

Switchgrass for Forage and Bioenergy: Effects of N, P, and K Fertilization

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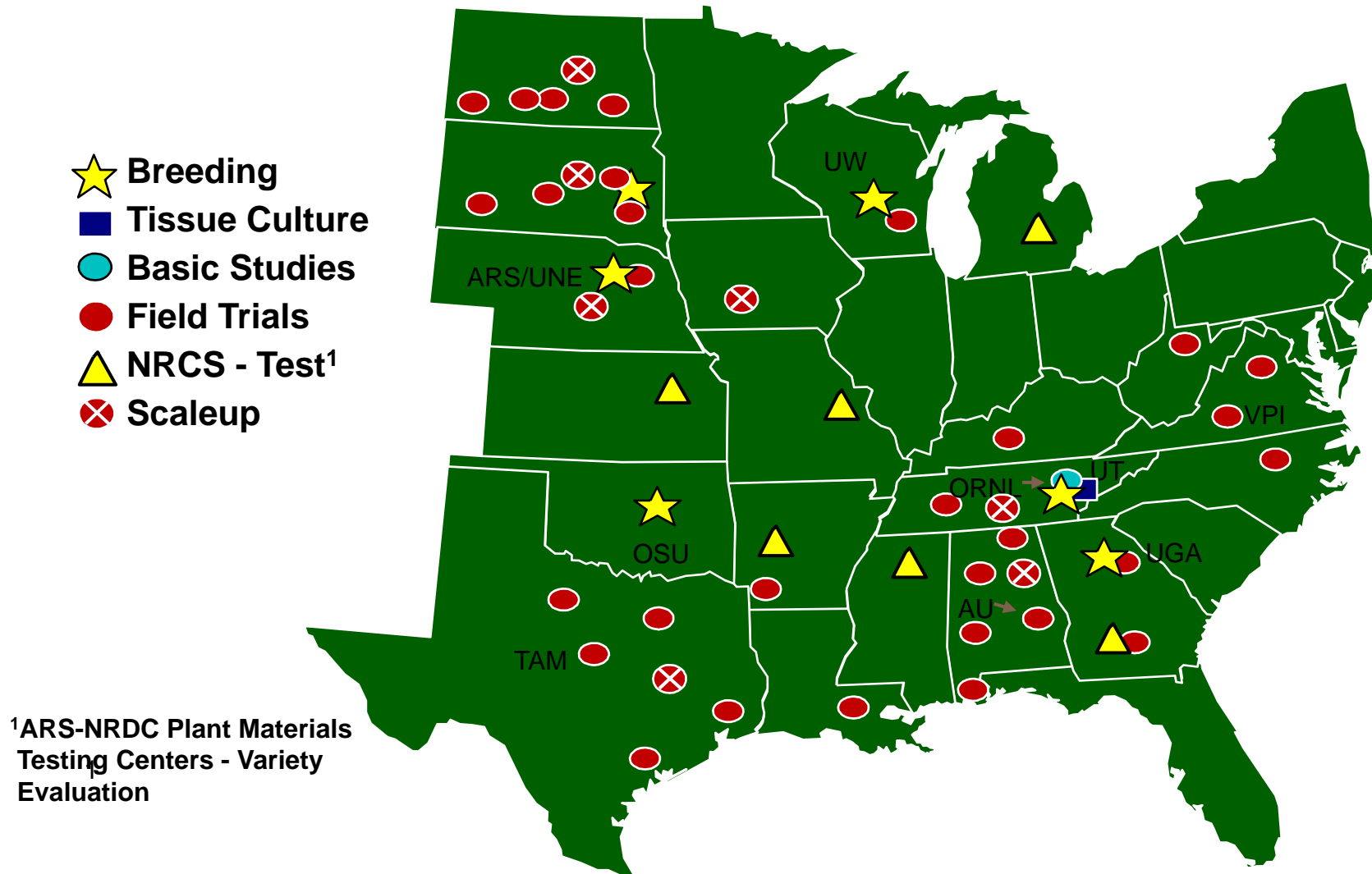
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ORNL - BFDP Switchgrass Research



Source: www.bioenergy.ornl.gov/02workshop/mclaughlin.ppt

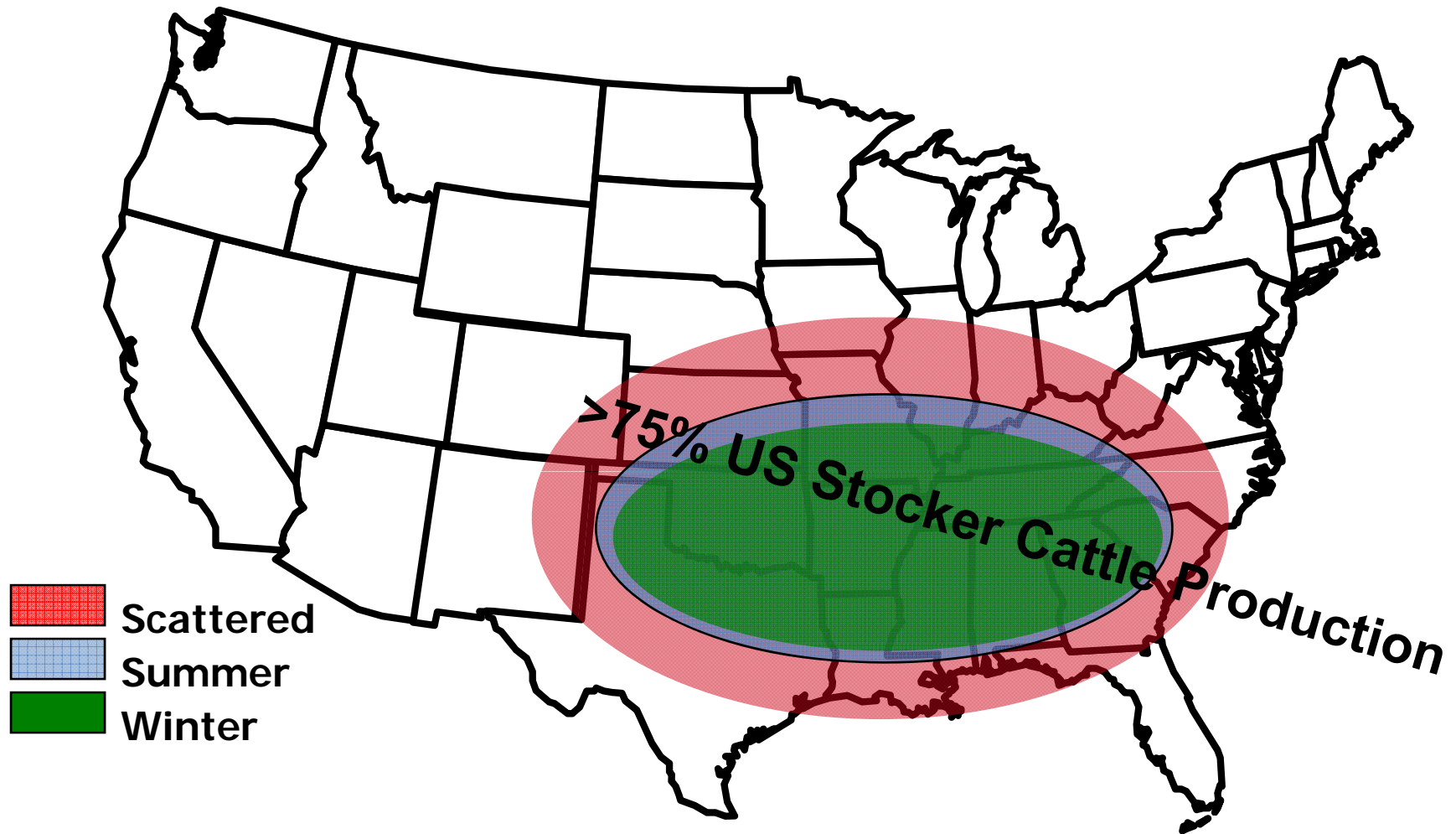
Switchgrass and Ethanol

- U.S. Energy Independence and Security Act of 2007
 - Renewable Fuel Standard (RFS)
 - 136 billion liters of ethanol by 2017
 - 56 billion liters from grain (starch)
 - 60 billion liters from cellulose-containing plant materials

Challenges

- No commercial cellulosic ethanol biorefineries
- Quantities of biomass needed
- Indirect land use effects
- Price per ton paid
- Logistical concerns
- Transition from conventional to bioenergy crop systems

Switchgrass may have value as forage

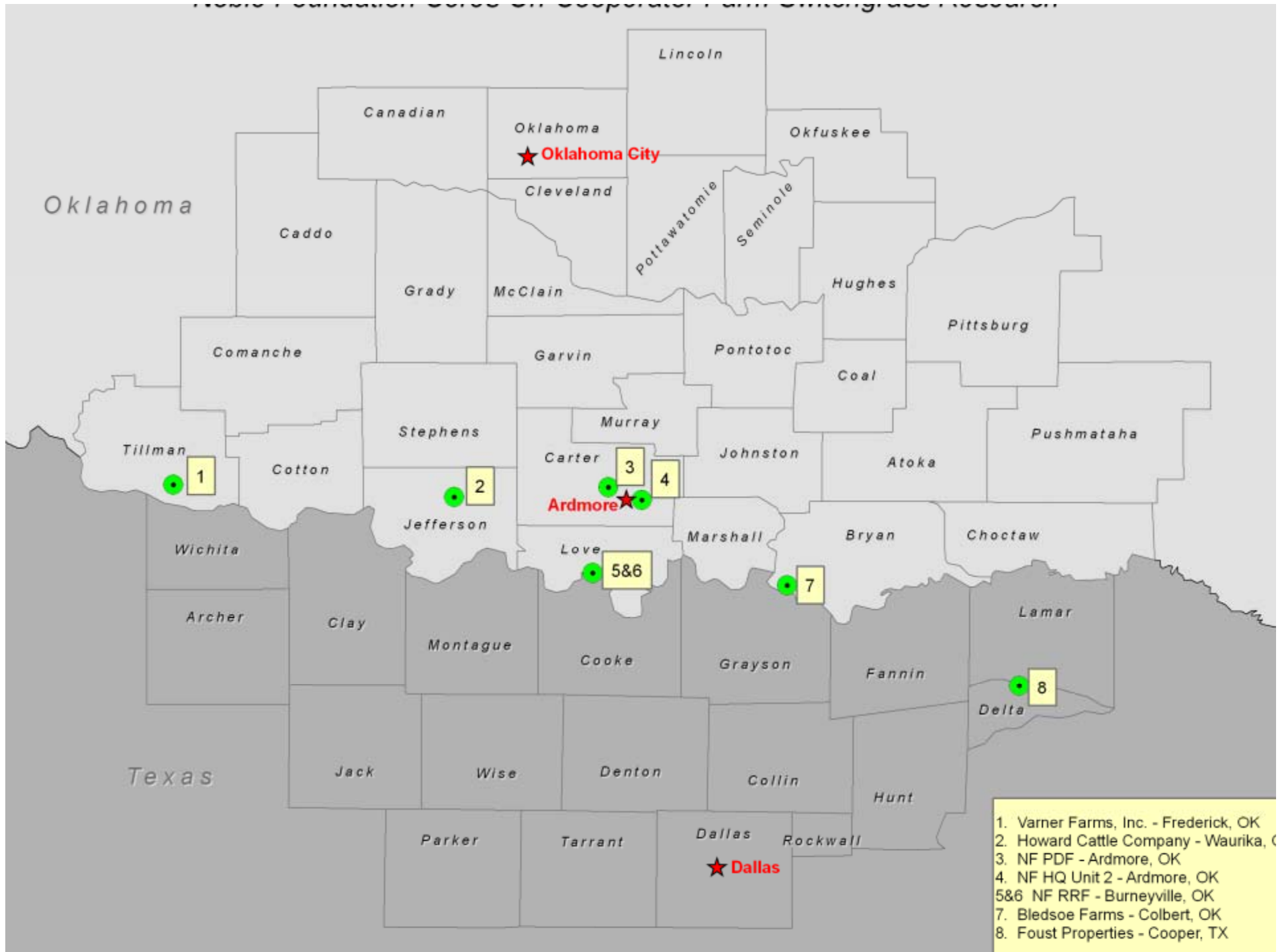


Objective

- Examine biomass yield and nutrient uptake responses to N, P, and K fertilizer rates under dual-purpose forage and bioenergy harvest scenarios



North Carolina, Texas and Oklahoma Cooperative Farm Emergency Research



Soils and Cropping History

	Frederick	Waurika	Ardmore (PDF)	Ardmore (HQ2)	Burneyville	Colbert	Cooper
Soil type	silt loam	loam	loam	loam	fine sandy loam	fine sandy loam	clay
Land type	Cropland	Cropland Pasture	Cropland Pasture	Marginal fallow	Cropland Pasture	Marginal pasture	Cropland
Soil pH	8.2	6.2	6.3	6.4	6.6	5.4	8.0
SOM	2.2	1.6	1.7	2.2	1.0	1.3	3.5
Soil P	71	8	132	6	74	24	22
Soil K	938	267	136	385	386	358	473

Nitrogen Rate Experiments

Source of Variation	df	Biomass Yield	N removal	P removal	K removal
		----- <i>P</i> value -----			
Location (L)	1	0.05	0.05	ns	0.01
Harvest System (H)	2	0.001	0.001	0.001	0.001
Nitrogen Rate (N)	5	0.05	0.001	0.001	0.001
L × H	2	0.001	0.001	ns	ns
L × N	5	ns	ns	0.05	0.01
H × N	10	0.05	0.01	0.01	0.001
L × H × N	10	ns	ns	ns	0.01

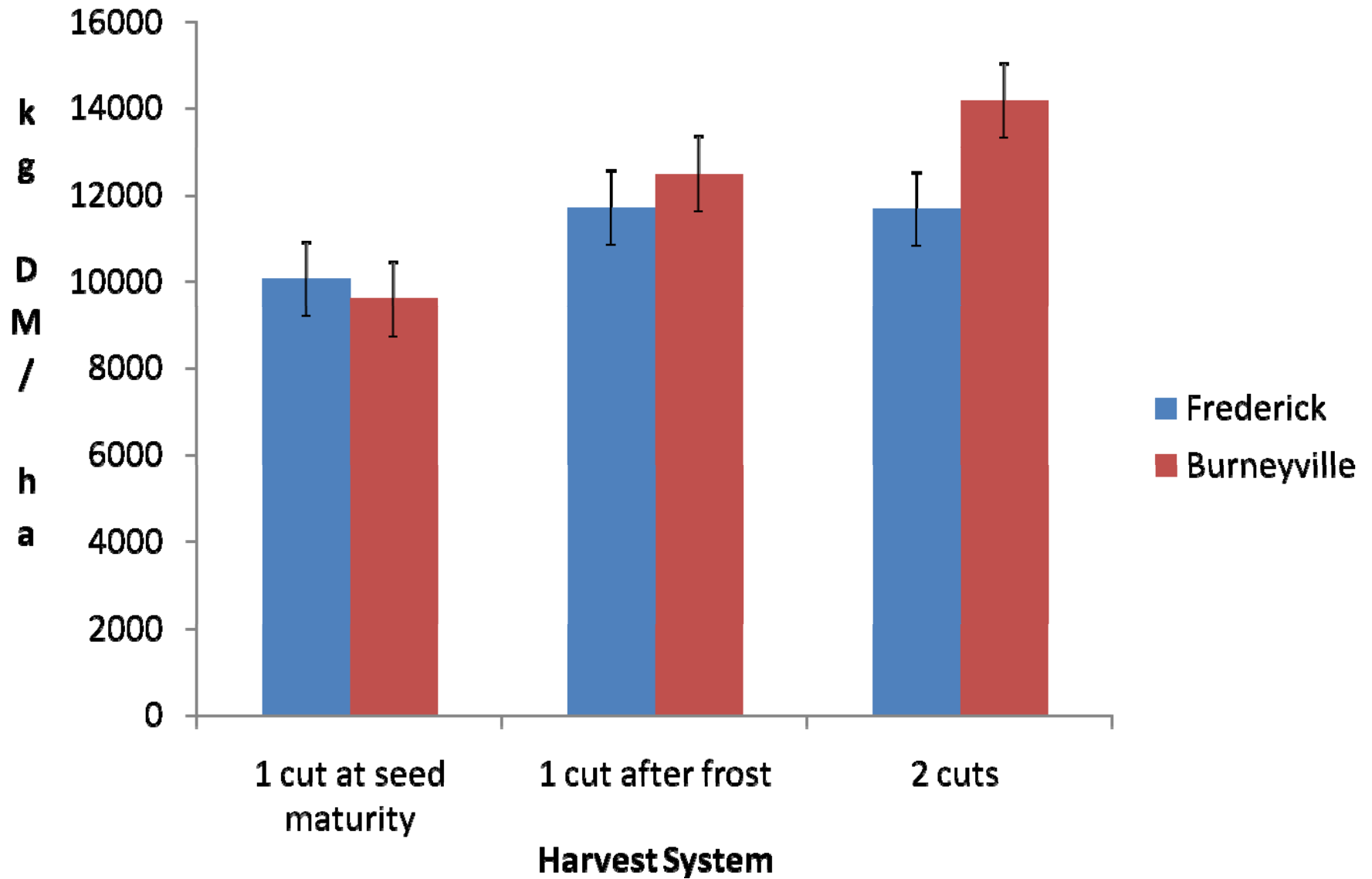
Phosphorus Rate Experiments

Source of Variation	df	Seedling establishment	1 st -Year Biomass	2 nd -Year Biomass
		----- <i>P</i> value -----		
Location (L)	1	ns	ns	0.001
Nitrogen Rate (N)	1	ns	ns	0.05
Phosphorus Rate (P)	3	ns	ns	0.05
L × N	1	ns	ns	ns
L × P	3	ns	ns	ns
N × P	3	ns	ns	ns
L × N × P	3	ns	ns	ns

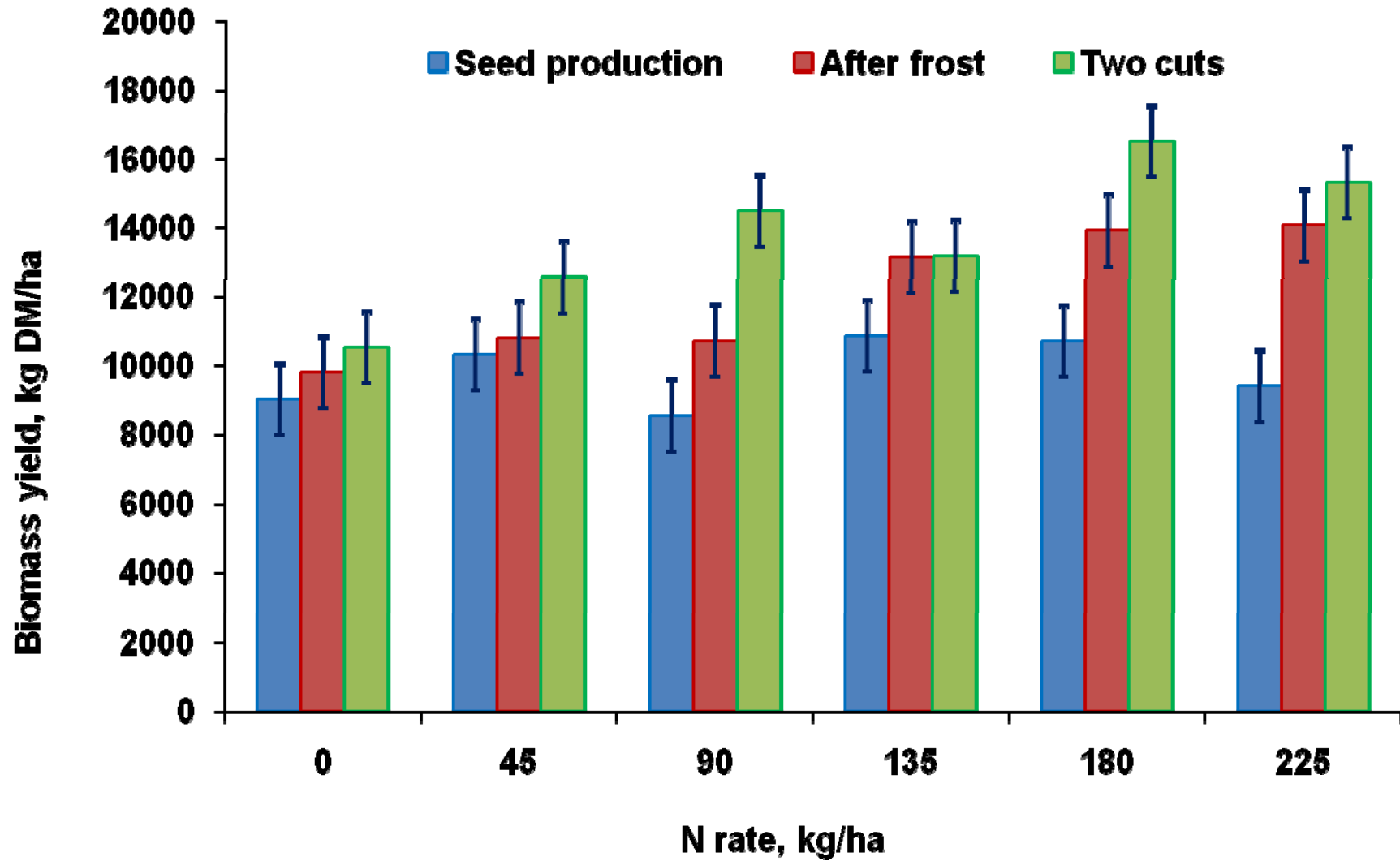
Potassium Addition Experiment

Source of Variation	df	Seedling Establishment	1 st -Year Biomass	2 nd -Year Biomass
		----- <i>P</i> value -----		
Harvest System (H)	1	ns	ns	ns
Nitrogen Rate (N)	1	ns	ns	ns
Potassium Rate (K)	1	ns	ns	ns
H × N	1	ns	ns	ns
H × K	1	ns	ns	ns
N × K	1	ns	ns	ns
H × N × K	1	ns	ns	ns

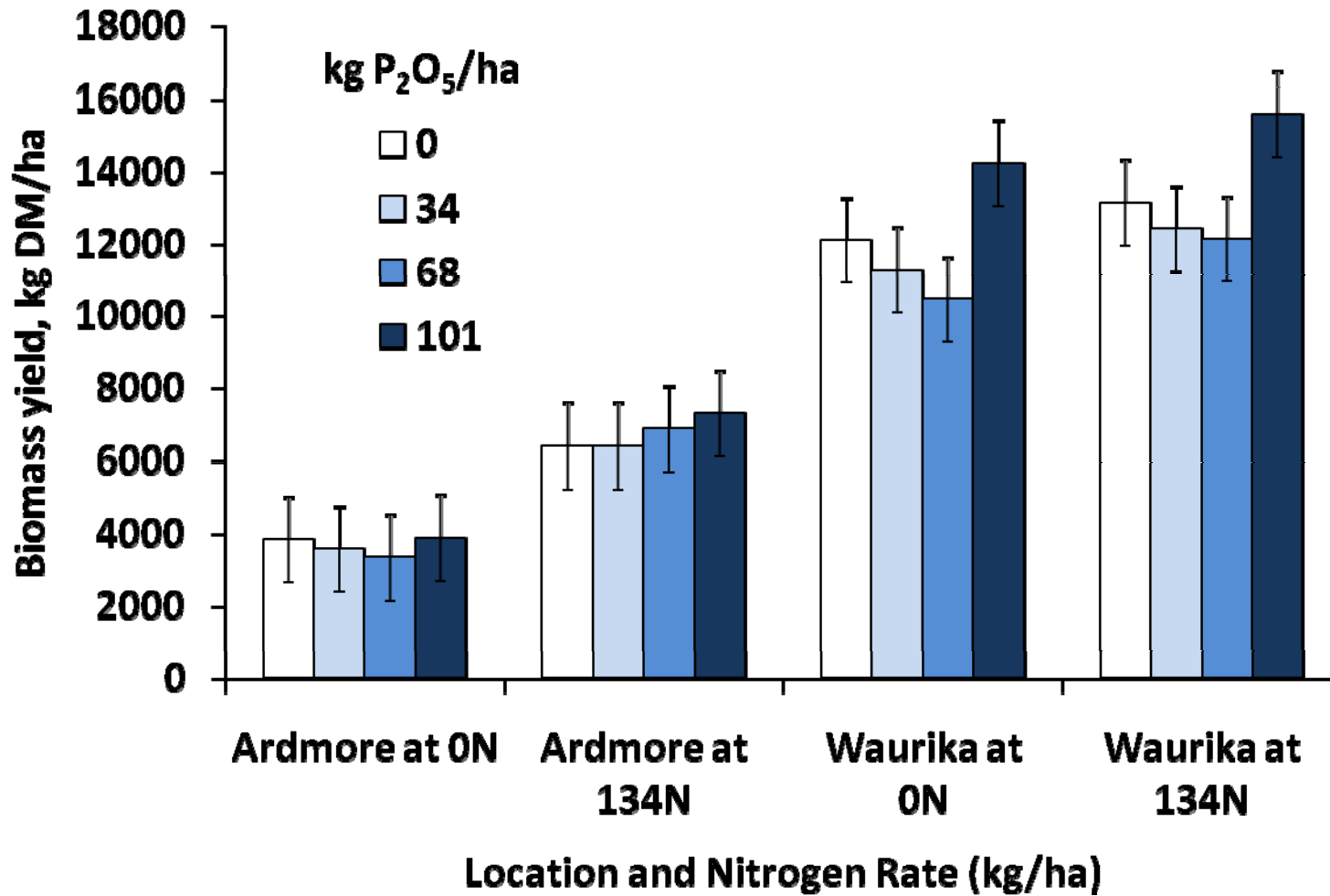
Location and Harvest Effects



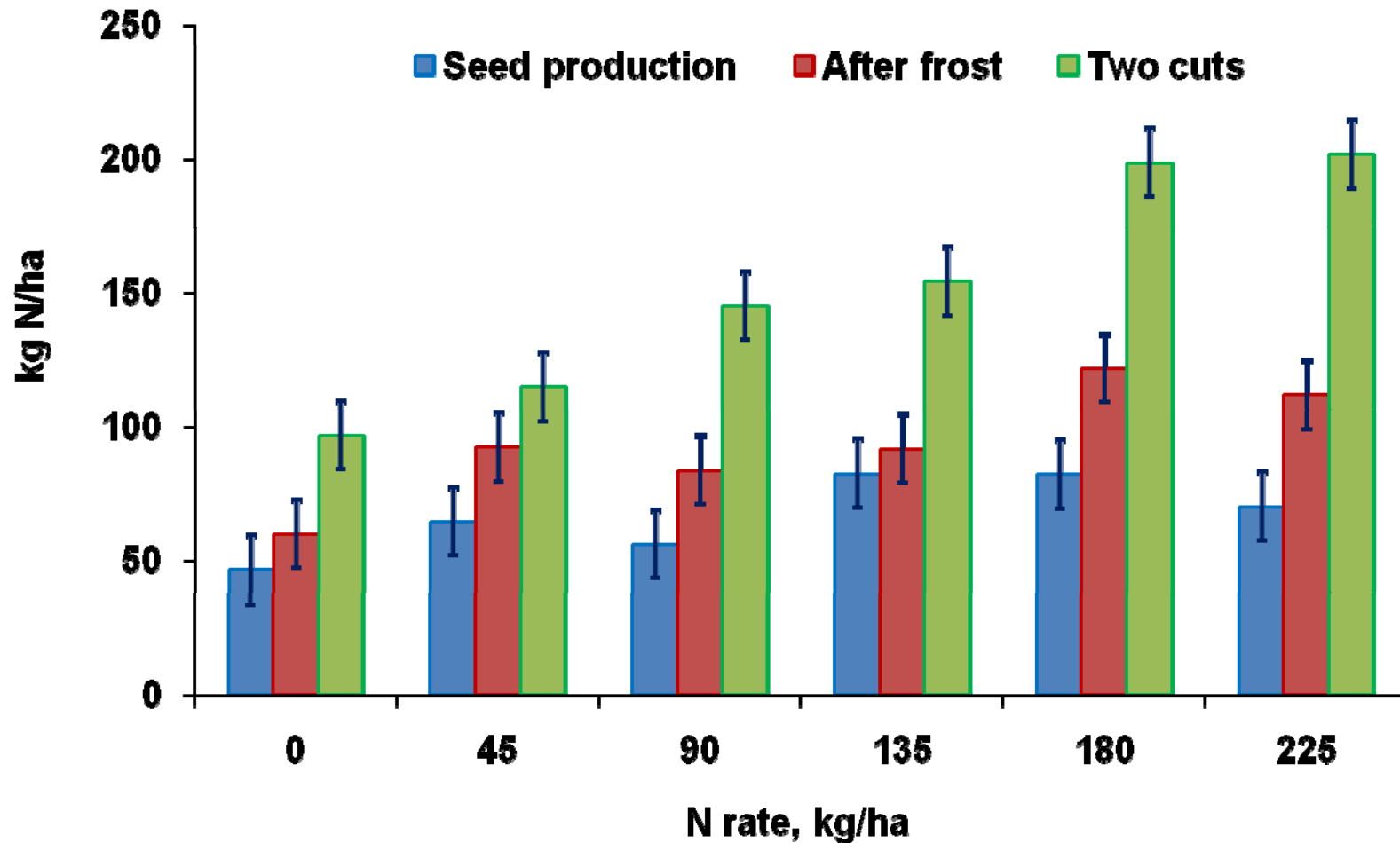
Nitrogen and Harvest Effects



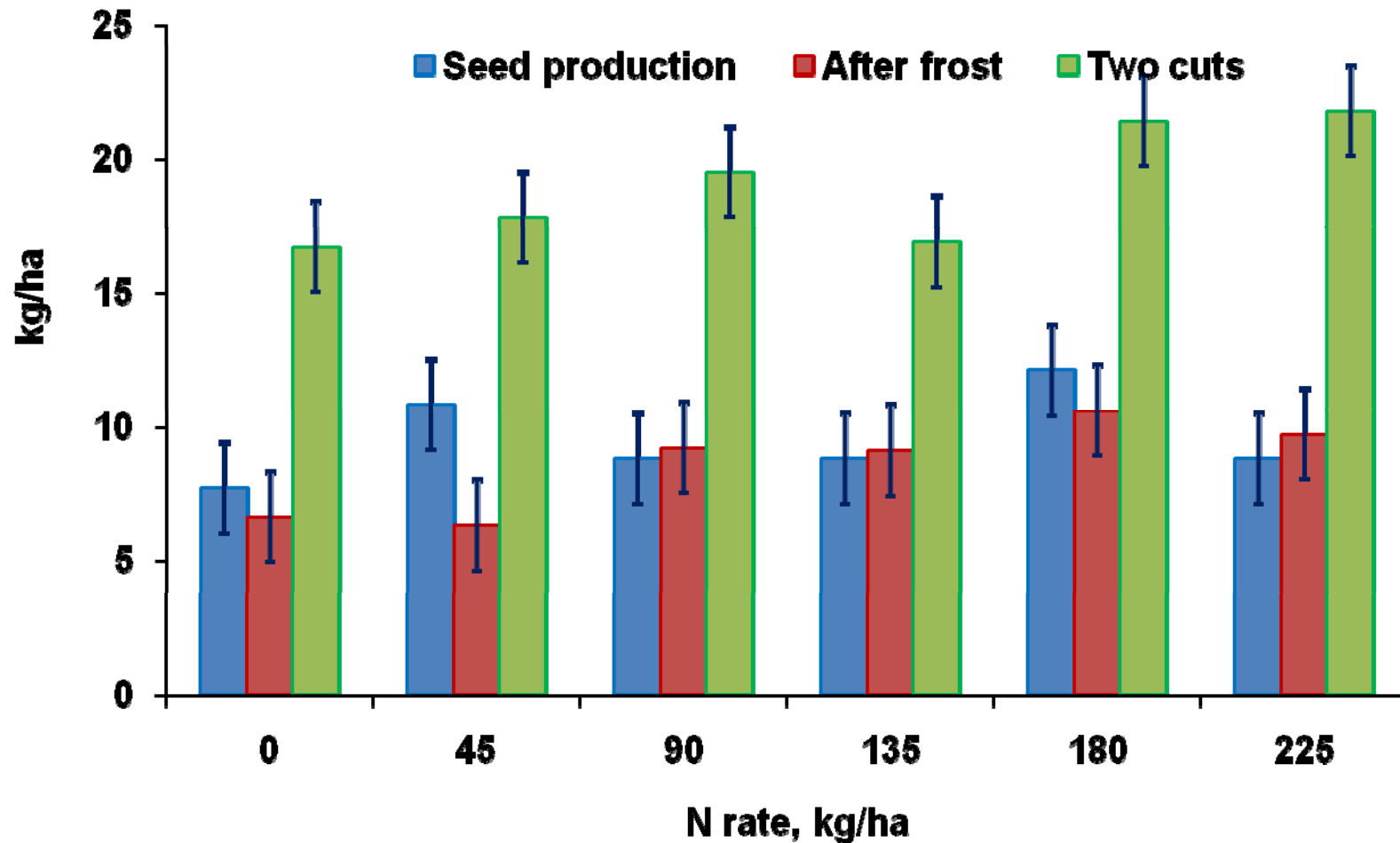
Phosphorus Effects



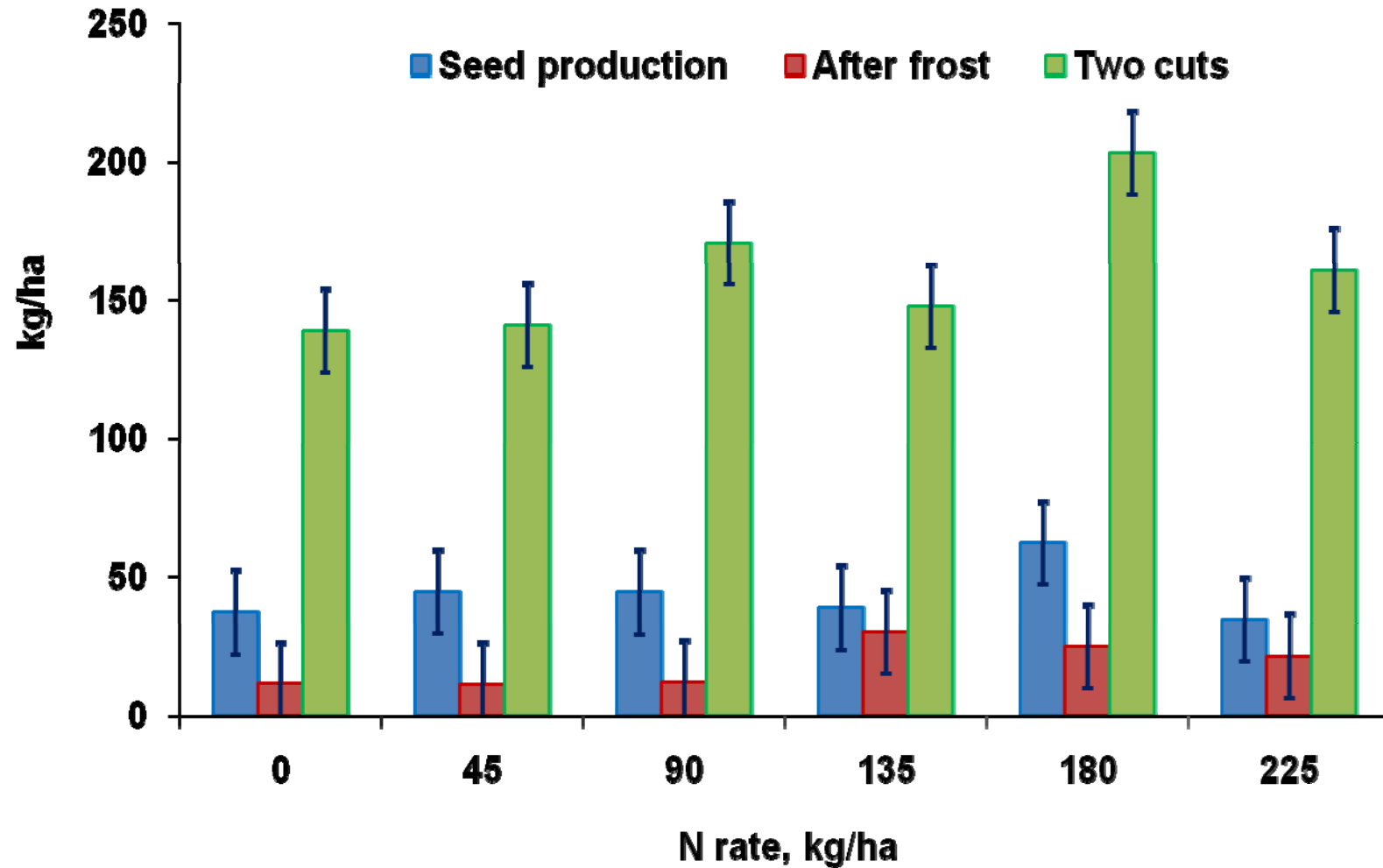
Nitrogen Removal



Phosphorus Removal



Potassium Removal



Conclusions

- Utilization of switchgrass early in the season will increase maintenance soil fertility requirements.
- Harvesting once after-frost ensures both high biomass production and reduced soil nutrient mining.