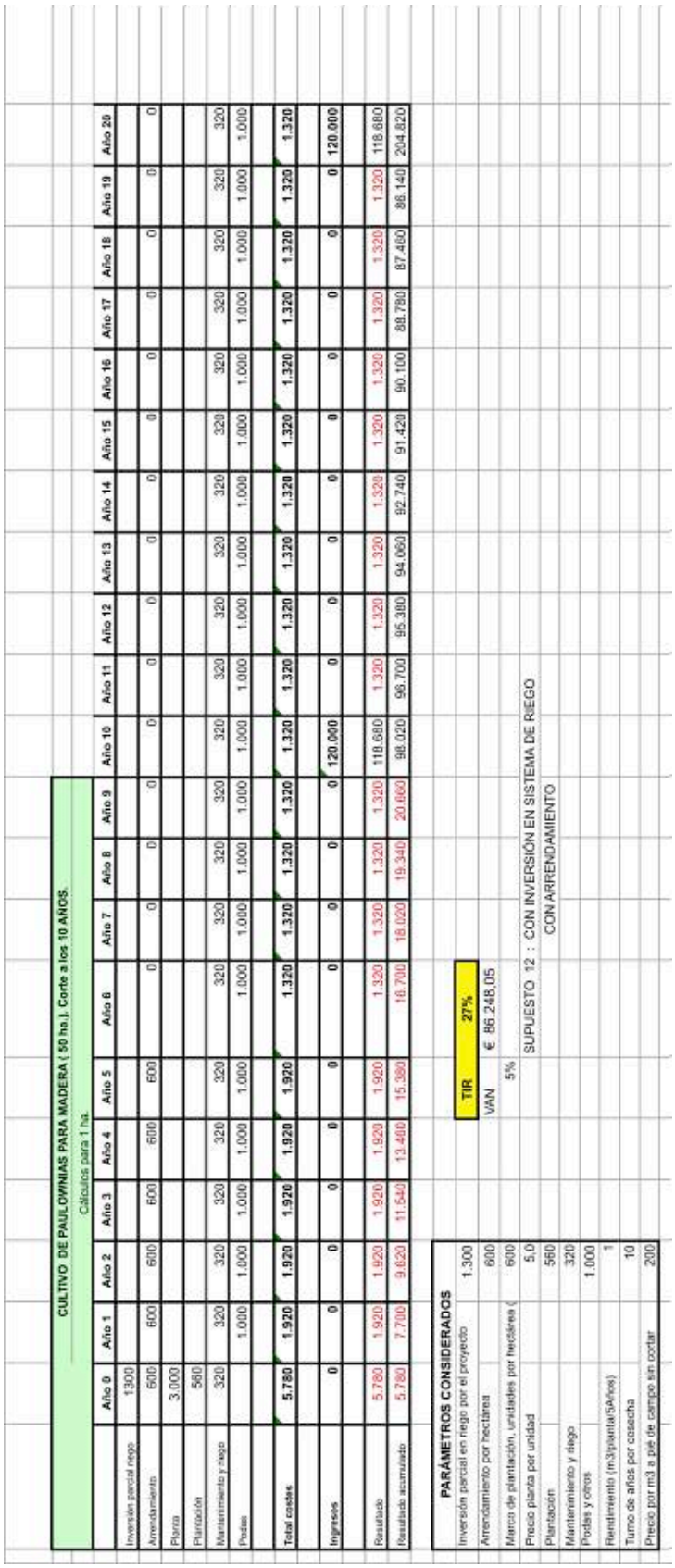


CULTIVO DE PAULOWNIAS PARA MADERA (50 ha). Corte a los 10 AÑOS Cálculos para 1 ha.																					
	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20
Inversión parcial riego	1300																				
Arrendamiento	.....	.....	.....	.....	.....	.....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planta	3.000																				
Plantación	560																				
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Podas		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total costes	**5.180**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**
Ingresos	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**120.000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**120.000**
Resultado	5.180	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	118.680	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	118.680
Resultado acumulado	5.180	6.500	7.820	9.140	10.460	11.780	13.100	14.420	15.740	17.060	101.620	100.300	98.980	97.660	96.340	95.020	93.700	92.380	91.060	89.740	208.420

PARÁMETROS CONSIDERADOS			
Inversión parcial en riego por el proyecto	1.300	TIR	30%
Arrendamiento por hectárea	.....	VAN	€ 89.293,46
Marco de plantación, unidades por hectá	600		5%
Precio planta por unidad	5,0		
Plantación	560		
Mantenimiento y riego	320		
Podas y otros	1.000		
Rendimiento (m3/planta/5Años)	1		
Turno de años por cosecha	10		
Precio por m3 a pié de campo sin cortar	200		

SUPUESTO 11 : CON INVERSIÓN EN SISTEMA DE RIEGO
SIN ARRENDAMIENTO

Simulation 11: Economic analysis for plantation with irrigation system and without plot rent. Objective: Wood production. Ten years old plantation.



CULTIVO DE PAULOWNIAS PARA MADERA (50 ha.). Corte a los 10 AÑOS.
Cálculos para 1 ha.

	Año 0	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Año 11	Año 12	Año 13	Año 14	Año 15	Año 16	Año 17	Año 18	Año 19	Año 20
Inversión parcial riego	1300																				
Arrendamiento	600	600	600	600	600	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planta	3.000																				
Plantación	580																				
Mantenimiento y riego	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Podas		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total costes	**5.780**	**1.920**	**1.920**	**1.920**	**1.920**	**1.920**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**	**1.320**
Ingresos	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**120.000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**120.000**
Resultado	5.780	1.920	1.920	1.920	1.920	1.920	1.320	1.320	1.320	1.320	118.680	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	1.320	118.680
Resultado acumulado	5.780	7.700	9.620	11.540	13.460	15.380	16.700	18.020	19.340	20.660	98.020	96.700	95.380	94.060	92.740	91.420	90.100	88.780	87.460	86.140	204.820

PARÁMETROS CONSIDERADOS	
Inversión parcial en riego por el proyecto	1.300
Arrendamiento por hectárea	600
Marca de plantación, unidades por hectárea (	600
Precio planta por unidad	5,0
Plantación	580
Mantenimiento y riego	320
Podas y otros	1.000
Rendimiento (m3/planta/5Años)	1
Turno de años por cosecha	10
Precio por m3 a pié de campo sin cortar	200

TIR 27%
VAN € 86.248,05
5%

SUPUESTO 12 : CON INVERSIÓN EN SISTEMA DE RIEGO
CON ARRENDAMIENTO

Simulation 12: Economic analysis for plantation with irrigation system and with plot rent. Objective: Wood production. Ten years old plantation.

5.- GRAPHIC INFORMATION.

In the current section some pictures from Paulownia clone in Vitro 112 plantation and laboratory cloning works are presented:

Picture 49. Detail of the paulownia cloning work.

Picture 50. Detail of the paulownia cloning work.

Picture 51. Picture from laboratory. Cloning Paulownia clone in Vitro 112® works.

Picture 52. Detail of the paulownia cloning work.

Picture 53. Greenhouse containing Paulownia clone in Vitro 112®.

Picture 54. Greenhouse containing Paulownia clone in Vitro 112®.

Picture 55. Greenhouse containing Paulownia clone in Vitro 112®. Trees without leaves.

Picture 56. Greenhouse containing Paulownia clone in Vitro 112®.

Picture 57. Greenhouse containing Paulownia clone in Vitro 112®.

Picture 58. Greenhouse containing Paulownia clone in Vitro 112®.

Picture 59. Paulownia clone in Vitro 112® box for transporting to the field site

Picture 60. Paulownia clone in Vitro 112® vehicle for transporting to the field site

Picture 61. Greenhouse containing Paulownia clone in Vitro 112®.

Picture 62. Paulownia clone in Vitro 112® plantation located in Merida (Spain).

Picture 63. Paulownia clone in Vitro 112® plantation located in Merida (Spain).

Picture 64. Paulownia clone in Vitro 112® plantation located in Tarragona (Spain).

Picture 65. Paulownia clone in Vitro 112® plantation located in Tarragona (Spain).

Picture 66. Paulownia clone in Vitro 112® plantation located in Valencia (Spain).

Picture 67. Paulownia clone in Vitro 112® plantation located in Valencia (Spain).

Picture 68. Paulownia clone in Vitro 112® plantation located in Sevilla (Spain).

Picture 69. Paulownia clone in Vitro 112® plantation located in Sevilla (Spain).

Picture 70. Paulownia clone in Vitro 112® plantation located in Gerona (Spain)

Picture 71. Paulownia clone in Vitro 112® plantation located in Gerona (Spain)

Picture 72. Piece of wood from Paulownia clone in vitro 112®.

Picture 73. Piece of wood from Paulownia clone in vitro 112® then to be.

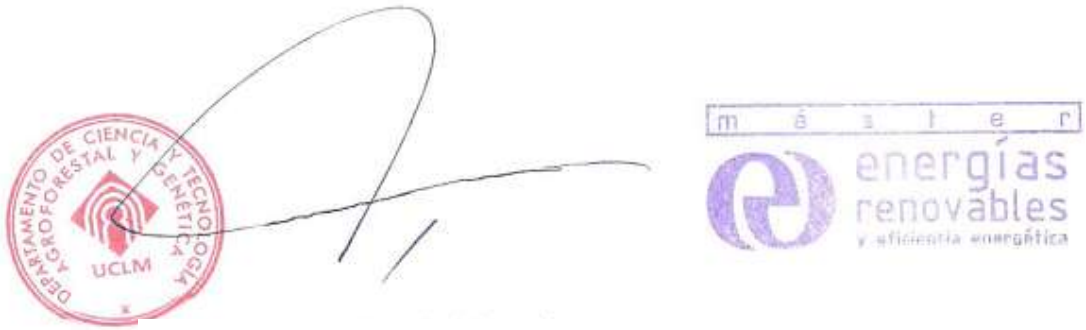
Picture 74. Piece of wood from Paulownia clone in vitro 112® .

Picture 75. Piece of wood from Paulownia clone in vitro 112® .

Picture 76. Pieces of wood from Paulownia clone in vitro 112® .

This technical report was elaborated by Castilla La Mancha University and Renewable Energy Research Institute research team.

Albacete, July 2013.



Fdo: Francisco Ramón López Serrano

Director of the Environmental Technology Área

6.- ADDITIONAL STUDIES RELATED WITH PAULOWNIA CLONE IN VITRO 112®.

The following additional studies are presented:

1.- Paulownia clone in Vitro 112 ® Wood physical properties (AIDIMA).

- Wood physical properties study
- Commercial card
- Certificate

2.- Paulownia clone in Vitro 112 ® Wood Chemical properties (IER-UCLM)

3.- Castilla La Mancha University research study.

4.- Research article related to soil properties.

5.- Registration of the registered mark (certificate)

6.- Comparative study about the use of petroleum coque and Paulownia in Vitro 112® as combustible.