Assessment of leaf area index and gas exchange in short rotation coppice poplar cultures

Scientific Report

Short Term Scientific Mission (STSM): COST Action FP1301

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BACKGROUND

From 31st May to 21st June 2016, I visited Plant & Vegetation Ecology (PLECO), Department of Biology, University of Antwerp, Belgium to explore the medium in which practical knowledge and experience were transferred within the coppice forestry mainly short rotation coppice (SRC) fast growing trees (poplar genotypes).

The original intention of STSM was to focus on the comparison of indirect leaf area index (LAI) methods (instruments) in SRC poplar cultures at two different places (Czech Republic and Belgium) and learn about gas exchange methods.

During my research stay, I focused on to write a manuscript entitled "Comparison of three indirect methods for estimating leaf area index in a high-density short-rotation coppiced plantation", where I discussed indirect LAI data (collected in April-October 2015) measured by me in SRC poplar clone J-105 (*Populus nigra* × *P. maximowiczii*) in Domaninek, Czech Republic (49°31´N, 16°14´E and altitude 530 m a.s.l.) using SunScan (delta-T, UK), LI-2000, (LiCor, USA) & LaiPen (LP_100, PSI, CR) and indirect LAI data (collected in April-November 2015) measured by my colleague, Ms. Cristina Ariza, in SRC poplar genotypes (see table 1) in Lochiristi, Belgium (51°06'44" N, 3°51'02" E) using SunScan, LAI-2000/2200 Plant Canopy Analyzer & Hemispherical Photograph. Apart from the indirect LAI data & publication I took part in the field work to learn gas exchange, stomatal conductance, water potential, sap flow methods in SRC poplar plantation (see table 1) in Lochiristi, Belgium. I also attend a three days EuroCoppice conference at University of Antwerp. This report comprises of details of all the activities I carried out during three weeks STSM stay at University of Antwerp, Belgium.

FIELD WORK

First visit - On 1st June 2016, I visited one of the largest short rotation coppice (SRC) poplar research site (Lochiristi Flanders, Belgium) consisting of twelve poplar genotypes (see Table 1) in the world, where I assisted a post doc (fellow of Marie Currie grant) Dr. Alejandra Navarro Garcia. I was exposed to several techniques such as sap flow (Dynamax Inc., Houston, TX,

USA), water potential (pressure chamber) and stomatal conductance (AP4, porometer, Delta-T, UK).

Table 1. Place of origin, botanical and parental characteristics of the twelve poplar genotypes studied (taken from Verlinden et al., 2013)

Genotype	Parentage	Section	Place of origin	Gender	Year of cross/ commerciali-zation
Bakan[1]	T × M	Tacamahaca	(Washington US × Oregon US) × Japan	♂	1975/2005
Skado[1]	T × M	Tacamahaca	(Washington US × Oregon US) × Japan	♀	1975/2005
Muur[1]	D × N	Aigeiros	(Iowa US × Illinois US) × (Italy × Belgium)	♂	1978/1999
Oudenberg[1]	D × N	Aigeiros	(Iowa US × Illinois US) × (Italy × Belgium)	♀	1978/1999
Vesten[1]	D × N	Aigeiros	(Iowa US × Illinois US) × (Italy × Belgium)	♀	1978/1999
Ellert[2]	D × N	Aigeiros	Michigan US × France	♂	1969/1989
Hees[2]	D × N	Aigeiros	Michigan US × France	♀	1969/1989
Koster[2]	D × N	Aigeiros	Michigan US × The Netherlands	♂	1966/1988
Robusta[3]	D × N	Aigeiros	Eastern US × Europe	♂	1885-1890/1895
Grimminge[1]	D × (T × D)	Aigeiros × (Tacamahaca × Aigeiros)	(Michigan US × Connecticut US) × (Washington US × (Iowa US × Missouri US))	♂	1976/1999
Brandaris[2]	N	Aigeiros	The Netherlands × Italy	♂	1964/1976
Wolterson[2]	N	Aigeiros	The Netherlands	♀	1960/1976

D = *Populus deltoides*, M = *Populus maximowiczii*, N = *Populus nigra*, T = *Populus trichocarpa*
[1] genotypes bred by the Institute for Nature and Forestry Research (INBO, Geraardsbergen, Belgium).
[2] genotypes bred by Research Institute for Forestry and Landscape Planning "De Dorschkamp" (Wageningen, The Netherlands).
[3] genotype originating from an open-pollinated *P. deltoides* tree, first commercialized by the nursery Simon-Louis Frères (Metz, France)

a

b

Figure 1. (a) Measuring diameter of breast height (dbh) using caliper (Mitutoyo, CD-15DC, UK, 0.01 mm precision), (b) trees with sap flow sensor (Dynamax Inc., Houston, TX, US**A**) & auromatic dbh measurement by a point dendrometer with a ring-shaped frame (ZN11-O-WP), (c) measuring stomatal conductance on the top of canopy using AP4 Porometer (Delta-T, UK) and measuring water potential using pressure chamber.

Second visit - On 10th June 2016, I revisited the same (as above mentioned) poplar research site (Lochiristi Flanders, Belgium) consisting of twelve poplar genotypes (see Table 1), where I assisted a post doc Dr. Manuela Balzarolo. I was exposed to gas exchange technique (LI-6400XT Portable Photosynthesis System) on tree level mainly leaf gas exchange.

Figure 2. Measuring photosynthesis using LI-6400XT (Portable Photosynthesis System) and collecting gas (in polythene bag) to estimate isoprene.

DATA ANALYSIS FOR THE PUBLICATION

After the first round of field work (from 2nd to 9th June 2016), We (I with colleagues at PLECO) had a discussion for previously (April- October 2015) collected indirect LAI data in SRC poplar clone J-105 in Domaninek, Czech Republic and for previously (April to November 2015) SRC poplar genotypes (see table 1) in Lochristi, Belgium. I processed the data from each indirect LAI instruments (SunScan delta T UK, LI-2000, Lincon USA and LP_100, PSI, CR) for a particular SRC poplar site (Domaninek) and clone J-105. I also studied the literature for the future publication entitled "Comparison of three indirect methods for estimating leaf area index in a high-density short-rotation coppiced plantation".

CONFERENCE

I attended a conference (16th – 17th June 2016) entitled "Coppice Forest in Europe: Ecosystem services, protection and nature conservation" at University of Antwerp, Belgium, where I attended several lectures and also took part in the following activities-

Poster presentation

I had a poster presentation entitled "Dynamics of biomass production in poplar clones grown under short rotation coppice management in the Czech Republic", which focused on biomass production of poplar clones at five different sites in Czech Republic. During the poster presentation I interacted with several participants who were interested in my poster.

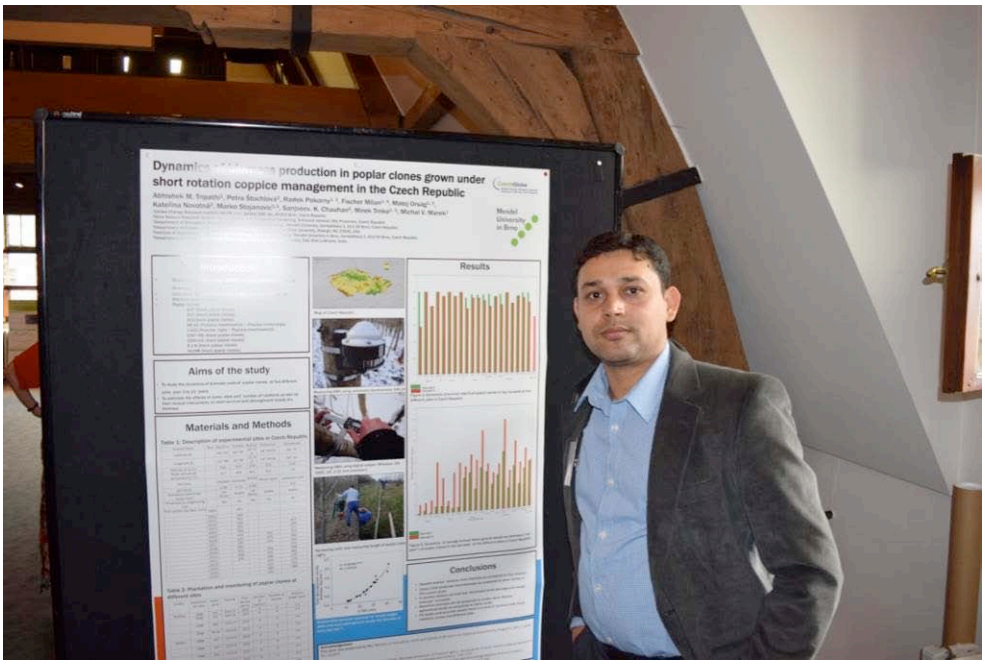

Figure 3. Presenting a poster entitled “Dynamics of biomass production in poplar clones grown under short rotation coppice management in the Czech Republic” at EuroCoppice conference (from 15th- 17th June 2016).

Field trip (part of conference)

During the field trip, I visited four places, which are mentioned below-

Muizenbos, Ranst- This is a reserve forest (area 34 ha) which was managed as a coppice (since 17th to 19th Century). In 1918, poplar genotypes were planted in between the coppice but the coppice management was maintained. In this coppice forest management system, I have learned about restoration of forest vegetation on eutrophicated farmland and conservation of light demanding biodiversity.

Figure 4. Listening about field Muizenbos, Ranst, Belgium.

The Short Rotation Coppice Plantation & Groep Mouton, Lochristi- The site is known for short rotation coppice poplar genotypes (12 genotypes planted on arable land with 11 ha area) and for the timber company, which provides the wood for timber construction, firewood, chips, biomass, pellets and briquettes. At this place, I have learned cultivation and use of poplar plantation under short rotation coppice management.

Figure 5. Poplar genotypes (a & b) at Lochristi and firewood biomass (c & d) at Groep Mouton company, Belgium.

Bos 'T Ename, Oudenaarde- Enam Wood used to be managed as a coppice with standards for hundreds of years. This consists of two disjoint parts, occupying 62 ha in the province of eastern Flanders, about 25 km south of Gent, Belgium and remaining of the 145 ha historically. In this coppice forest, I have learnt about how the biodiversity increased under coppice management.

Figure 6. A view of a coppice forest Bos 'T Ename, Oudenaarde, Belgium.

PRESENTATION AT PLECO

On 20th June 2016, I delivered a presentation on the topic "COMPARISON OF THREE INDIRECT METHODS FOR ESTIMATING LEAF AREA INDEX IN A HIGH-DENSITY SHORT-ROTATION COPPICED POPLAR PLANTATION". It was a great learning experience for me to present my results of the study related to indirect LAI measurements in front of a panel of LAI experts. Defending myself to the questions, I received few valuable suggestions and comments, which I would implement to improve writing my manuscript.

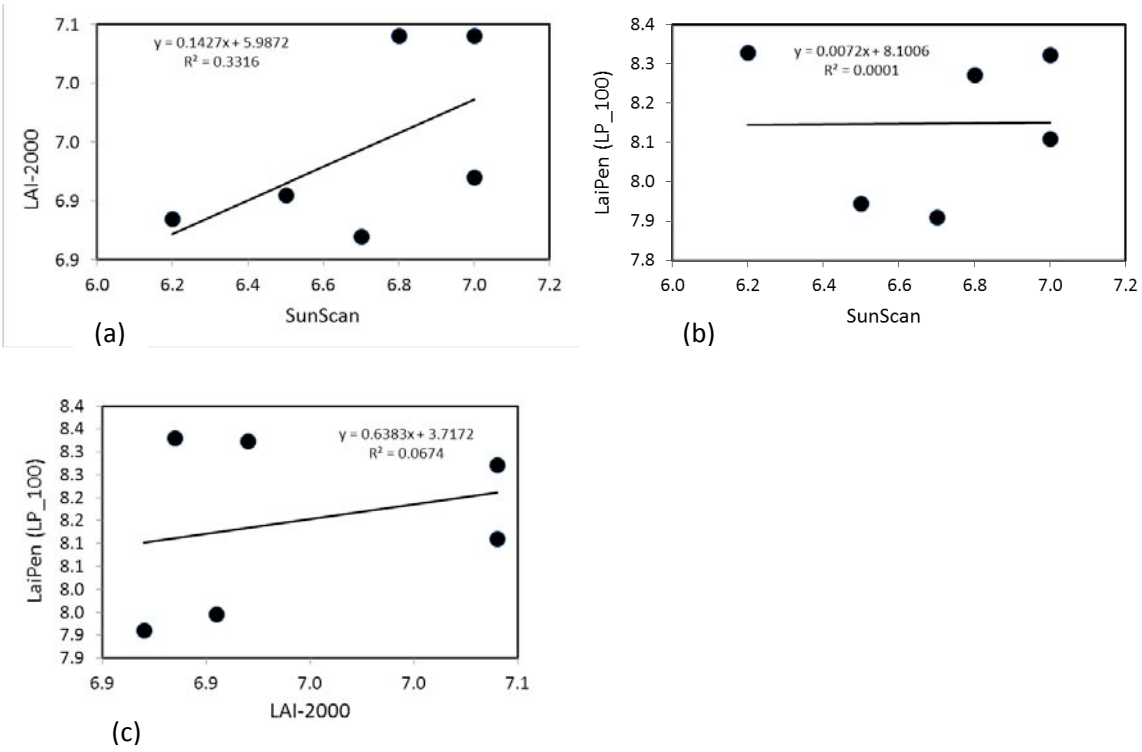

Figure 7. Comparison of indirect LAI-2000 vs. SunScan (a), LaiPen (LP_100) vs. SunScan (b) and LaiPen (LP_100) vs. LAI-2000 plant canopy analyzer measurements of leaf area index (LAI) in short rotation coppiced (SRC) poplar plantation .

CONCLUSIONS

- Receiving STSM to my credit was a best opportunity for me as a researcher (PhD student), to gain knowledge by interacting with experts and enhance (improve) networking.
- STSM has empowered me to upsurge my insight about SRC poplar genotypes, thus enabling me to refine my knowledge and learn about new measurement techniques which could be used in future studies in Czech Republic.
- I plan to write a joint publication with colleagues at PLECO with impact factor concerning comparison of indirect LAI method in SRC poplar at two different research sites in Europe.
- EuroCoppice conference was one of best moment in my research life to gain the indoor and outdoor (lecture and field work) knowledge at the same time. I have also discussed for future collaboration with some participants at conference including host organization.

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