Growing perennial energy crops with different cycles improves feedstock flow to bioenergy Plants: the cases of *Miscanthus giganteous* and *Cynara cardunculus*

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Introduction & Objectives

Perennial grasses have a great potential for bioenergy production. However, because their growing cycles coincide and harvest occurs at approximately at the same time, this triggers harvesting, transportation and storage issues. Inclusion of diverse species into the biomass production chain might help optimizing logistics and increasing biodiversity. In this context, we compared growth cycles, leaf area indexes and productivities of two perennial biomass crops: miscanthus (*Miscanthus giganteous*) and cynara (*Cynara Carduncului*), with particular emphasis on cynara as this crop has not been researched in the USA.

Materials & Methods

Location: Thessaly Plain, central Greece (39.2°N, 22.3°E)

Soils: Calcixerollic Xerochrept and Aquic Xerofluvent

Climate : see figure 1

Crops:	Miscanthus	Cynara
Type:	C_4 perennial	C_3 perennial
Family:	Poaceae	Asteraceae
Annual cycle:	April to Nov	Sept to Aug
End product:	Biomass	Biomass & seeds
Propagation:	rhizomes	Seeds

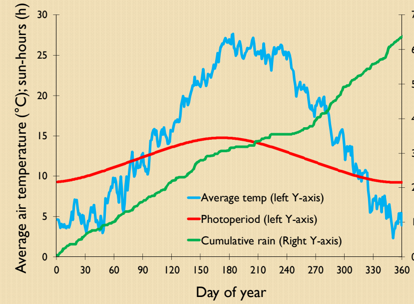

Fig 1: The climate at the experimental site is Mediterranean with hot dry summers and cold humid winters. Temperature and precipitation data are means over 2004-2010. Sun-hours values were calculated.

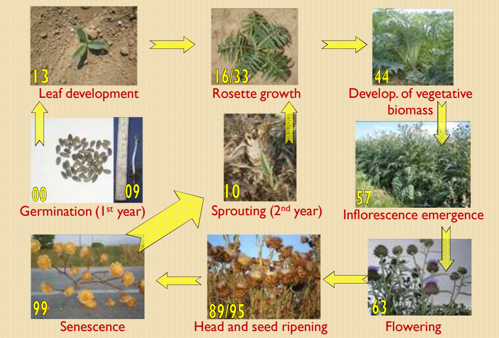

Fig 2: *Cynara cardunculus* growth stages according to BBCH scale (Archontoulis et al., 2010; Annals of Applied Biology 156: 253-270)

Results

Fig 2 illustrates the growth stages for cynara. The growth dynamics and the corresponding harvesting periods for miscanthus and cynara are presented in Figs. 3 and 4, respectively. Both crops scored high biomass yields. The seed/biomass ratio for cynara was 0.15. Seeds contained 23% oil and 19% protein.

Concluding remarks:

a) Miscanthus is more productive than cynara

b) Crops harvested at different periods, thus improving logistics and biomass flow to Plants

c) Cynara re-grows much faster than miscanthus (depending on rain × temperature), keeping the soil covered for longer periods (acts as a cover crop)

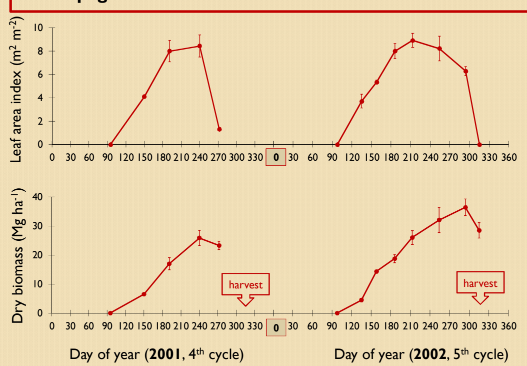

Fig 3: Leaf area index and above ground dry matter dynamics of irrigated Miscanthus. Data are means ± SE of plant density × N-fertilization treatments (for details Danalatos et al., 2007; Biomass & Bioenergy 31: 145-152). At harvest, biomass had a moisture content of 50%.

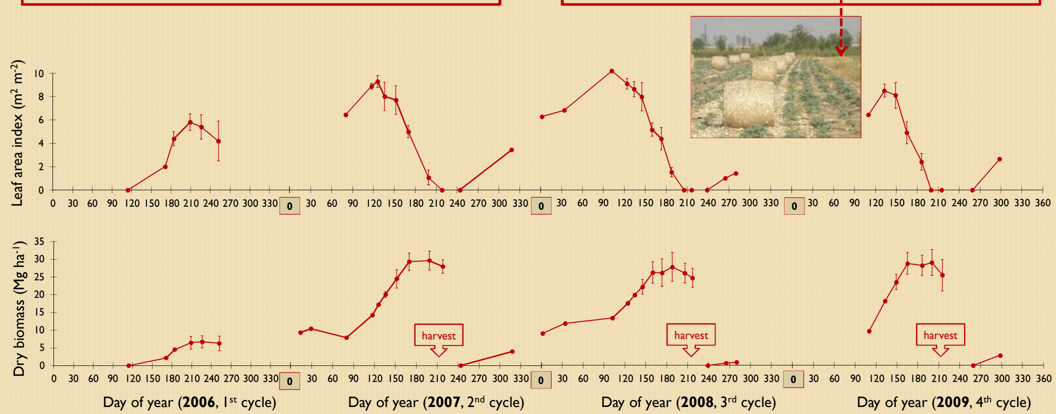

Fig 4: Leaf area index and above ground dry matter dynamics of Cynara. Data are means ± SE of irrigation × N-fertilization treatments (for details Archontoulis et al., 2010; GCB-Bioenergy 2: 113-129, and Archontoulis 2011; PhD Thesis Wageningen University, the Netherlands). At harvest, the biomass had a moisture content of 15%. Crop expansion due to seed dispersal was not evident. Cynara fields were converted to corn or cotton or wheat cultivations using a 40 cm plow and 2 disc operations. This minimizes reasonable concerns about the possible action of cynara as a weed.

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