



# COMPARING *POPULUS* CLONES FOR SHORT ROTATION FORESTRY IN ITALY AFTER THE SECOND TWO-YEAR ROTATION CYCLE: SURVIVAL, GROWTH AND YIELD

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# Summary of the presentation

- Introduction: SRF in Italy
- M&M: Sites; Clones; Exp. Design; Measurements
- Results: Rooting; Survival; Yield; Growth
- Conclusions

# Introduction

PLANTATION  
ESTABLISHMENT



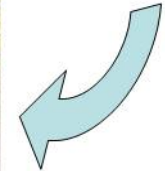
WEED CONTROL

MECHANICAL  
HARVEST



AFTER 2 YEARS  
SPROUTS ARE 6-9 M  
HIEGHT

VIGOROUS  
SPROUTING  
AFTER  
COPPICING



SRF in Italy:

- 10.000 ha of poplar SRF commercial plantations
- Swedish model (high density, 2-3 years of rotation cycle)
- Public grants to farmers for plantation establishment
- Bioenergy and phytoremediation

# M&M: Sites

Vinovo

Zinasco

Bigarello

Mira

**Mira**  
(High Fertility)  
Establishment: 2003  
Soil: pH 8.3, sandy-loam  
Prec.: 910 mm y<sup>-1</sup>

**Vinovo**  
(Medium Fertility)  
Establishment: 2003  
Soil: pH 7, sandy-loam  
Prec.: 1083 mm y<sup>-1</sup>

**Bigarello**  
(Low Fertility)  
Establishment: 2003  
Soil: pH 8.3, clay soil;  
Prec.: 710 mm y<sup>-1</sup>

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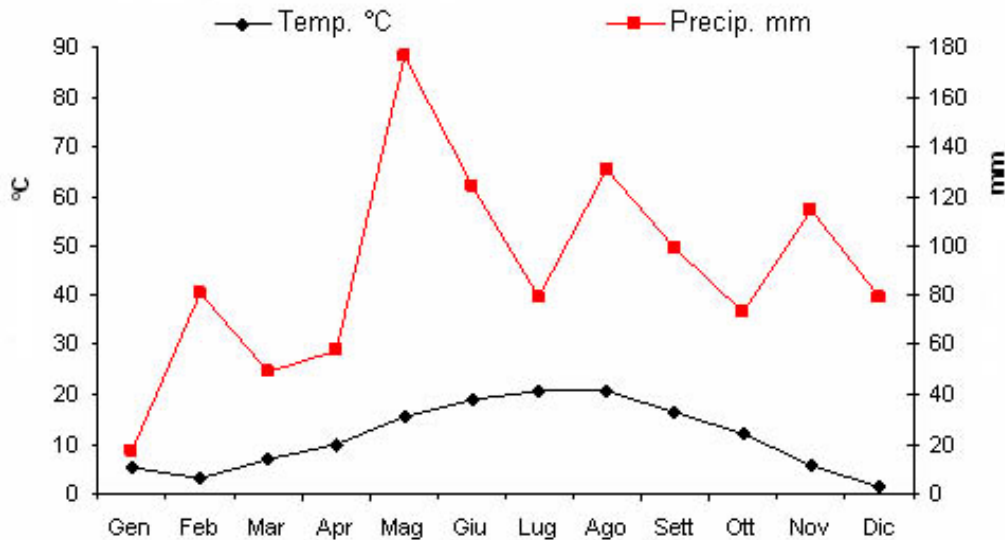
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# M&M: Sites

## Site Conditions:

- Sub-continental climate type
- Agricultural soils

Vinovo-observation period: 1996-2003- Precipitation: 1083 mm per year



# M&M: Clones

Section	Species and Section hybrids	Clone	Breeder
<b>Aigeiros</b>	<i>P. x euramericana</i>	<b>I214*</b>	Casale M., Italy
	<i>P. x euramericana</i>	<b>Sirio</b>	F. Alasia Vivai, Italy
	<i>P. x euramericana</i>	<b>AF2</b>	F. Alasia Vivai, Italy
	<i>P. x euramericana</i>	<b>83.148.041</b>	Casale M., Italy
	<i>P. deltoides</i>	<b>Lux*</b>	Casale M., Italy
<b>Tacamahaca x Aigeiros</b>	<i>(P. x interamericana) x P. x nigra</i>	<b>AF6</b>	F. Alasia Vivai, Italy
	<i>(P. x interamericana) x P. trichocarpa</i>	<b>AF8</b>	F. Alasia Vivai, Italy
	<i>P. maximowiczii x P. nigra</i>	<b>AF10</b>	F. Alasia Vivai, Italy
	<i>(P. x interamericana) x P. nigra</i>	<b>Monviso</b>	F. Alasia Vivai, Italy

\* Control Clones, not selected for SRF

# M&M: Experimental design

- Randomized block design with 3-4 replications per clones in each site
- Plot area: approx. 110 m<sup>2</sup> with 5 rows

## Cultural Operations

Site	Year			
	2003	2004	2005	2006
Bigarello (LF)	1H.2I.3Mw	2I	1I.2Mw	2I.2Mw
Vinovo (MF)	1H.3I.3Mw	-	1I.2Mw	2I.2Mw
Mira (HF)	1H.3Mw	-	1F.2Mw.2M	1F.2Mw

**F=Fertilization, H=herbicide spraying, Mw=mechanical weed control, Irrigation (30-50 mm); M=Mowing. *n*= number of operations**

# M&M: Measurements

- Yield estimation according to the equation:

$$AGWB_{dw} = b D^c \text{ (Telenius- Biomass and Bioenergy 16, 1995).}$$

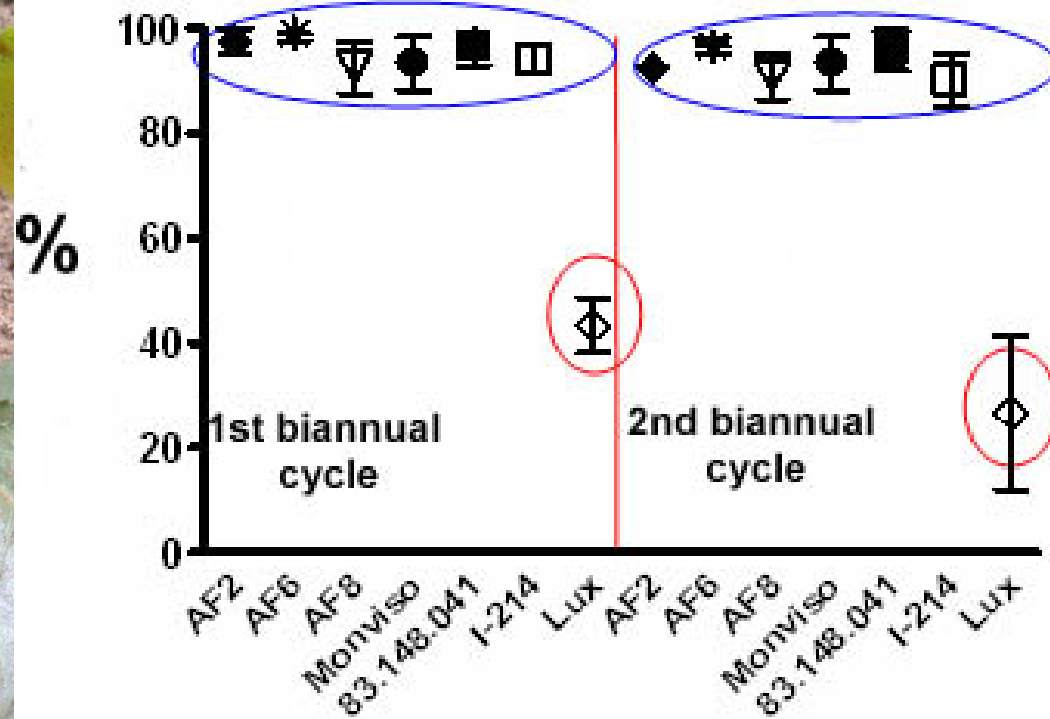
With:

- ✓  $AGWB_{dw}$  = above ground woody biomass, on dry weight basis
- ✓  $D$  = stem diameter at 1 m
- ✓  $b$  and  $c$ , specific parameters, function of clone, age and site
- Specific regression for each clone, in each site, at each year



# Results: Rooting and Survival (3 sites)

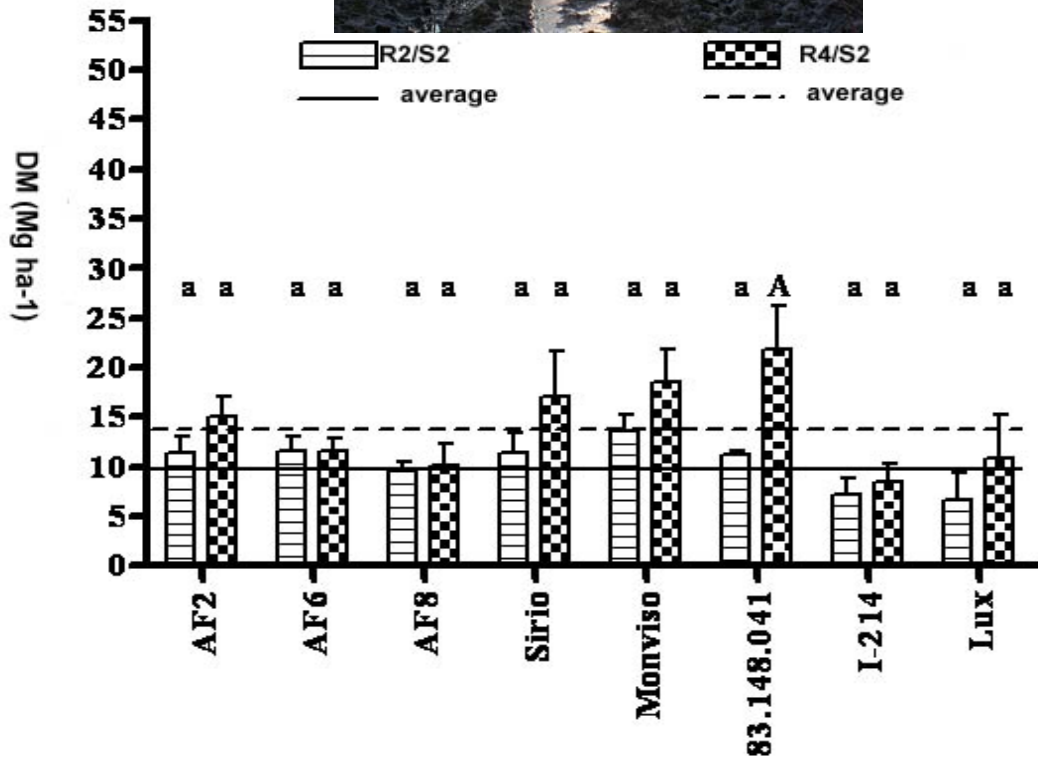
*Rooting is a key factor affecting the technical success of the plantation*



✓ Rooting was good (>90%) in all sites for all clones, with the exception of Clone Lux

✓ After the first coppicing, sprouts survival was very high at the end of the second rotation

# Results: Yield - Bigarello (LF)

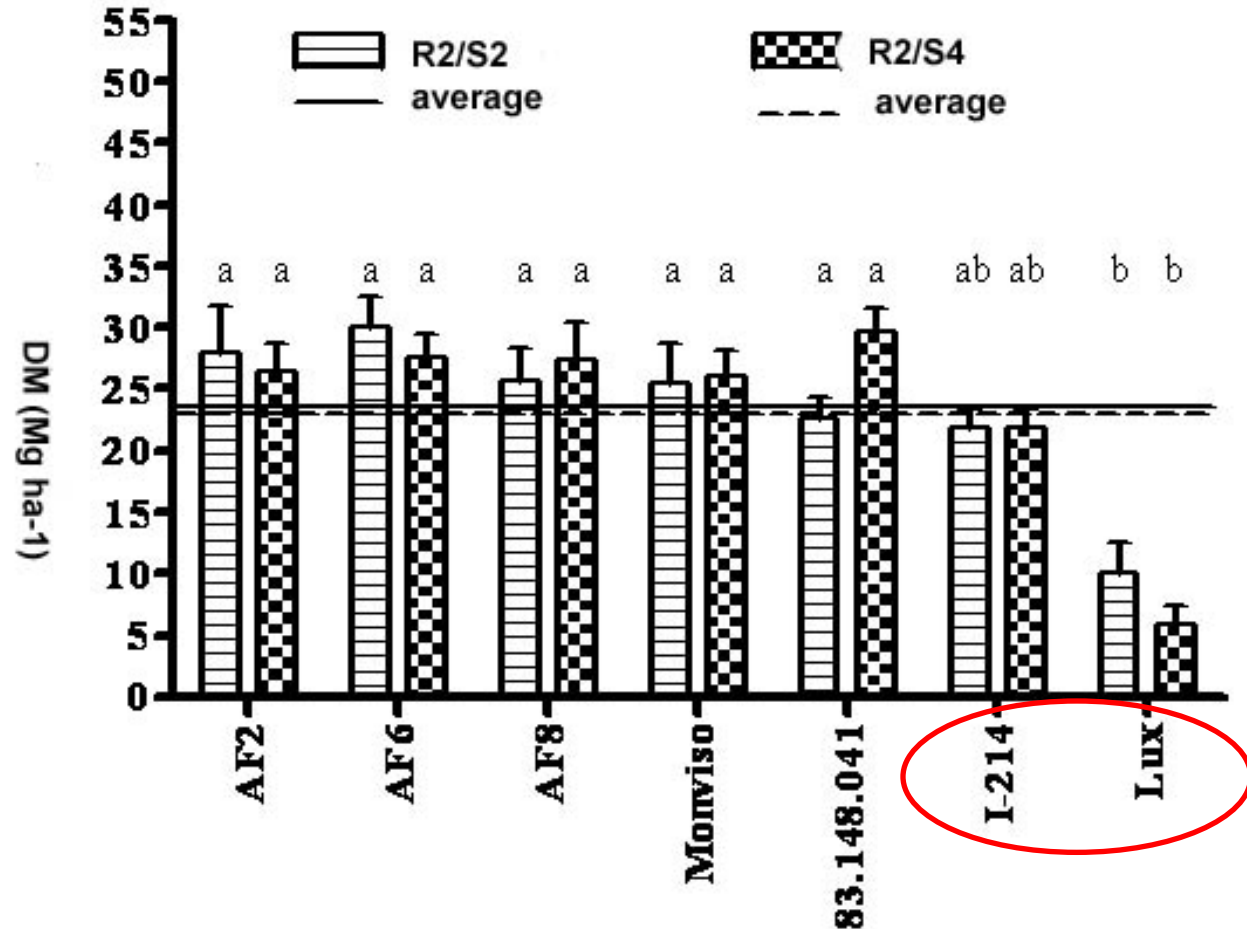


- ✓ Yield differences among clones were not significant in both cycles
- ✓ Average yield increased between the first and the second rotation (10 > 14 Mg dm ha<sup>-1</sup>, with significant differences just for the clone 83.148.041)

Within each rotation, bars with same letters are not significantly different for  $p \leq 0.05$ . Capital letters indicate significant difference between the 1<sup>st</sup> and the 2<sup>nd</sup> cycle.

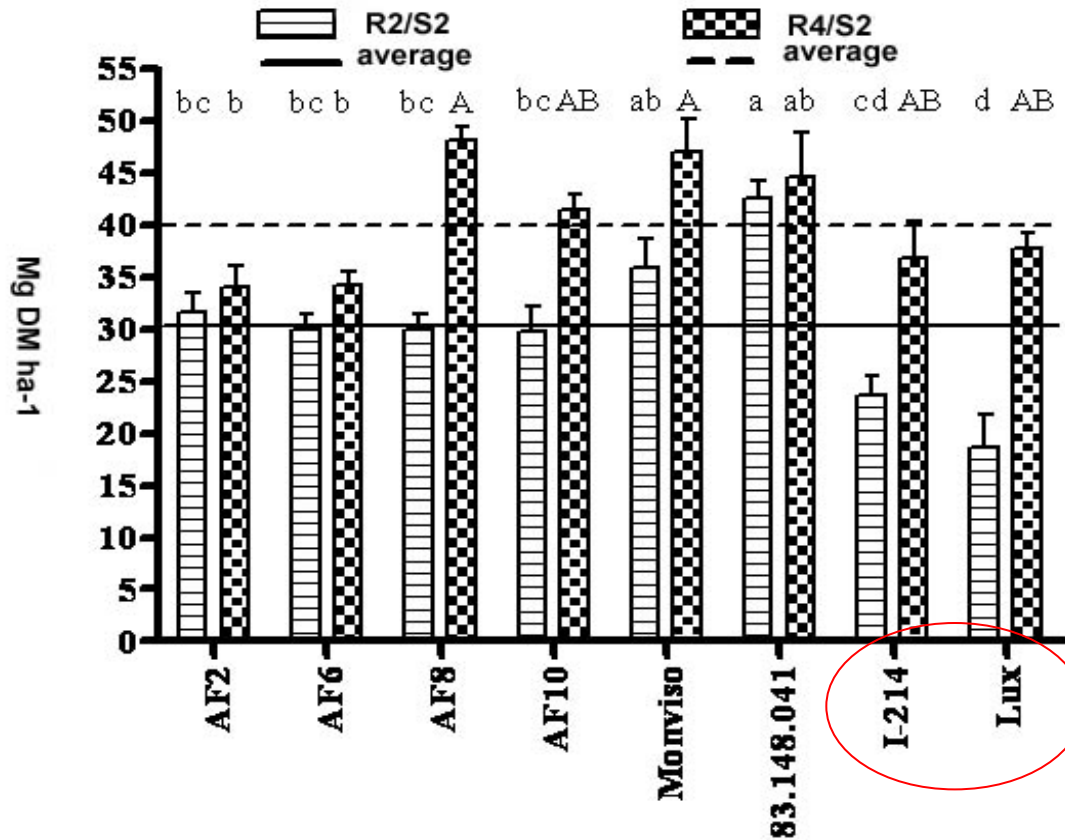
# Results: Yield - Vinovo (MF)

- ✓ Yield differences among clones significant in both cycles
- ✓ Any mean yield increment between the first and the second rotation (~23 Mg dm ha<sup>-1</sup>)
- ✓ Control Clones (I214 and Lux) had lower significant yields



Within each rotation, bars with same letters are not significant different for  $p \leq 0.05$   
 Capital letters indicate significant difference between the 1<sup>st</sup> and the 2<sup>nd</sup> cycle.

# Results: Yield - Mira\* (HF)



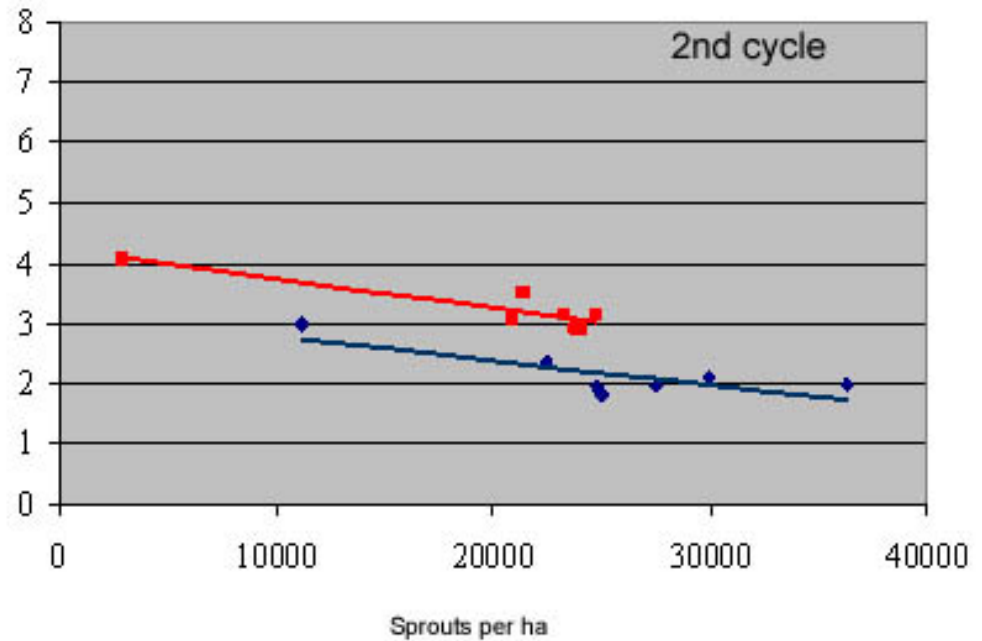
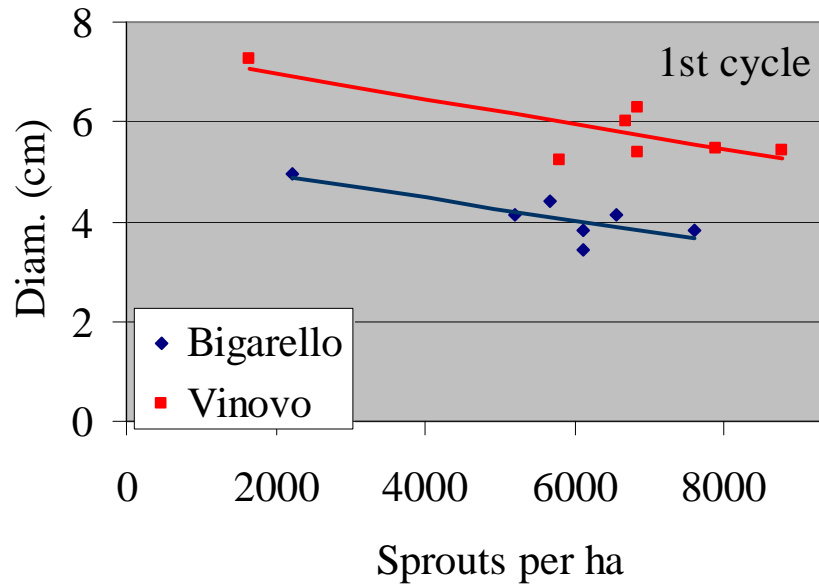
- ✓ Yield differences among clones significant in both cycles
- ✓ Strong mean yield increment between the first and the second rotation (30 > 40 Mg dm ha<sup>-1</sup>)
- ✓ Control Clones (I214 and Lux) had lower significant yields



Within each rotation, bars with same letters are not significant different for  $p \leq 0.05$   
 Capital letters indicate significant difference between the 1<sup>st</sup> and the 2<sup>nd</sup> cycle.

\* N Fertilization (150 Kg N ha<sup>-1</sup>) during the second rotation

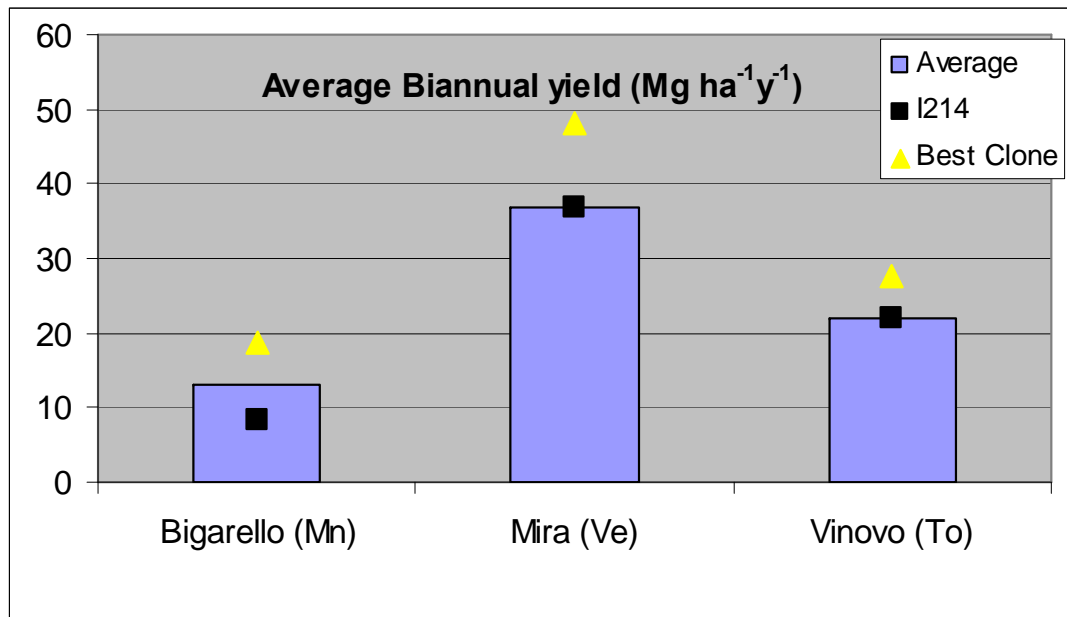
# Results: sprout density



From the first to the second rotation cycle there was a strong increase of sprout density, along with a dramatic reduction of the average shoot diameter



# Yield and Profitability, biannual cycle

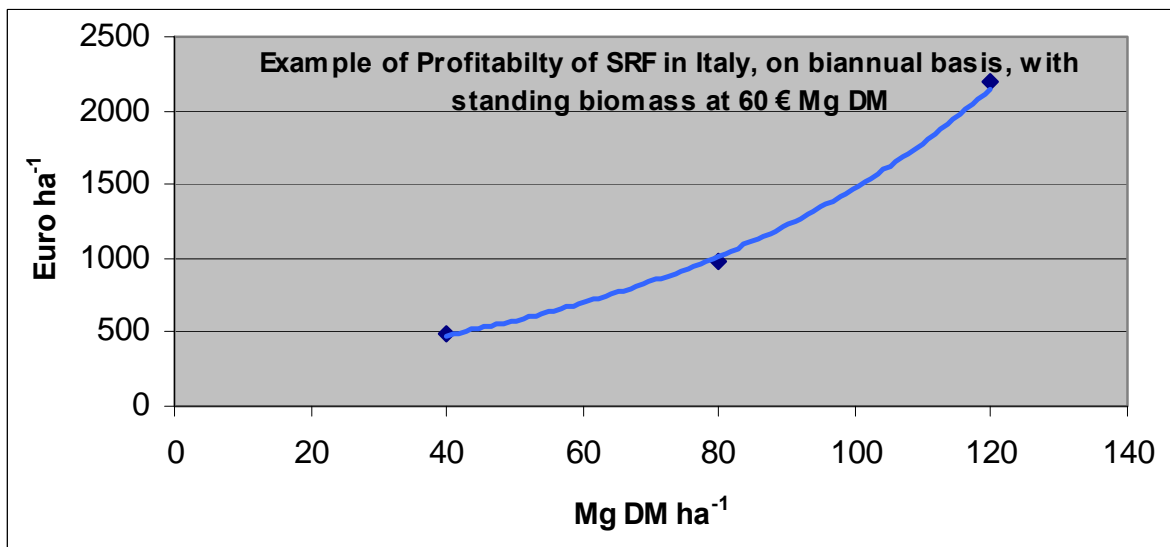


## Best Clones:

✓ Bigarello: 83.148.041 and Monviso

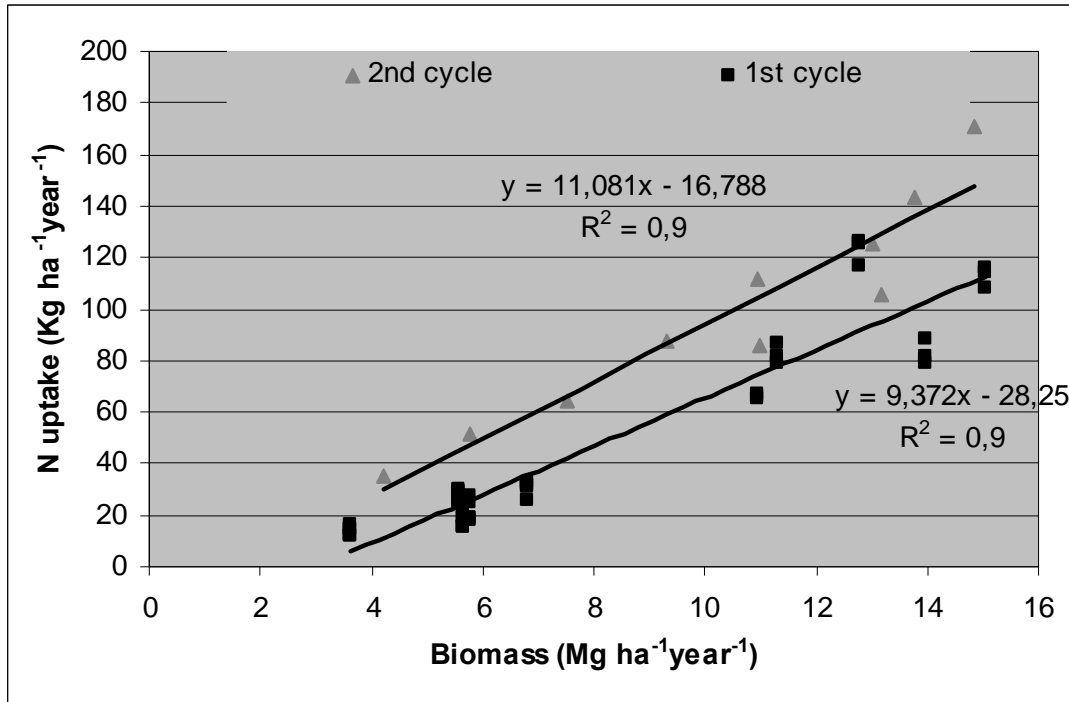
✓ Vinovo: AF6

✓ Mira: AF8, Monviso and 83.148.041



Only at Mira, the best site of the network, the best clones are able to strongly enhance the profitability of the woody crop, well over 500 € ha<sup>-1</sup>

# Growth and Nitrogen balance



-> Second rotation cycle: strong increase of sprout density, along with a dramatic reduction of the average shoot diameter

This strongly increases the amount of Nitrogen uptake with the biomass harvesting. This has important consequences on fertilization rates, but also create interesting opportunities for phytoremediation of those contaminants that are allocated preferably on the smaller shoots rich in bark



# Conclusions

- High SRF profitability can be achieved only under good site conditions
- New SRF poplar clones generally showed higher yield in comparison to control clones
- Among the tested clones for SRF, the more stable were Monviso and 83.148.041