Obtención de nuevos biocombustibles de alta capacidad energética a partir de nuevas brasicáceas

Miguel Alfonso. 5 Julio 2017

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¿En qué nos basamos?

Pennycress (*T. arvense*)

Es una Brasicácea. No compite con cultivos de uso agroalimentario

Puede ser cultivada en suelos marginales/abandonados

Es una especie muy prolífica: hasta 5.000 semillas/planta

No requiere maquinaria específica ni fertilización especial

Exploración de la biodiversidad vegetal

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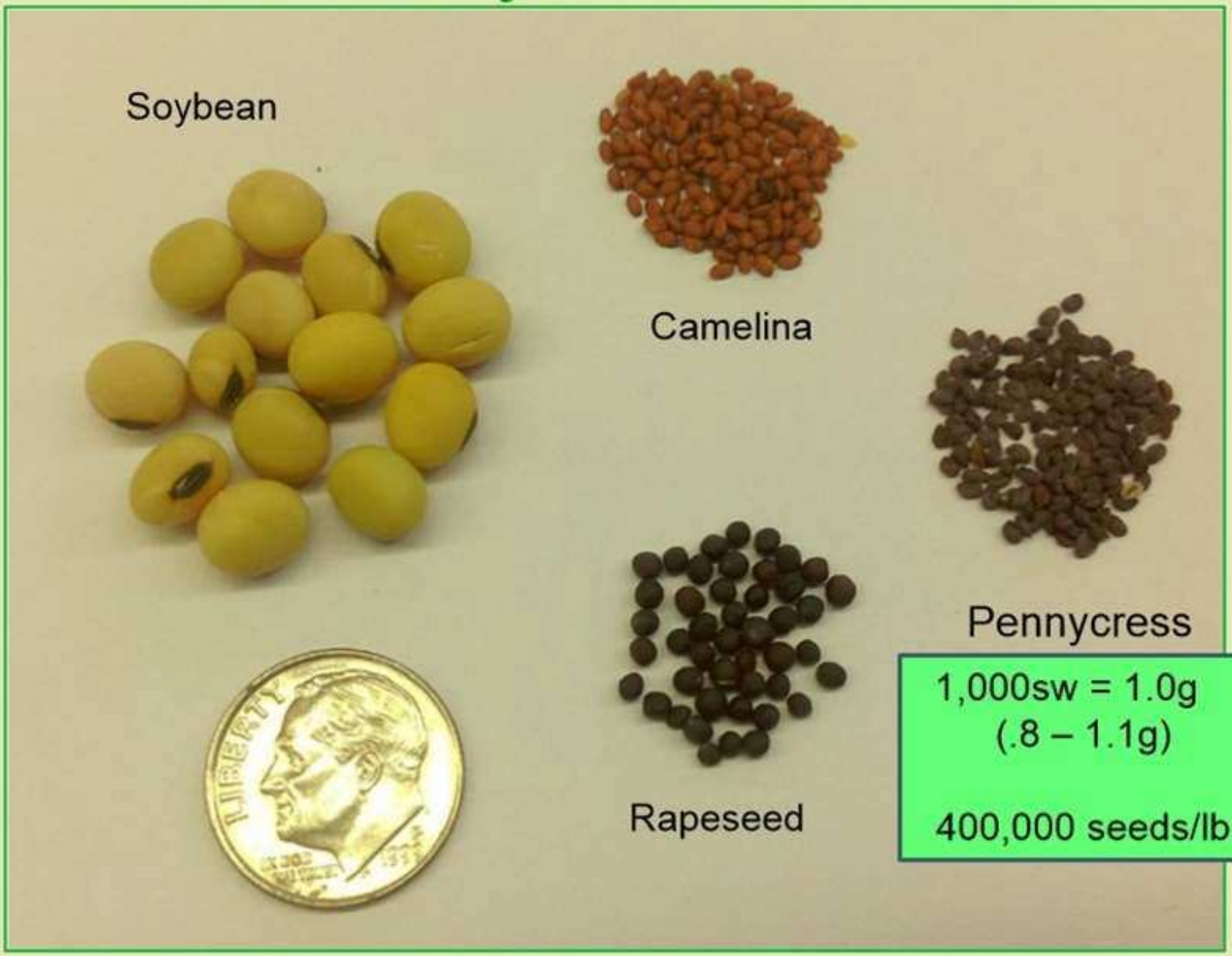
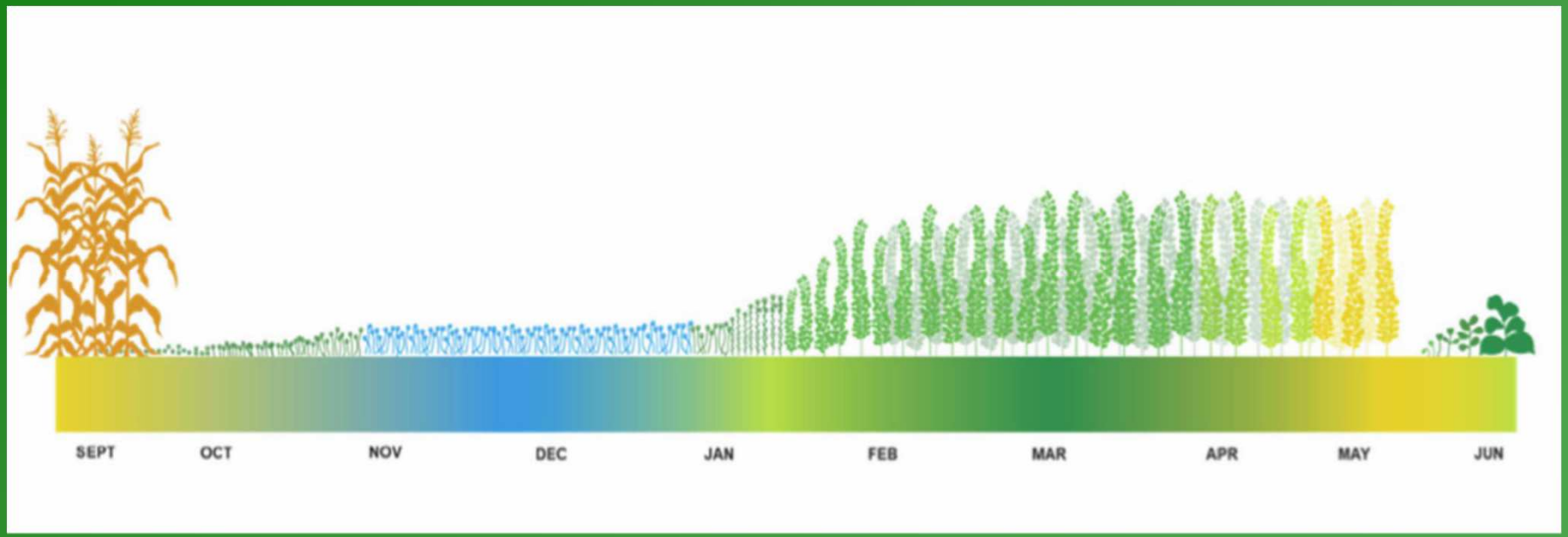
Field Pennycress (*Thlaspi arvense L.*)



Cortesía Dr. Phippen (WIU, USA)

Sostenible y con impacto medioambiental

Pennycress es una planta de desarrollo invernal. Reduciría el riesgo de erosión y pérdida de nutrientes durante el periodo de barbecho (en rotaciones año y vez)



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Pennycress posee unas características únicas para la producción de biocombustibles de segunda generación

Innovación tecnológica

Sus semillas contienen un 36% de aceite (doble que la soja o igual que colza o camelina)

La composición química de su aceite (38% ácido erúcico, 22:1) proporciona unas características óptimas para la producción de biocombustible

Cloud point: -10 ºC

Número de cetano: 59,8

JET-FUEL

BUENA ALTERNATIVA SOSTENIBLE PARA LA PRODUCCIÓN DE BIODIÉSEL

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Rendimiento agronómico comparado de varias especies utilizadas en la producción de biocombustibles*

	Cont. Aceite/semilla % peso	Rend.semilla /ha Kg ha año	Rend.aceite Kg ha año
Palma			4000-10,000
Soja	18-22	2140-2840	347-562
Colza	40-44	2680-3390	965-1342
Jatropha	27-40	2000-5000	540-2000
Camelina	36-47	1500-3000	540-1410
Pennycress**	32-42	900-2500	250-806

* Moser, (2012) Biofuels: 3.

** Producción campaña 2015/2016 y 2016/2017 EEAD: 650 kg/ha.

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El aceite de Pennycress tiene otras aplicaciones industriales

Erucamida: componente utilizado en la elaboración de plásticos y tintas para impresión.

Se comercializa con el nombre de STRUKTOL®

STRUKTOL® TR 131
SLIP AGENT
LUBRICANT
DISPERSANT
MOLD RELEASE AGENT
COMPOSITION: Unsaturated primary amide derived from erucic acid.

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Todo empezó con tres semillas...

Siembra: Sept. 2013

Siembra: Oct. 2015

Siembra: Oct. 2016

Ensayo primavera 2014

Ensayo primavera 2016

Ensayo primavera 2017

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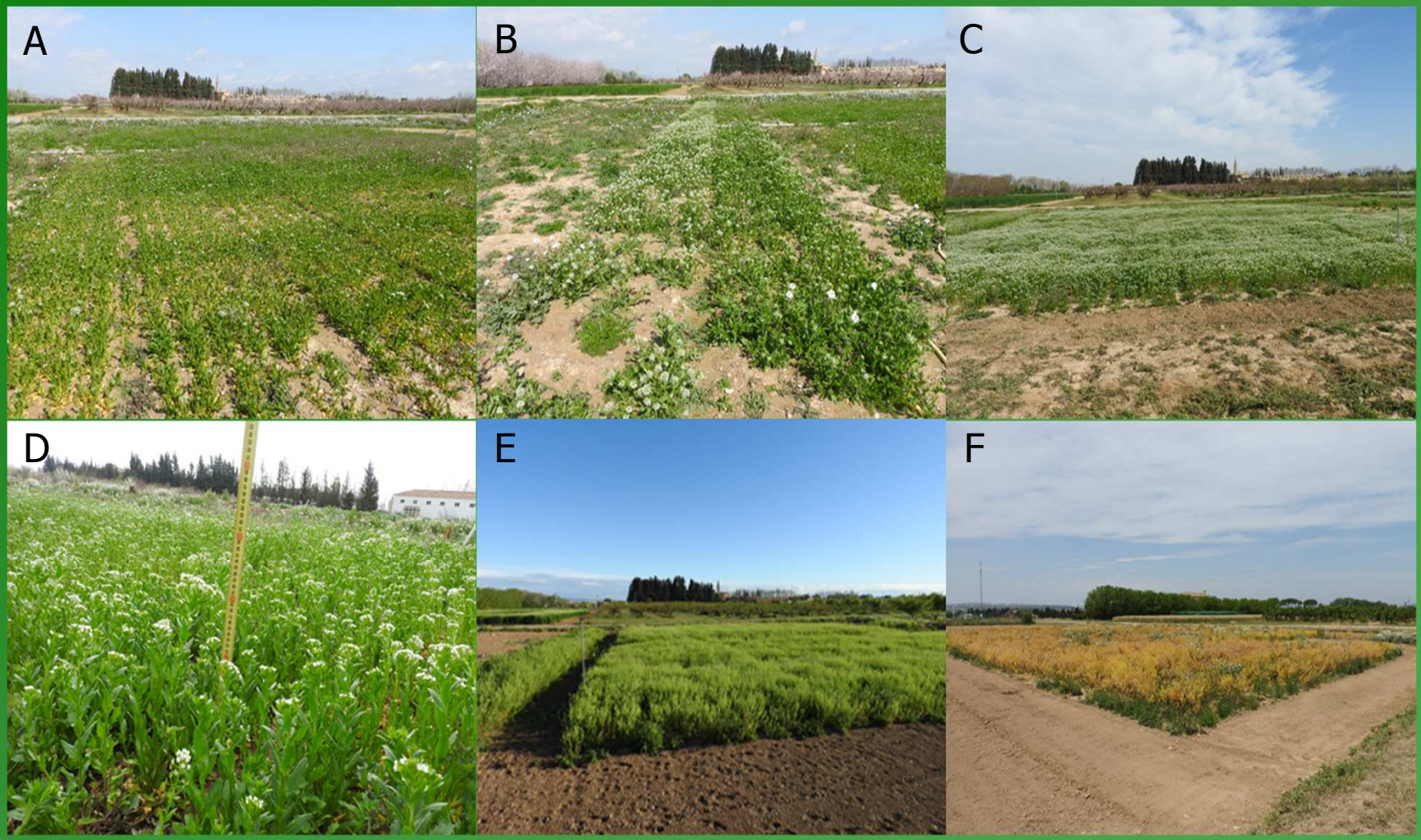
Actualmente realizamos ensayos agronómicos sobre 4 variedades de Pennycress



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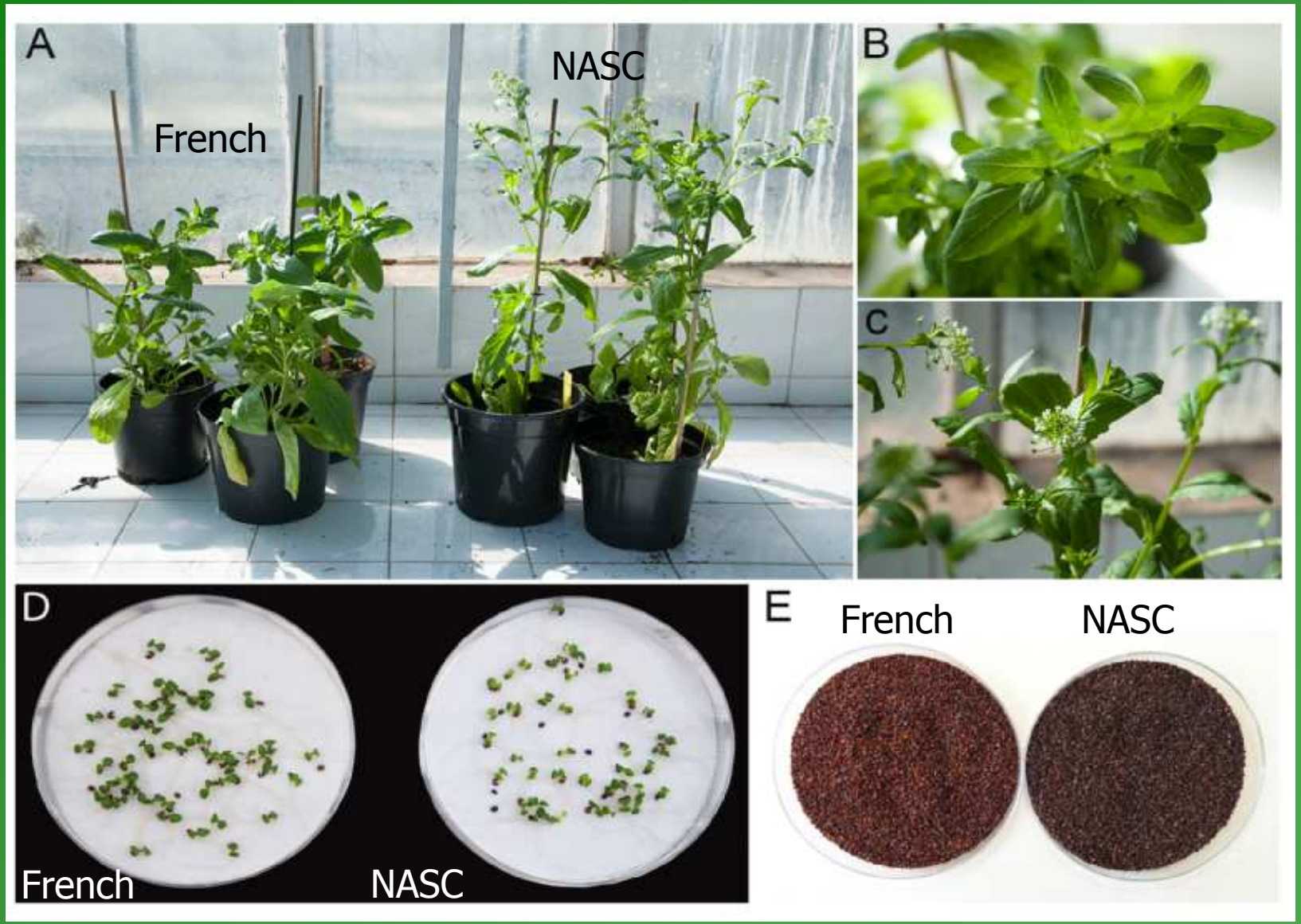
Selección de nuevas variedades dirigida al incremento de la calidad del aceite y el biodiésel.



Selección de nuevas variedades dirigida al incremento de la calidad del aceite y del biodiésel.

Table 1. Seed oil and size characteristics of various *Thlaspi arvense* L. strains.

	% oil[1]	%22:1[2]	Seed wt (g)[3]	Pods/plant[4]	Seeds/pod[4]	Seeds/plant[4]
NASC Line	39.08±5.08	35.12	0.123±0.003	349	9.32±1.88	3252.7
French Line	41.71 ± 7.61	36.34	0.101±0.004	490	9.21±1.64	4512.9

[1] Calculated as total amount of oil on a seed dry weight basis (dwb).
[2] Data were obtained from four biological replicates.
[3] 100 seeds were weighted. Data were obtained from 10 independent determinations.
[4] Data were obtained from 10 different plants.

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Identification of target genes and processes involved in erucic acid accumulation during seed development in the biodiesel feedstock Pennycress (*Thlaspi arvense* L.)

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FAE1 (fatty acid elongase 1)
Biofuel

ABSTRACT

We studied erucic acid accumulation in the biodiesel feedstock Pennycress (*Thlaspi arvense* L.) as a first step towards the development of a sustainable strategy for biofuel production in the EU territory. To that end, two inbred Pennycress lines of European origin, "NASC" and "French," were cultivated in a controlled chamber and in experimental field plots, and their growth, seed production and seed oil characteristics analyzed. Differences in some agronomical traits like vernalization (winter-French versus spring-NASC), flowering time (delayed in the French line) and seed production (higher in the French line) were detected. Both lines showed a high amount (35–39%) of erucic acid ($22:1^{\Delta 13}$) in their seed oil. Biochemical characterization of the Pennycress seed oil indicated that TAG was the major reservoir of $22:1^{\Delta 13}$. Incorporation of $22:1^{\Delta 13}$ to TAG occurred very early during seed maturation, concomitant with a decrease of desaturase activity. This change in the acyl fluxes towards elongation was controlled by different genes at different levels. *TaFAE1* gene, encoding the fatty acid elongase, seemed to be controlled at the transcriptional level with high expression at the early stages of seed development. On the contrary, the *TaFAD2* gene that encodes the Δ12 fatty acid desaturase or *TaDGAT1* that catalyzes TAG biosynthesis were controlled post-transcriptionally. *TaWRI1*, the master regulator of seed-oil biosynthesis, showed also high expression at the early stages of seed development. Our data identified genes and processes that might improve the biotechnological manipulation of Pennycress seeds for high-quality biodiesel production.

1. Introduction

Field Pennycress (*Thlaspi arvense* L.) is a winter annual that belongs to the Brassicaceae family. As many other members of this family, such as Miscanthus (Robson et al., 2013), Etiopian mustard (*Brassica carinata*; Bouaid et al., 2009) and Camelina (*Camelina sativa*, Frohlich and Rice, 2005), Pennycress has attracted the attention of researchers as a promising alternative oilseed feedstock for biodiesel production, that accomplishes the land use and sustainability criteria and displaces other plant species like Jatropha (*Jatropha curcas*) or Crambe (*Crambe abyssinica*) that are not well adapted to the temperate climate conditions of Europe and North America (Moser, 2012). Native of Eurasia, Pennycress is widely distributed across temperate regions all around the world and is highly adapted to a wide variety of climatic conditions (Warwick et al., 2002; Vaughn et al., 2005; Moser et al., 2009a). Because of its growth cycle, it can be successfully planted at the end of the summer and germinates in the fall developing a low-growing rosette that protects the plant from low temperatures and cold winds during the winter. Pennycress is an extreme cold tolerant plant (Sharma et al., 2007). The plant resumes its growth in the spring, sets seeds and is harvested at the beginning of the summer. Because of its culture cycle it can be used in rotations, not displacing existing agricultural production (Moser, 2012). It does not need any agricultural inputs like fertilizers or pesticides and has no specific water requirements. Furthermore, Pennycress could be planted in lands not otherwise suited for agricultural production (Moser, 2012). Therefore, it does not compete with food chain cultures. Pennycress has been signaled for its potential to produce biomass for renewable biofuel production (Moser et al., 2009a,b; Moser, 2012), being a prolific seed producer (Fan et al., 2013). Harvested Pennycress seeds contain around 36% oil (w/w), which is

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Emparentada con Arabidopsis

Accesible desde el punto de vista molecular

Identificación de dianas biotecnológicas para la manipulación del aceite en brasicáceas

Actualmente:

Ensayos agronómicos en parcelas de la EEAD. Necesario colaborar con agricultores y ensayar producción en diferentes zonas agroclimáticas.

Primera extracción de aceite por moltura prevista para septiembre de este año.

Avanza el conocimiento "básico" del metabolismo de aceite en la semilla de Pennycress.

Futuro a corto plazo (2-4 años)

Obtención de biofuel y biojet (CARTIF). Pruebas funcionales en motores diesel y turbinas de aviación (INTA).

Atraer al sector privado (cooperativas agrarias, plantas de biodiesel, productores de componentes para plásticos).

¿Quiénes somos?

Investigadores

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CARTIF

Empresas

PROCASE SEMILLAS

PCTAD

Fundación AulaDei