Field Report 2002-J Welker, P. Sullivan and J. Fahnestock

NATEX studies of tundra responses to deeper snow and warmer summer temperatures

This year we have focused on the coupling of belowground root growth patterns with leaf growth in the tussock graminoid, *Eriophorum vaginatum* at Toolik Lake, AK under a series of climate change scenarios. Our protocols were as follows:

Experimental Design:

3 treatment regimes: warming (0.84ºC above ambient with ITEX open-topped chambers), 22-4-4 NPK fertilization (2 applications: May 31 and June 21, each at a rate of 15g N m^{-2}) and increased winter snow

Replication: 8 control tubes, 6 warmed tubes, 8 fertilized tubes and 8 tubes with increased winter snow

Measurements:

- Root production
  - Instrument: minirhizotron camera system
  - Sampling regime: approximately 7 day intervals from May 22 to August 18, 2002

    Approximately 80 images $tube^{-1}$ $sampling\ date^{-1}$ at vertical interval of 0.87cm
  - Analysis regime: image analysis with MSU ROOTS to identify live standing root area by cohort
- Root production
  - Instrument: 5.0 cm I.D. soil corer
  - Sampling regime: approximately 7 day intervals from May 23 to August 18, 2002
    - 4 cores sampling date taken from tussock centers
      - random selection of tussocks, stratified by tussock height
  - Analysis regime: cores sorted by cohort for live standing root biomass
    - qualitative samples taken of rhizomes, > 2 year standing dead roots, 2001standing dead roots and bulk soil

- Leaf Growth
    - Instrument: metric ruler
    - Sampling regime: approximately 7 day intervals from May 17 to August 16, 2002
        - 3 individual tillers tagged per plot (minirhizotron tube)
        - Sequentially emerging leaves (n=5) measured for growth and senescence
- Microbial Biomass
    - Instrument: 5.0 cm I.D. soil corer
    - Sampling regime: approximately 7 day intervals from June 5 to August 13, 2002
        - 5 cores sampling date^{-1} sorted to remove live standing root biomass
        - Protocol: chloroform fumigation-extraction for microbial biomass N and C (Brookes et al., 1985) and gravimetric soil moisture determination.
- Soil water chemistry
    - Instrument: 5.0 cm I.D. soil corer
    - Sampling regime: approximately 7 day intervals from May 18 to August 9, 2002 from tussock centers
        - 4 cores sampling date^{-1}
    - soil water pressed from cores and filtered (1.0µm glass fiber filter)
- Foliar mineral nutrition
    - Sampling regime: approximately 7 day intervals from May 19 to August 15, 2002
        - 5 replicates (individual tussocks) leaf cohort^{-1} sampling date^{-1}
            - leaves cut and separated into live and senesced material
- Depth of thaw
    - Instrument: 100cm stainless steel thaw probe
    - Sampling regime: approximately 7 day intervals from May 18 to August 16, 2002 from tussock centers
    - 10 replicates along an elevational transect adjacent to the ITEX site
- Ambient air temperature at 1.0m

    - Instrument: Hobo single channel temperature logger
        - n=3 positioned along elevational transect within the ITEX site
    - Sampling regime: 2hr intervals from May 20 to August 18, 2002
- Soil surface temperature
    - Instrument: Hobo single channel temperature logger
        - n=30 placed in each plot (minirhizotron tube)
    - Sampling regime: 2hr intervals from May 20 to August 18, 2002

Our most important findings are:

1) Root growth is accelerated under warmer temperatures in early summer and the maximum rates of growth are greater under warmer temperatures.

2) Deep snow postpones root growth in spring and early summer, though root growth is prolonged in the later summer-early fall under deeper snow.

3) Root growth is affected by episodes of cold weather but there is a lag of a week and the growth of leaves and roots are off set with periods of rapid leaf growth corresponding with periods of low root growth.

These findings have recently been presented at the ITEX meeting in Finse, Norway, October 2002.