Comparing the Soil CO_2 Flux in Short Rotation Willow Crop (*Salix dasyclados*) Stand as Affected by Tear Out and Continues Production Treatments

State University of New York
College of Environmental Science and Forestry

Renato S. Pacaldo*, Timothy A. Volk, and Russell D. Briggs

Department of Forest and Natural Resource Management, SUNY College of Environmental Science and Forestry, 1 Forestry Drive, Syracuse, NY 13210

Introduction

In willow biomass crops, a complete understanding of the carbon balance requires the quantification of inputs and outputs from various carbon pools. Carbon dioxide (CO_2) emissions via root respiration and decomposition of organic matter may constitute a major fraction of carbon losses in willow biomass crops. At the end of the crop's life the roots and stools will be ground up and left to decompose releasing accumulated carbon as CO_2. However, there are no data on soil respiration rates in willow biomass crops. Hence, there is a need to investigate soil respiration to refine the carbon balance in willow biomass crops.

Objectives

- To compare total soil respiration between regrowing willow biomass crops and willow that has been harvested and ground up along a 19-year chronosequence.
- To quantify belowground heterothropic respiration in regrowing willow biomass crops along a 19-year chronosequence.

Materials and Equipment

- Willow (SV1 – *Salix dasyclados*) planted in 1990, 1995, 1997, and 2004 and managed on a three year coppice rotation
- Soda lime
- Soil respiration machines

LI-8100 and LI-8150 (LiCor)

Long-term chamber

Survey chamber

- Soil collar (10 cm and 30 cm PVC pipe with 8 cm diameter)
- Plastic containers

Methods

- Site locations: 4 in Tully, and 1 Lafayette, New York
- Experimental Design: Split-Plot Design RCBD with age (4) as whole plot, 4 replications, and 2 treatments.
- Harvest willow and apply tear out treatment

Harvest willow crop

Apply herbicides and grind up stools in tear out treatment

Insert soil collars to 5cm and 30 cm depths

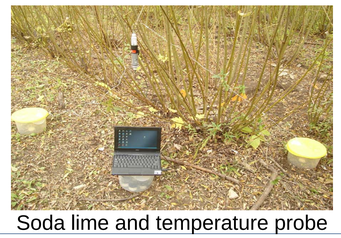
- Automated CO_2 flux measurement over 105 days
  Short- and long-term measurements to capture spatial and temporal variability of CO_2 flux

Short term survey measurements using LI-8100 and survey chamber

Long term continuous measurements using LI 8100 and multiplexer (LI-8150)

- Simultaneous CO_2 flux measurement using soda lime

Soda lime in plastic container



Soda lime and temperature probe

Results

- For the 1995 and 1997 plantings, total CO_2 flux is highest in the tear out treatment
- Heterothropic respiration is consistently lower than root respiration in all continuous production treatments
- For the 1990 and 2004 plantings total CO_2 flux in tear out plots is highest from August to October.
- Range of CO_2 flux values for 105 days period:
  - > Tear out: 3.9 to 4.9 μmol s^{-1} m^{-2} ≈ 16 to 20 Mg ha^{-1}
  - > Continuous: 4.1 to 5.6 μmol s^{-1} m^{-2} ≈ 16 to 22 Mg ha^{-1}
  - >Heterothropic: 2.8 to 4.1 μmol s^{-1} m^{-2} ≈ 11 to 16 Mg ha^{-1}
  - > Root respiration: 1.3 to 1.5 μmol s^{-1} m^{-2} ≈ 5 to 6 Mg ha^{-1}

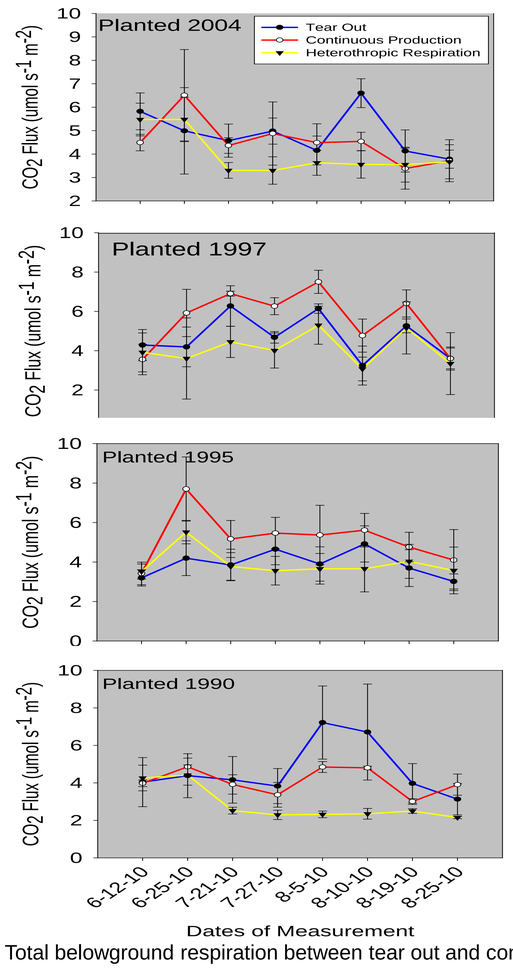


Fig. 1. Total belowground respiration between tear out and continuous production and heterothropic respiration by year in planting measured from June 12 to August 25, 2010.

Discussion

- The high CO_2 flux for continuous production treatment in 1995 and 1997 plantings could be attributed to high fine root biomass compared to 2004 and 1990.
- The low initial CO_2 flux in tear out plots compared to continuous production is probably due to low decomposition rate. The increased CO_2 flux after two months reflects increased decomposition rate of labile carbon.

Acknowledgment

This research is funded by USDA CSREES through the initiatives of Tim Volk and Larry Abrahamson