

NURSERY NUTRIENT LOADING INCREASED GROWTH AND NITROGEN RETRANSLOCATION IN JACK PINE SEEDLINGS PLANTED ON AN OIL SANDS RECLAIMED SOIL



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INTRODUCTION

Background

- Low nitrogen (N) availability is one of the major limiting factors of tree growth in land reclamation in the oil sands region
- Nutrient loading is an alternative approach to broadcast fertilization to reduce severe competition with understory vegetation
- Nutrient loading in nursery builds up nutrient reserves in seedlings that improves nutrient retranslocation and supports new tissue growth soon after outplanting

Rationale

- A study of nursery N loading on oak seedlings by Salifu et al. (2009) reports improved field performance on abandoned mine lands
- The effect of nutrient loading and importance of nutrient retranslocation vary in species and environmental conditions (Nelson et al. 1995)
- There is not much information on growth of nutrient-loaded jack pine (*Pinus banksiana* Lamb.) seedlings on oil sands reclamation

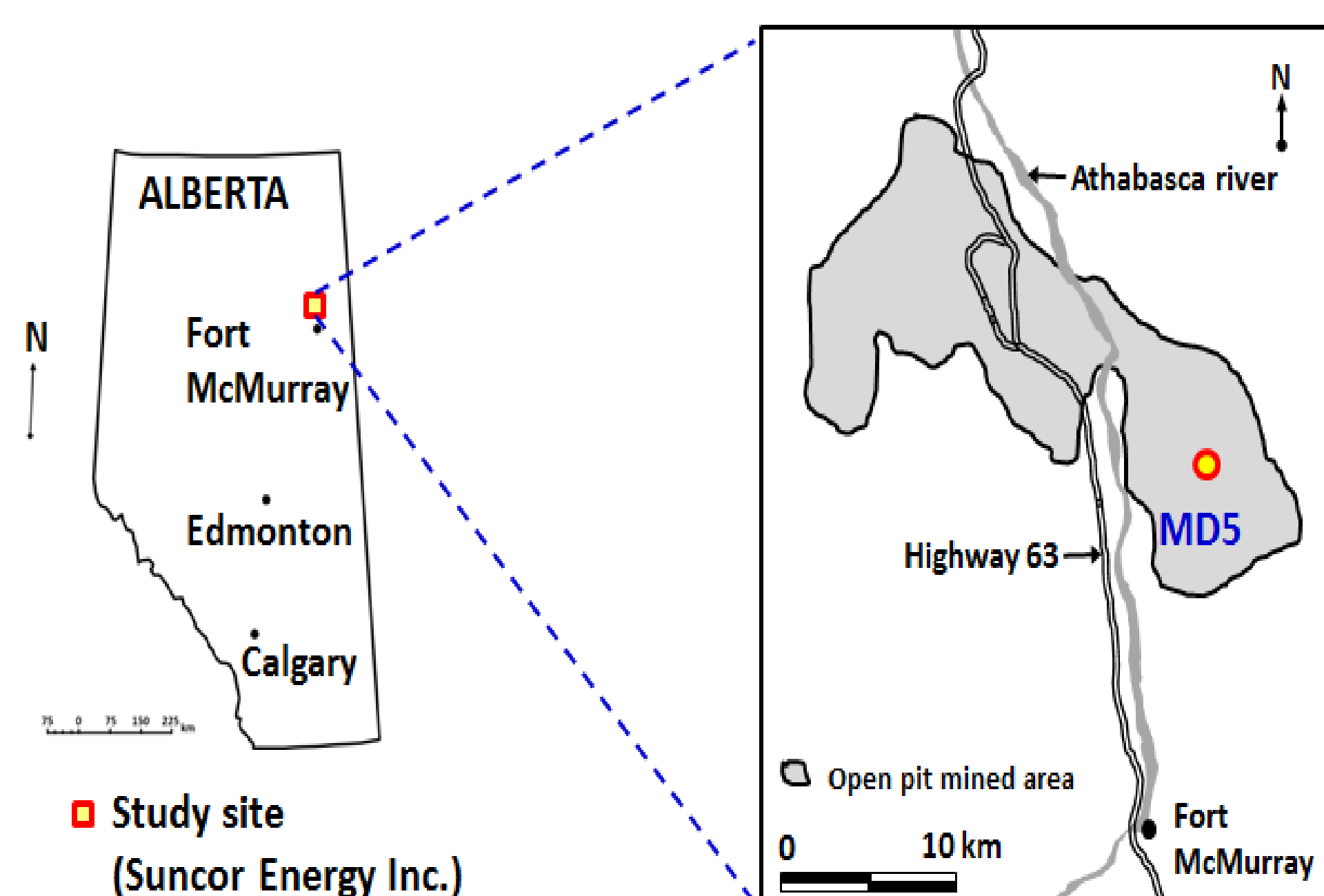
Objectives

- To examine the field performance of nutrient loaded seedlings of jack pine in reclaimed soils of oil sands
- To quantify the amount of N remobilized and N uptake from soil into new growth of nutrient loaded seedlings

MATERIALS & METHODS

Study Area

The study was conducted at Suncor Energy Inc. reclamation area (~25 km North Fort McMurray) in Alberta, Canada.



- Nutrient-loaded and conventional seedlings produced in nursery

Seedlings	Fertilizer rate (mg seedlings ⁻¹)
Nutrient-loaded	500
Conventional	300

- Seedlings planted on reclaimed soils with peat mineral soil mix as a cover material on overburden

Experimental design

A 2 (Nutrient loaded (NL) vs Conventional (C)) x 2 (weed intact (+W) vs weed removed (-W)) factorial design with 5 replicates

Soil sampling and analyses

- Sampling depths: 0-10 cm and 10-30 cm
- Analyses: pH, electrical conductivity (EC), ammonium (NH₄⁺-N), nitrate (NO₃⁻-N), total C, total N and bulk density

Seedlings size measurement and nutrient analyses

- Seedlings height and root collar diameter (RCD) were measured in June, August, and October in 2014
- Biomass and N concentrations, nitrogen derived from plant (NDFP) and nitrogen uptake from soil (NDFS) were determined

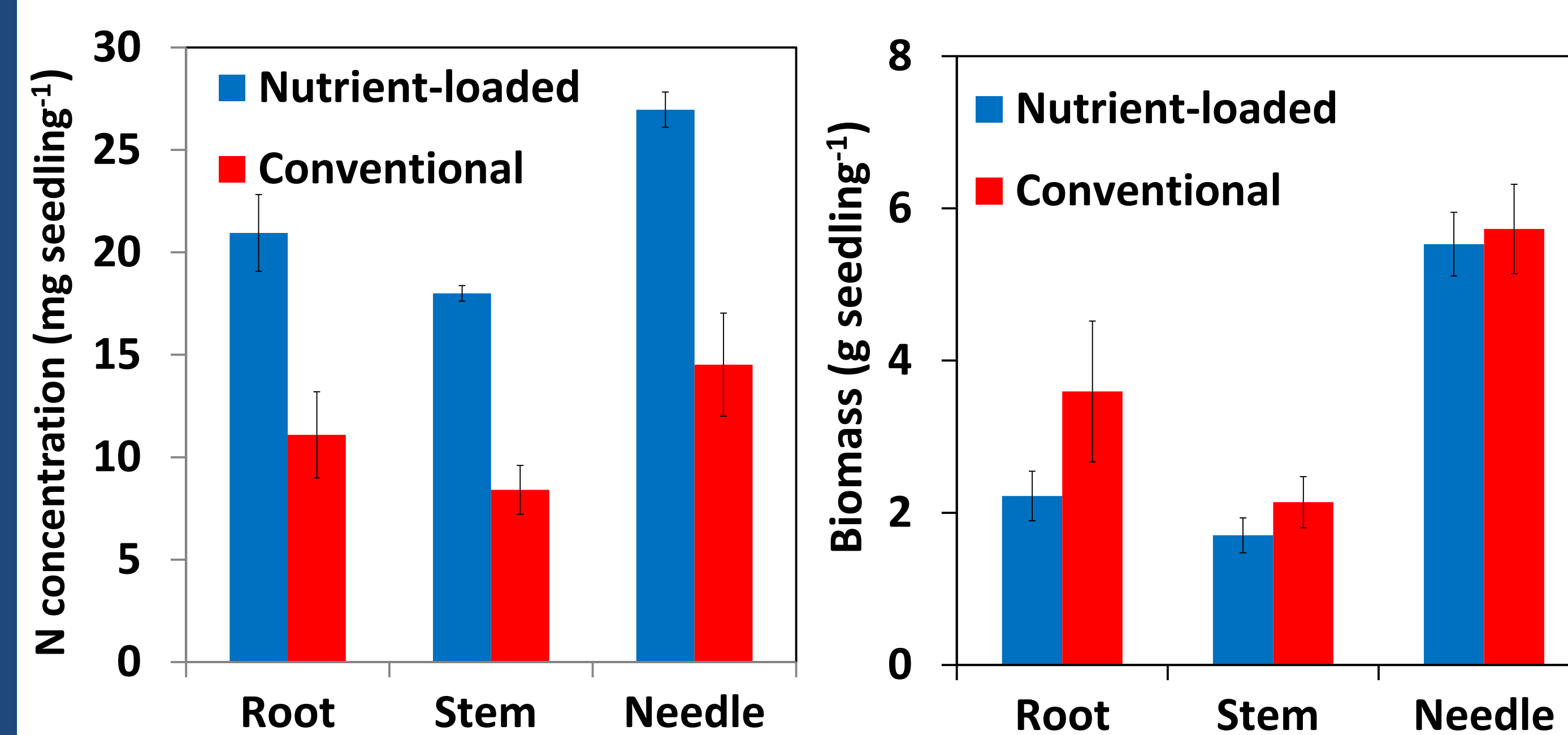


RESULTS

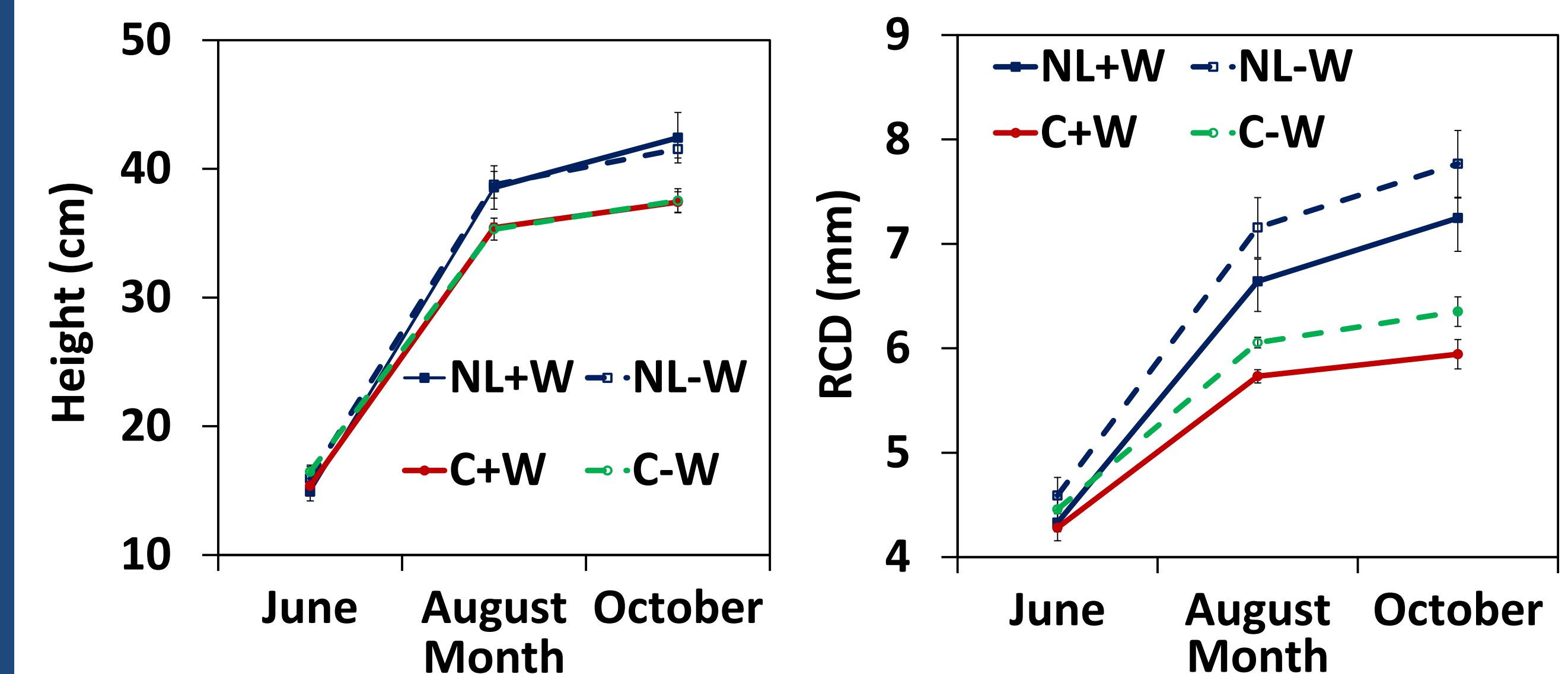
Physical and chemical properties of soil

Depth (cm)	pH	EC (ds m ⁻¹)	Total C (g kg ⁻¹)	Total N (g kg ⁻¹)	C:N	NH ₄ ⁺ -N (mg kg ⁻¹)	NO ₃ ⁻ -N (mg kg ⁻¹)	Bulk density (g cm ⁻³)
0-10	6.85 (0.05)	1.42 (0.11)	83.53 (7.99)	3.07 (0.33)	29.92 (2.16)	5.59 (0.54)	3.81 (0.59)	0.55 (0.04)
10-30	6.96 (0.06)	1.44 (0.13)	76.99 (10.14)	2.62 (0.42)	39.60 (6.63)	4.00 (0.33)	3.01 (0.47)	0.52 (0.04)

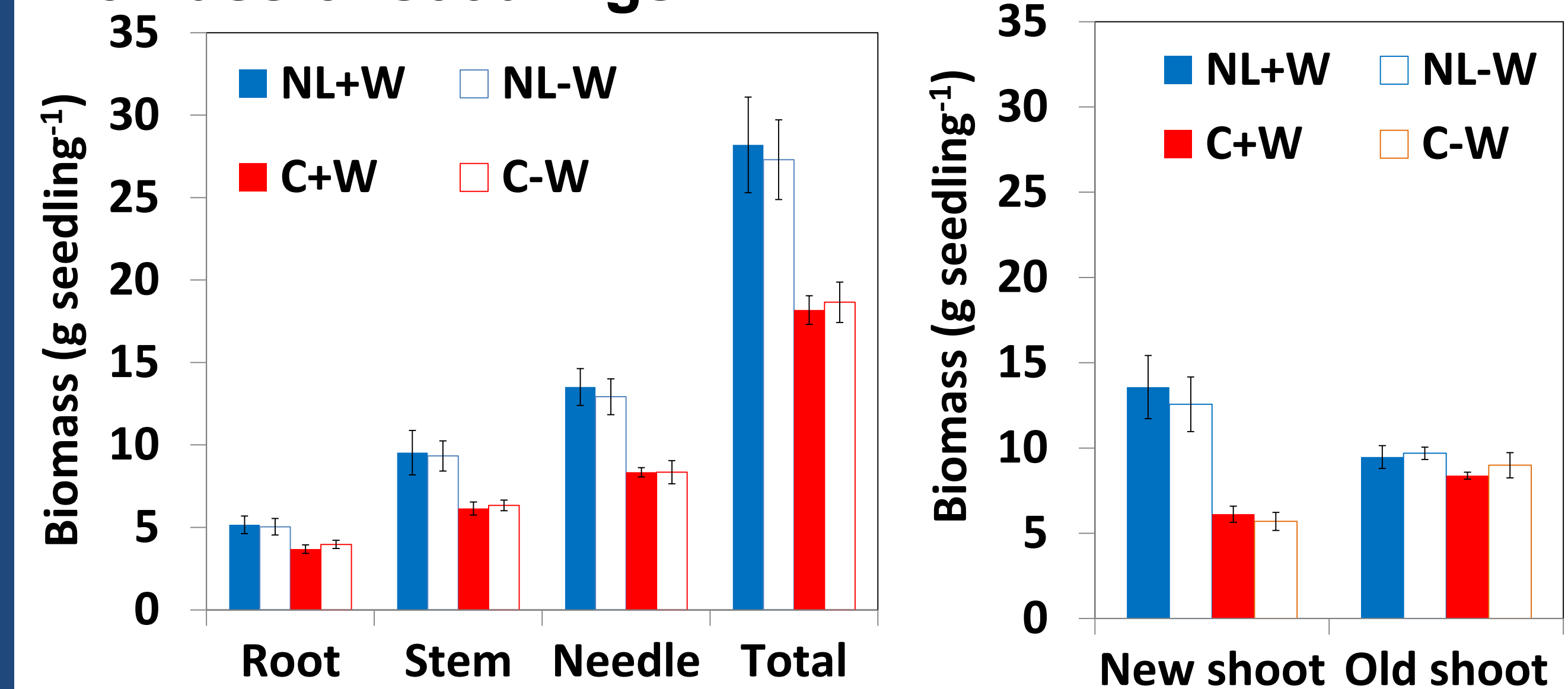
N concentration and biomass of seedlings (before outplanting)



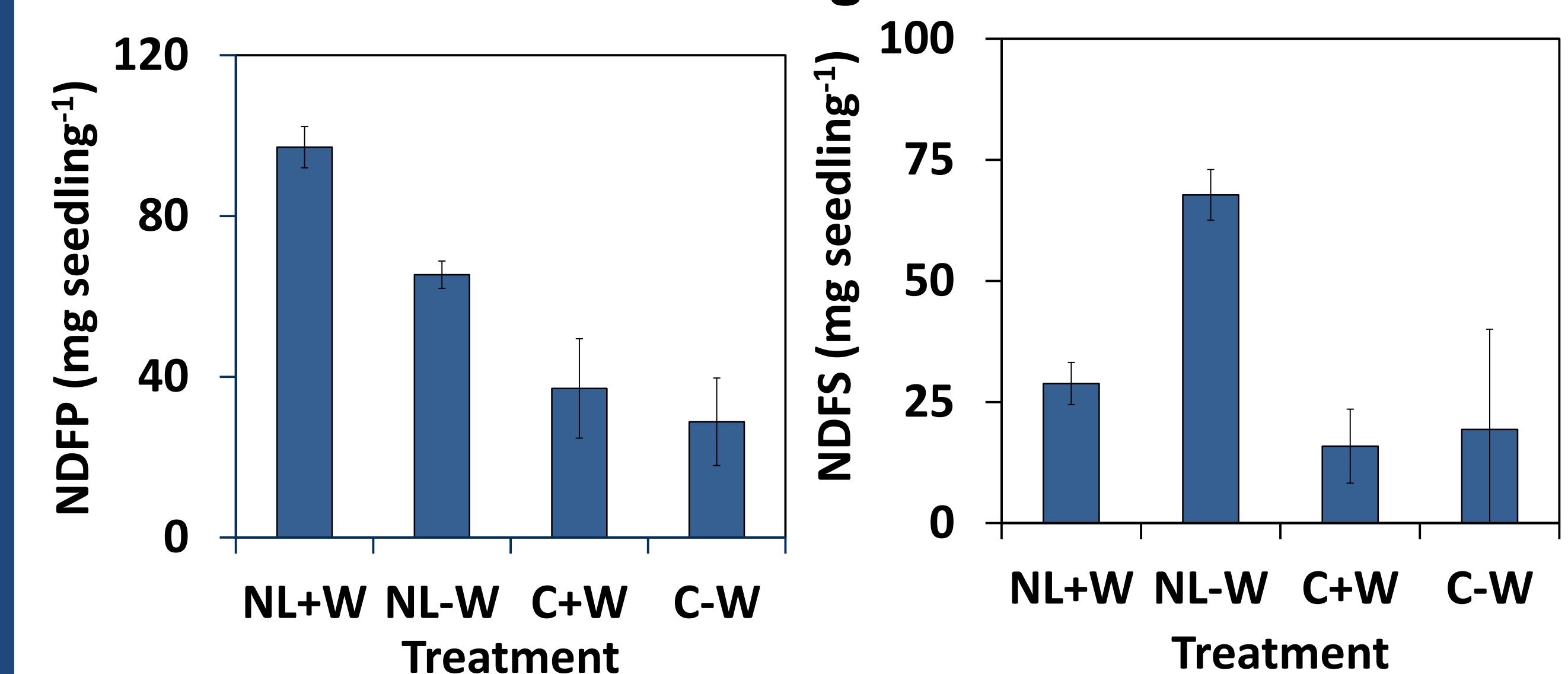
Height and RCD of seedlings (after outplanting)



Biomass of seedlings



NDFP and NDFS in seedlings



CONCLUSIONS

- Component N concentration of nutrient-loaded seedlings were greater than that of C seedlings in nursery phase that leads to nutrient reserve built in nutrient loaded seedlings
- After outplanting in the field, nutrient loading improved height, RCD, component dry mass of seedlings, NDFP and NDFS in the first year
- Improved growth and N retranslocation in nutrient-loaded seedlings may be attributed to the greater nutrient reserve built up in these seedlings in nursery
- Nutrient loading in jack pine seedlings has potential to improve growth performance planted on reclaimed soils

ACKNOWLEDGEMENTS

