Nitrogen Utilization in Container Grown Rhododendron

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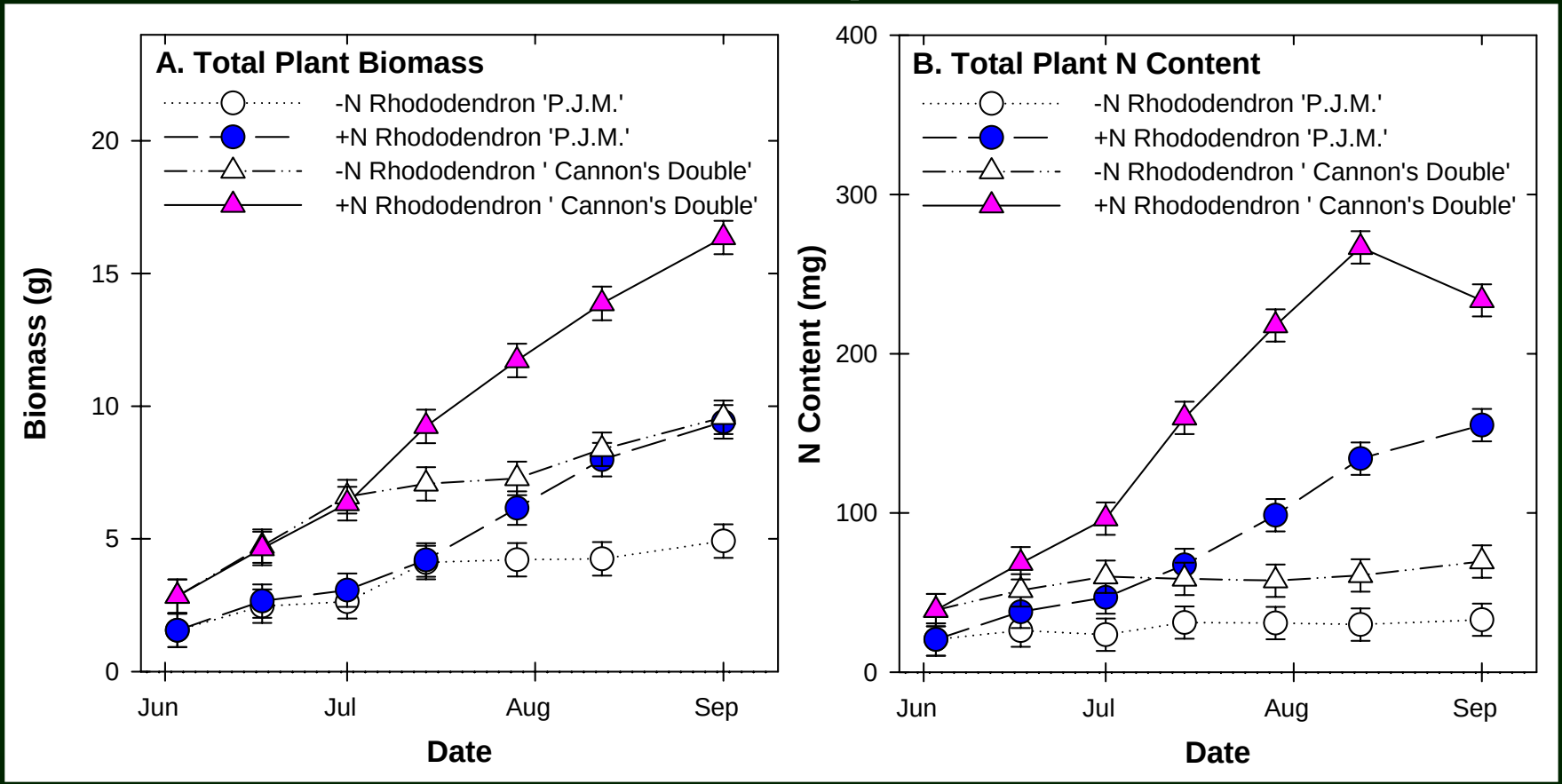
PLANT GROWTH & N CONTENT
-- June to September --

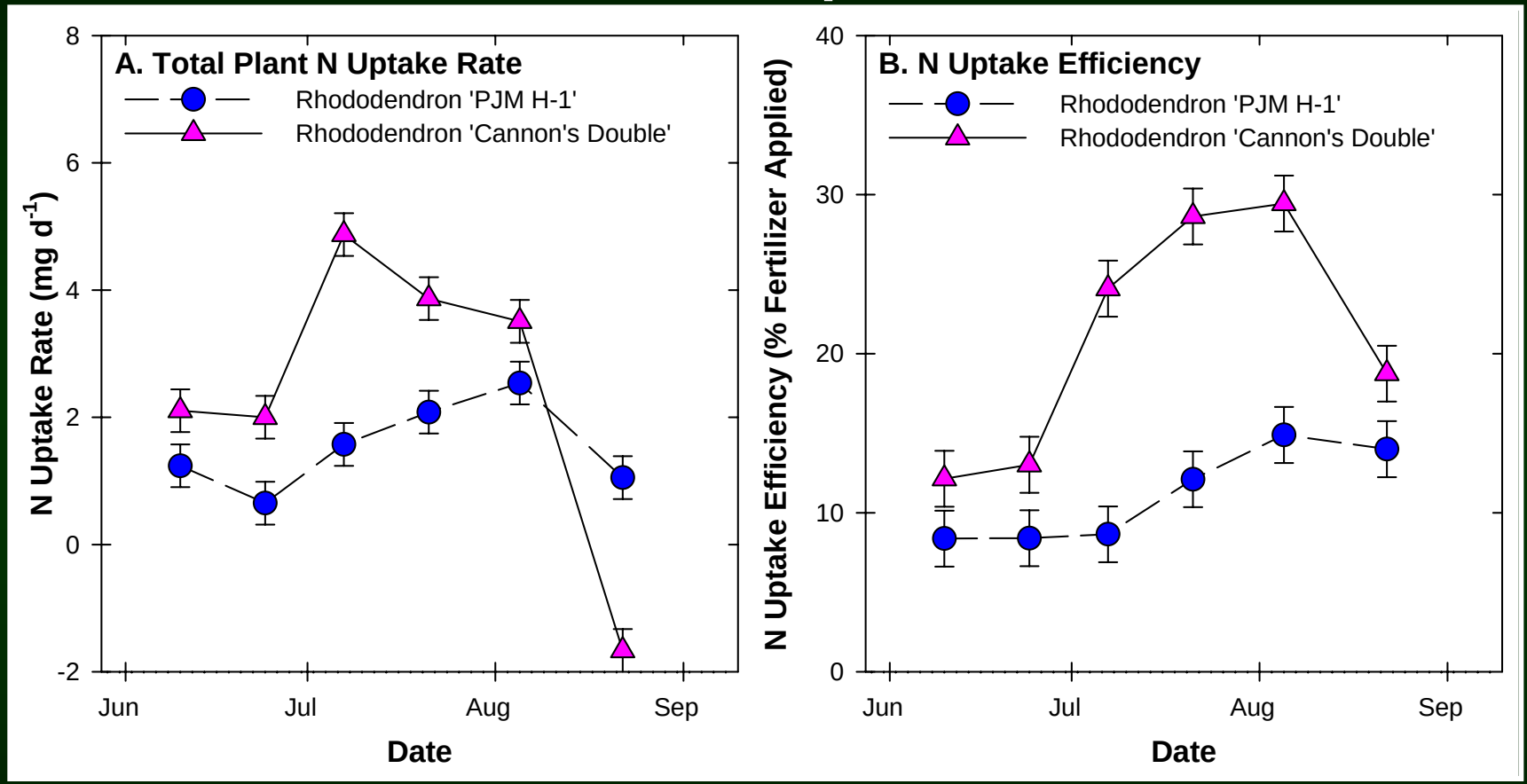


•N availability did not influence growth or N content until July.

•Residual N in liner was able to meet plant demand for about 1 month.

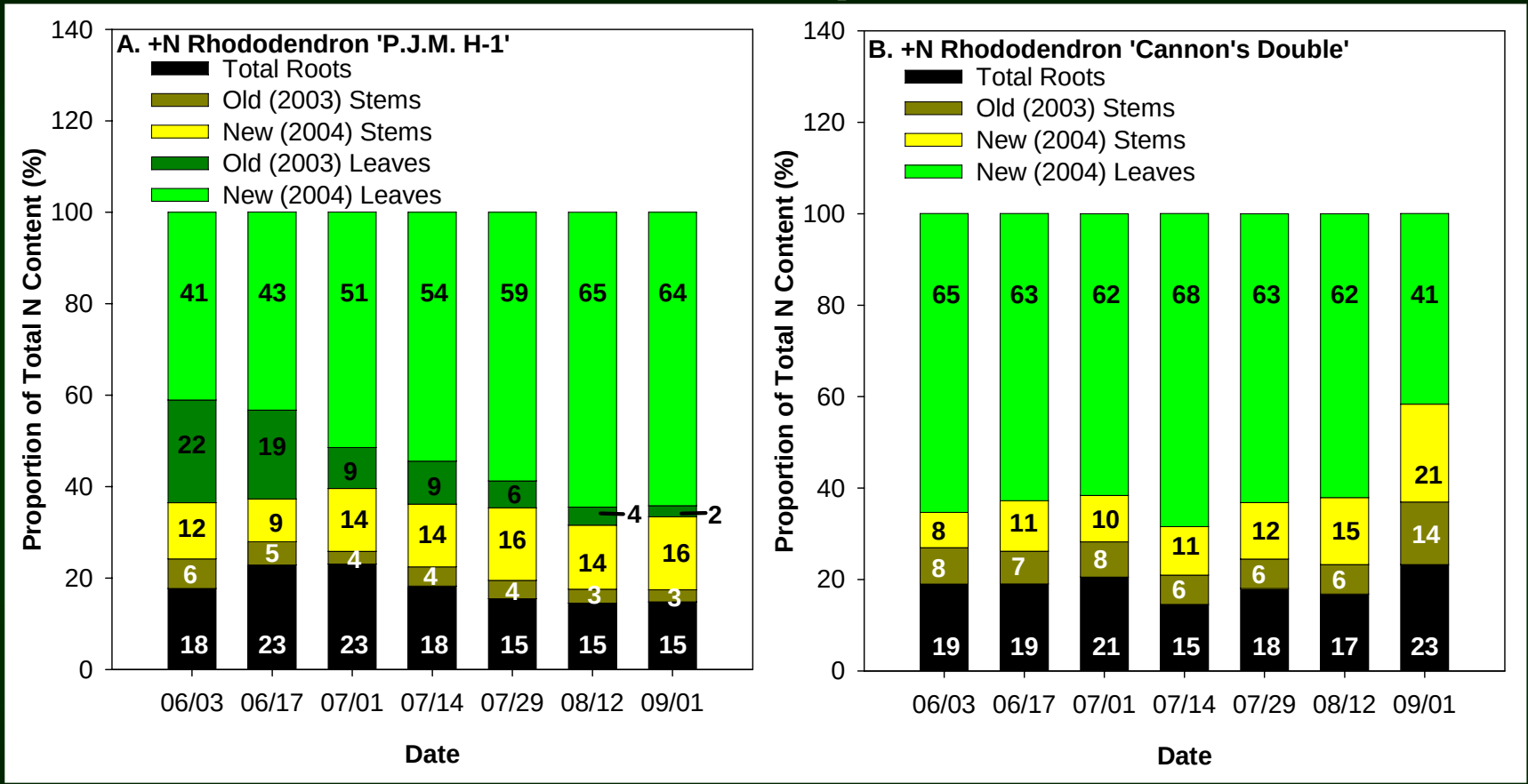
•What happens in the autumn?

N UPTAKE & FERTILIZER USE
-- June to September --



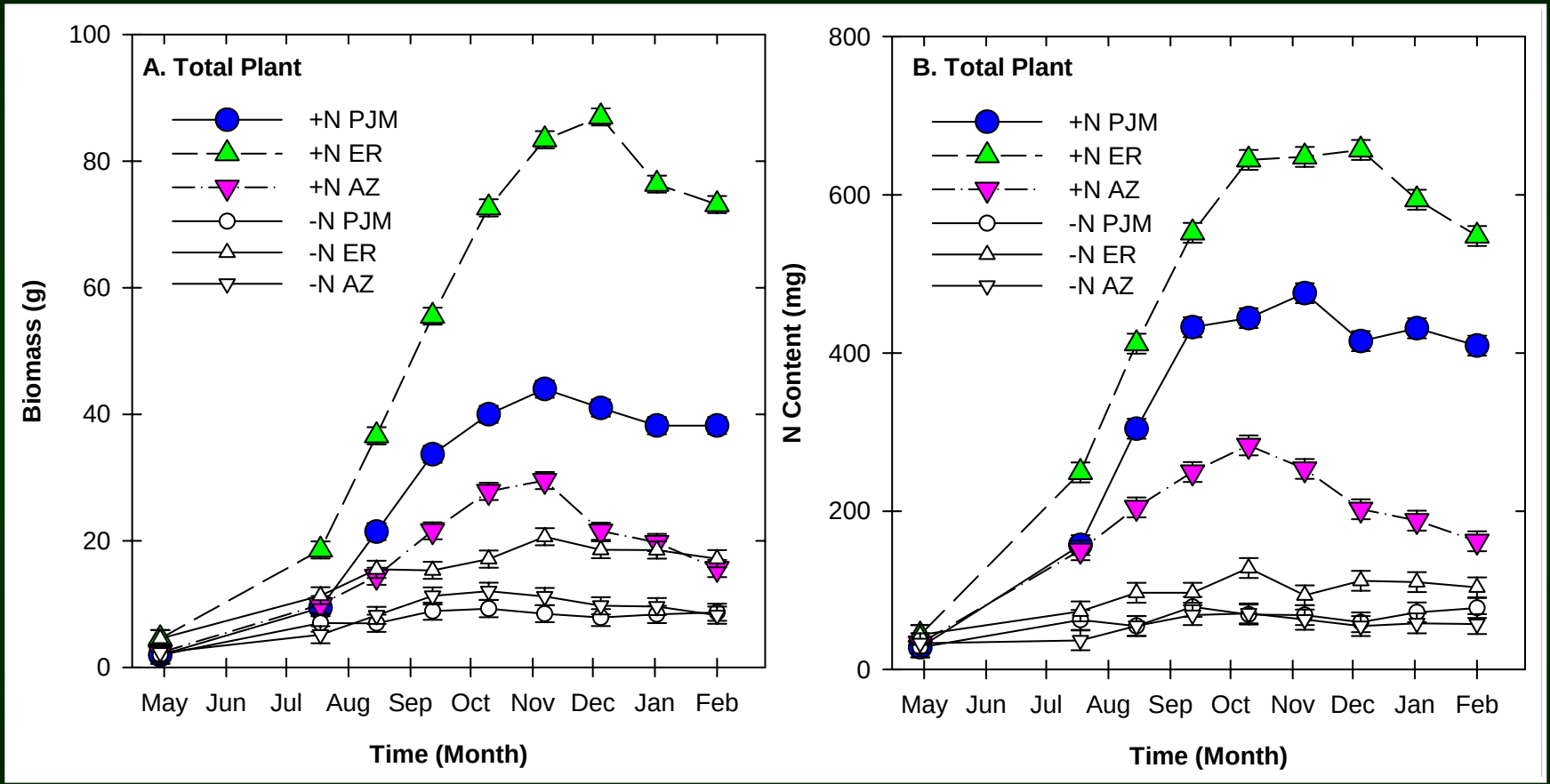
- **Highest N uptake in July and August**
- **Uptake efficiency from fertilizer low during June and early July**
- **Fertilizer practices should synchronize availability with demand.**

WHERE DOES N GO?
-- June to September --



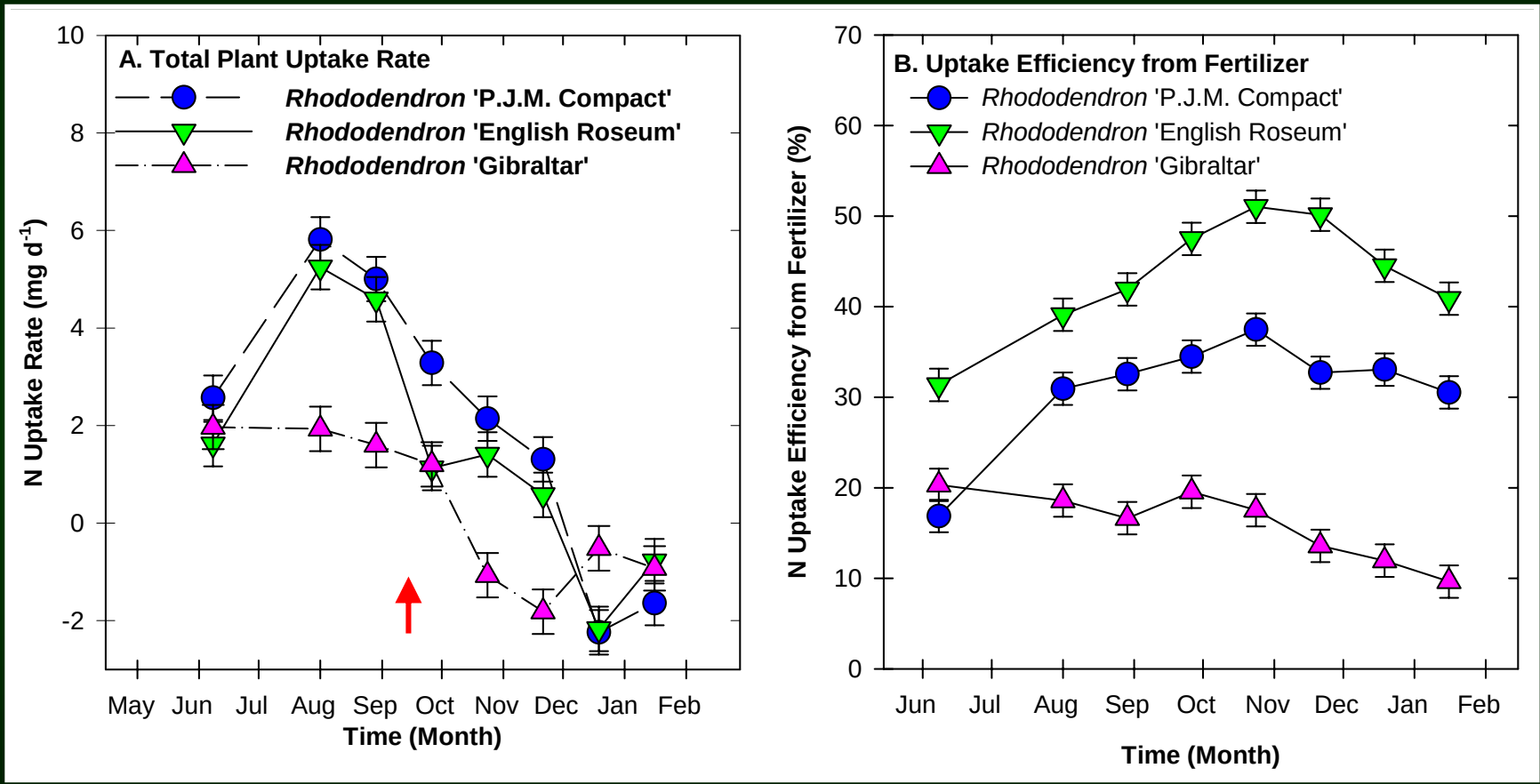
- **Increased N in new leaves**
- **Increased N in new stems & roots**

PLANT GROWTH & N CONTENT -- May to February



- **N availability did not influence total plant growth until July.**
- **N content of PJM remained relatively stable during the winter.**
- **ER and AZ lost N during winter.**

N UPTAKE & FERTILIZER USE
-- May to February --

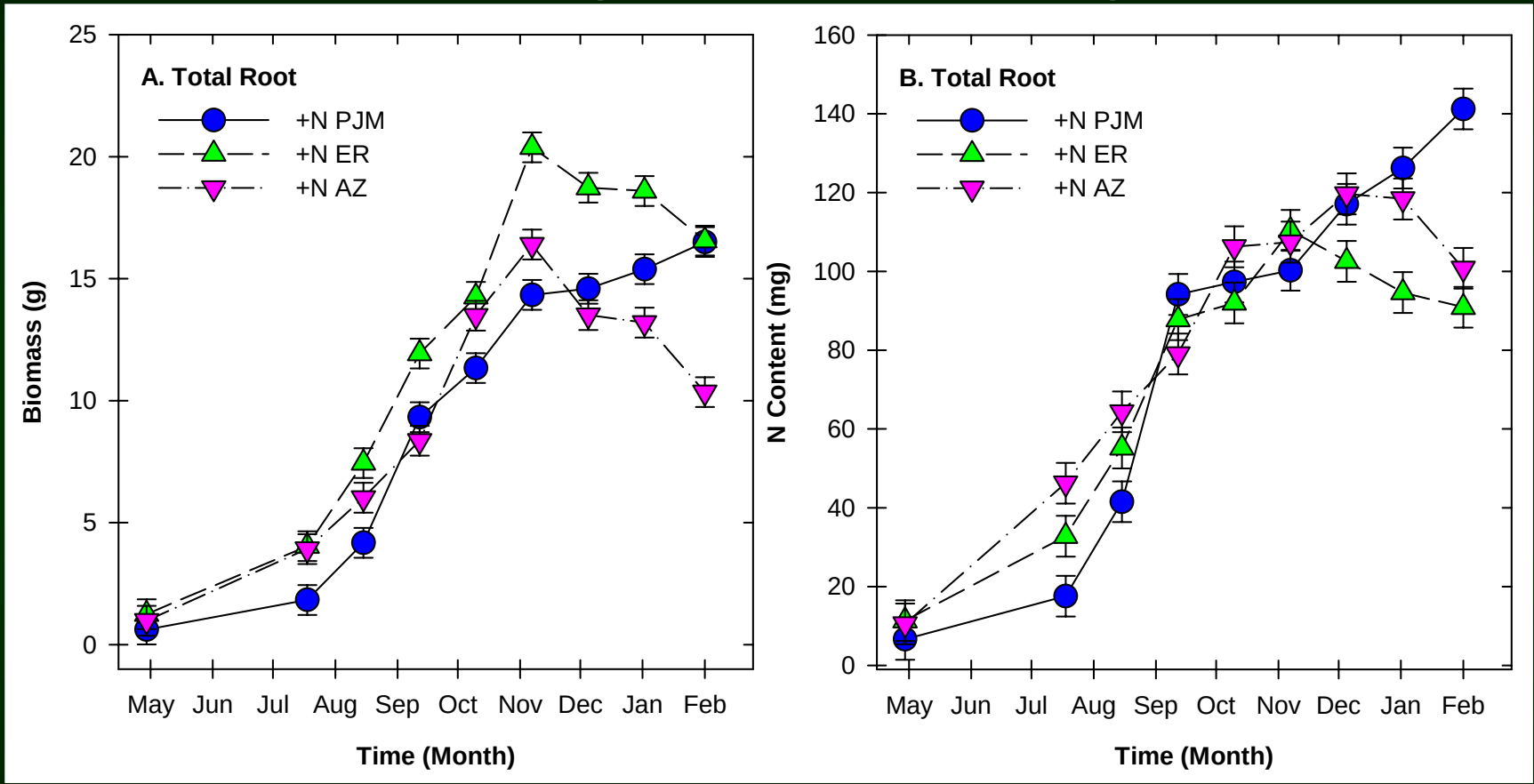


•Uptake can occur in the autumn.

•Up to 16% of total N uptake occurred after August.

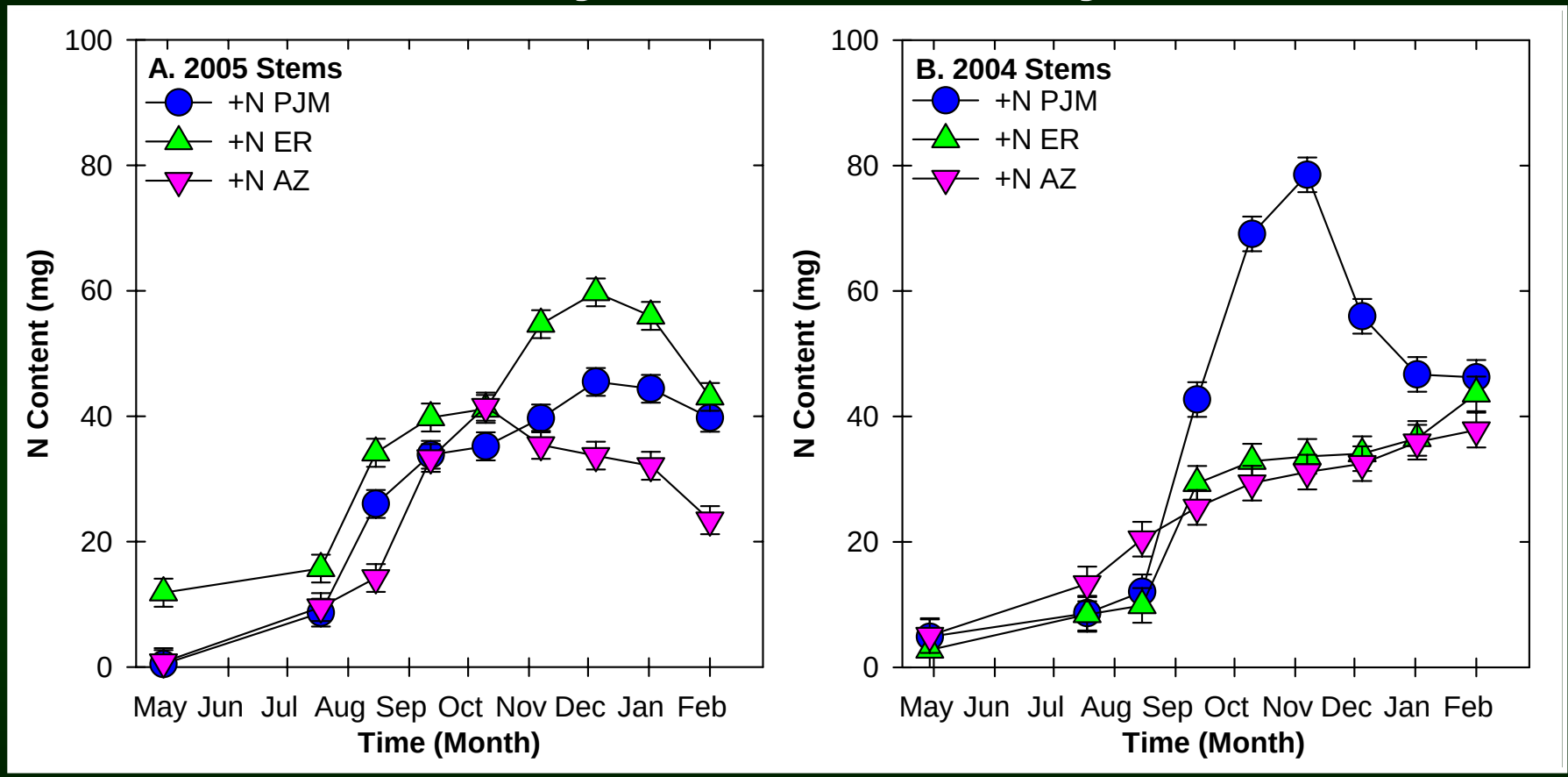
•Uptake efficiency decreases in winter in ER and PJM

ROOT GROWTH & N CONTENT
-- May to February --



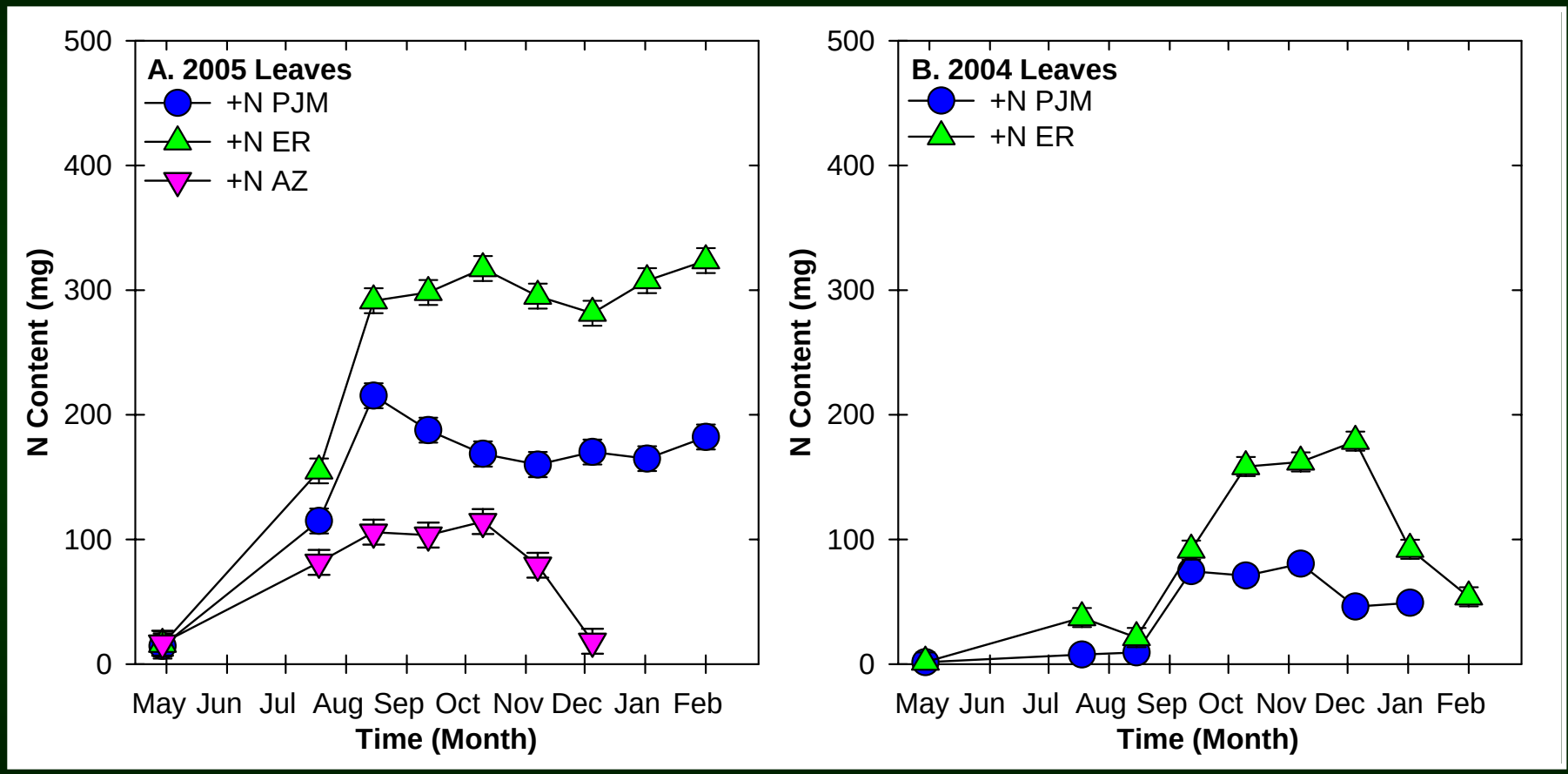
- **N availability did not influence root growth until September.**
- **Roots accumulated N into winter**
- **15-19% loss of total plant N of ER and AZ due to root turnover.**
- **How does root cold hardiness influence nutrient dynamics in plants?**

STEM N CONTENT
-- May to February --



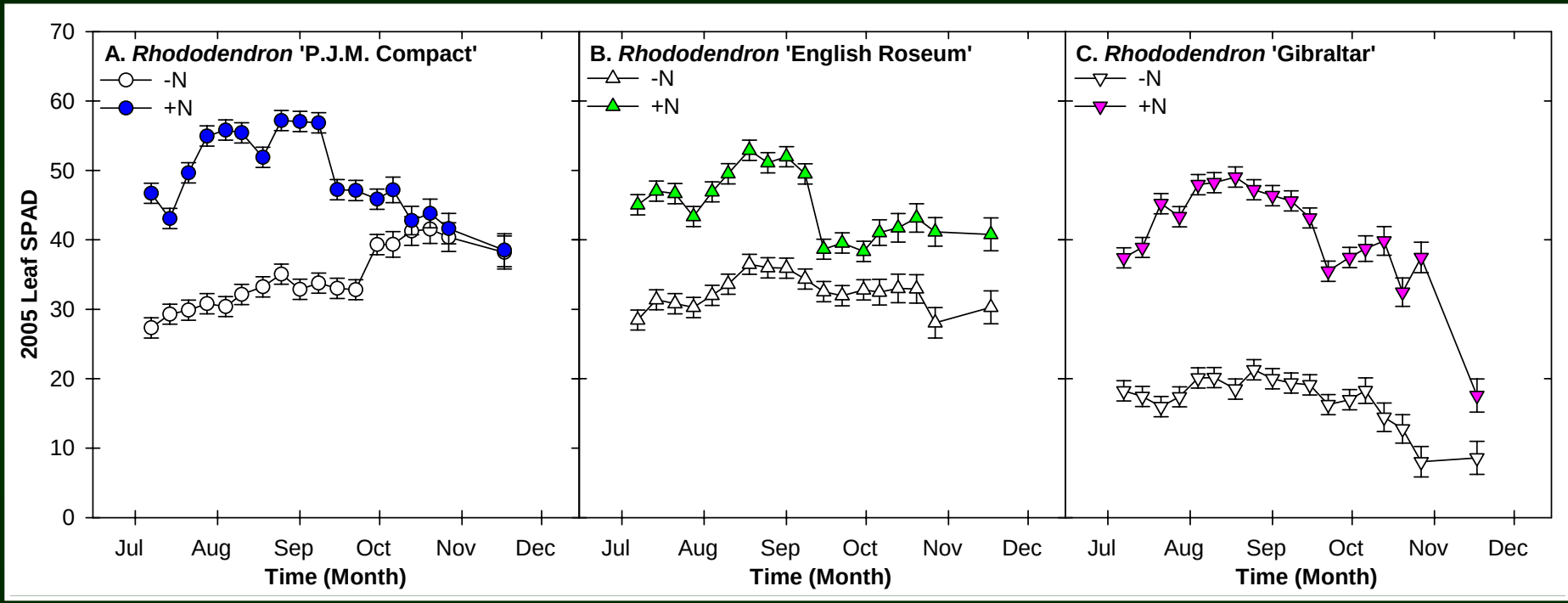
- **N in old stems of PJM moves from stems to other storage locations during winter.**
- **N in new stems of ER and AZ moves from stems to other storage locations during winter.**

LEAF N CONTENT
-- May to February --



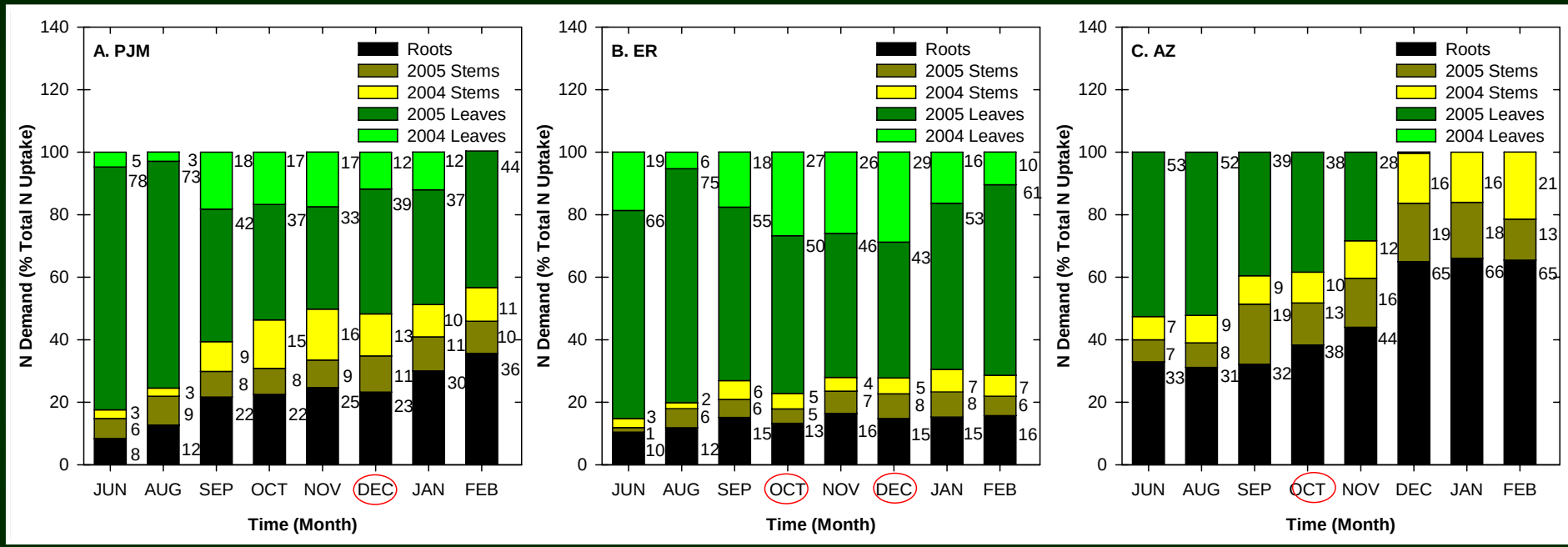
- **New leaves are a stable location for N storage in ER**
- **Some N from new leaves of PJM moves to other storage locations.**
- **Some N from old leaves of ER moves to other storage locations.**

SPAD & NITROGEN



- **Predictive value of SPAD for N status can vary with cultivar and time of year.**
- **Differences in N on old leaves of evergreen cultivars were always detectable with SPAD.**

WHERE DOES THE N GO?
-- May to February --

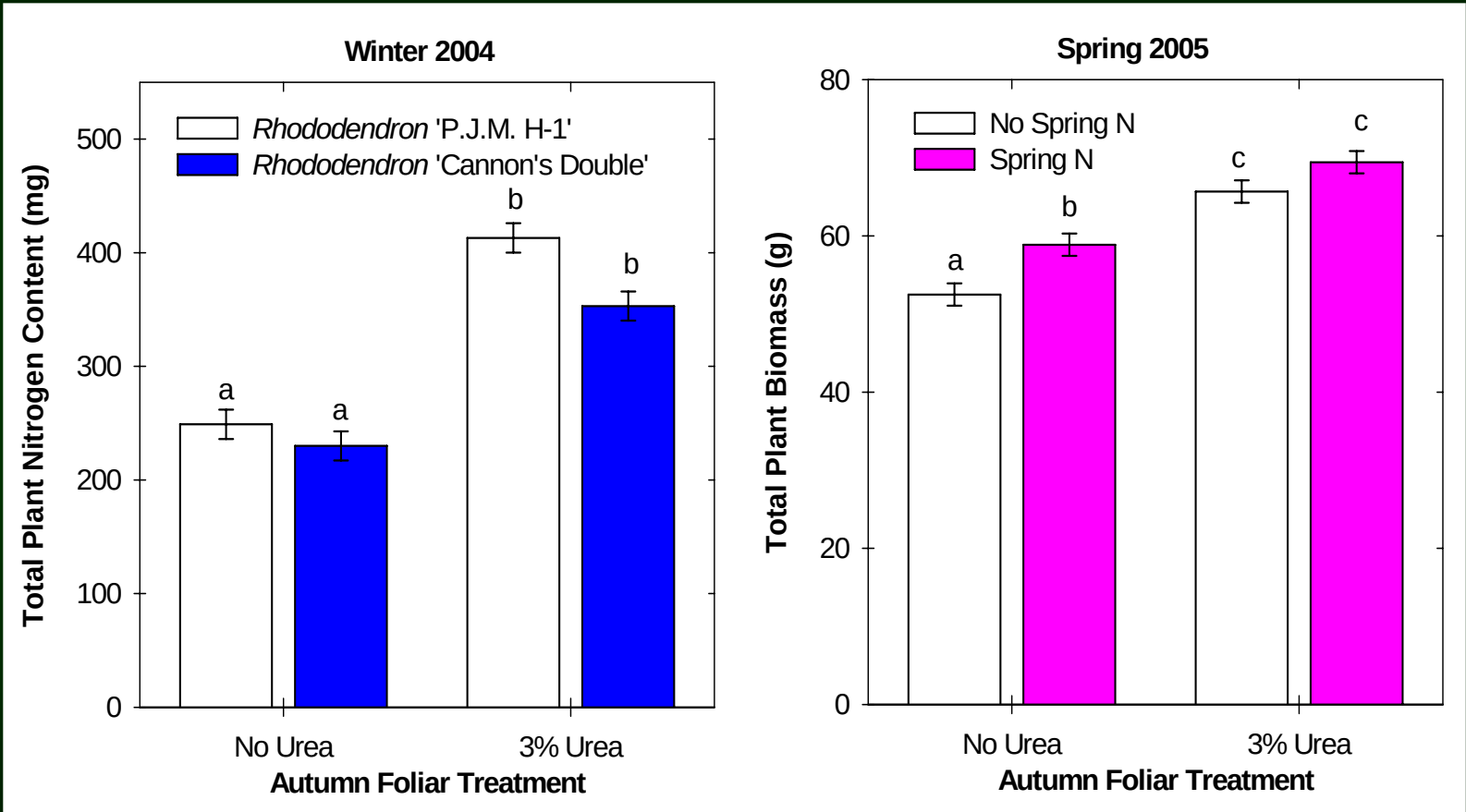


•N storage leaves>roots>stems
•In winter N from old leaves moves to roots and new leaves

•N storage leaves>roots=stems
•In winter, N moves from old leaves to roots to compensate for N loss

•N storage roots>stems
•In winter leaf N moves to roots and stems; N from new stems moves to roots and old stems.

AUTUMN FOLIAR UREA
-- Rhododendron --



•Foliar urea improved plant N content in autumn.

•Spring growth improved by autumn application of foliar urea.

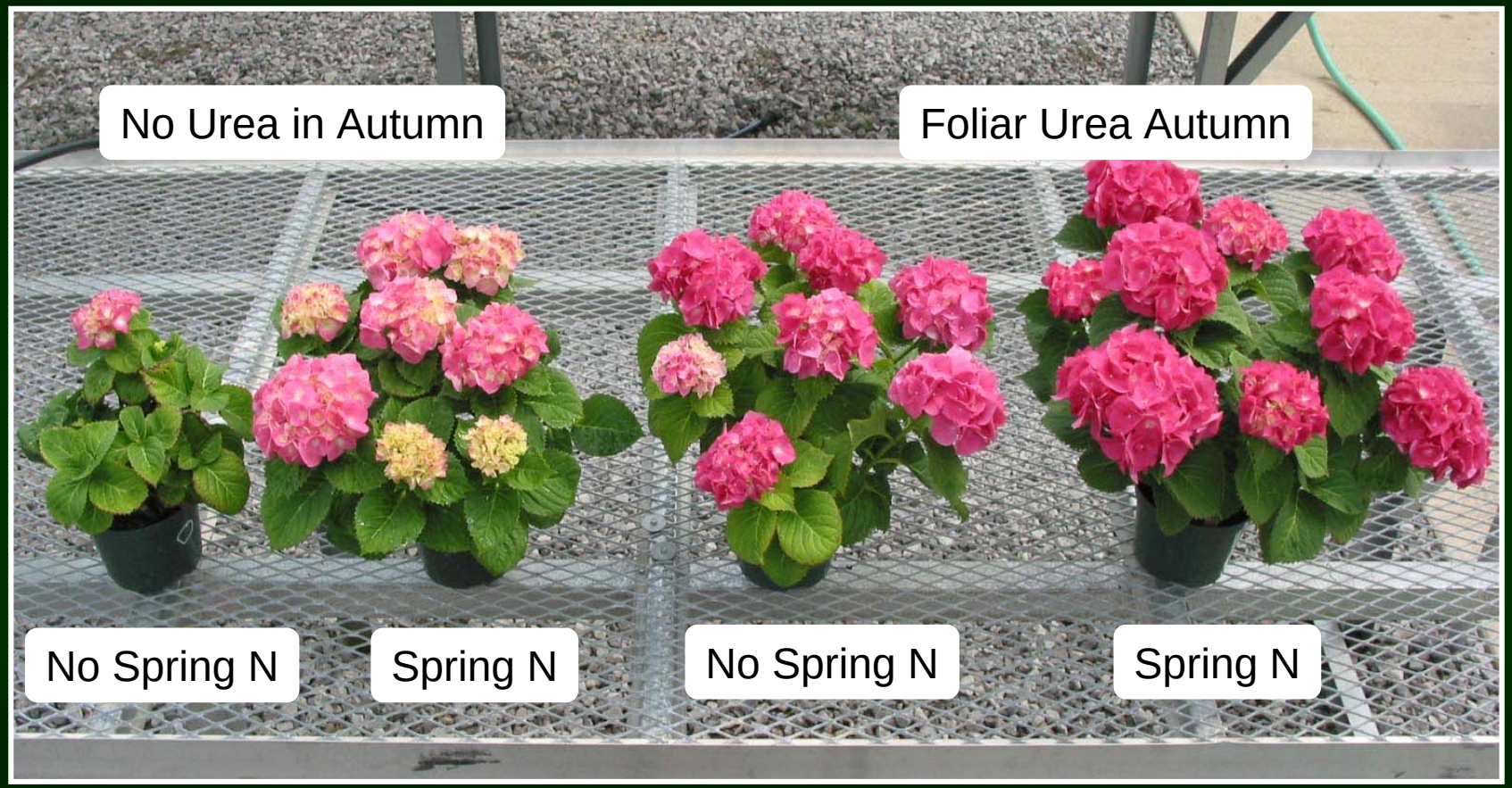
•Foliar urea decreased dependence on N in spring.

AUTUMN FOLIAR UREA
-- Hydrangea --

- **Foliar urea in autumn increased rate of spring growth.**

Bi 2006

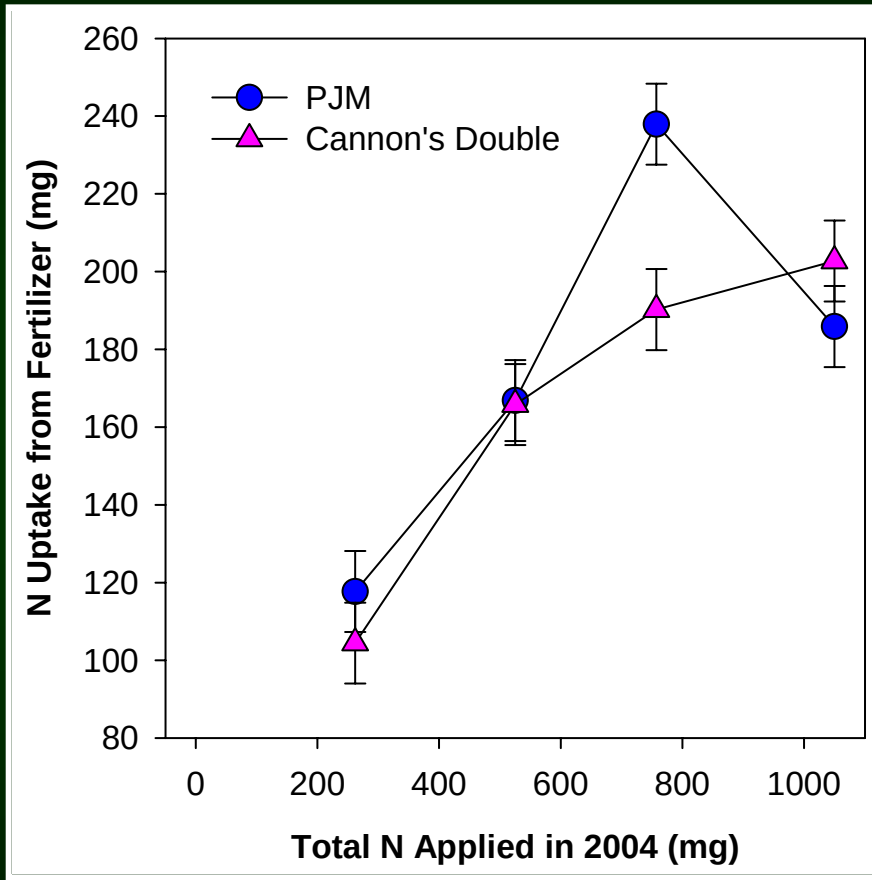
AUTUMN FOLIAR UREA
-- Hydrangea --

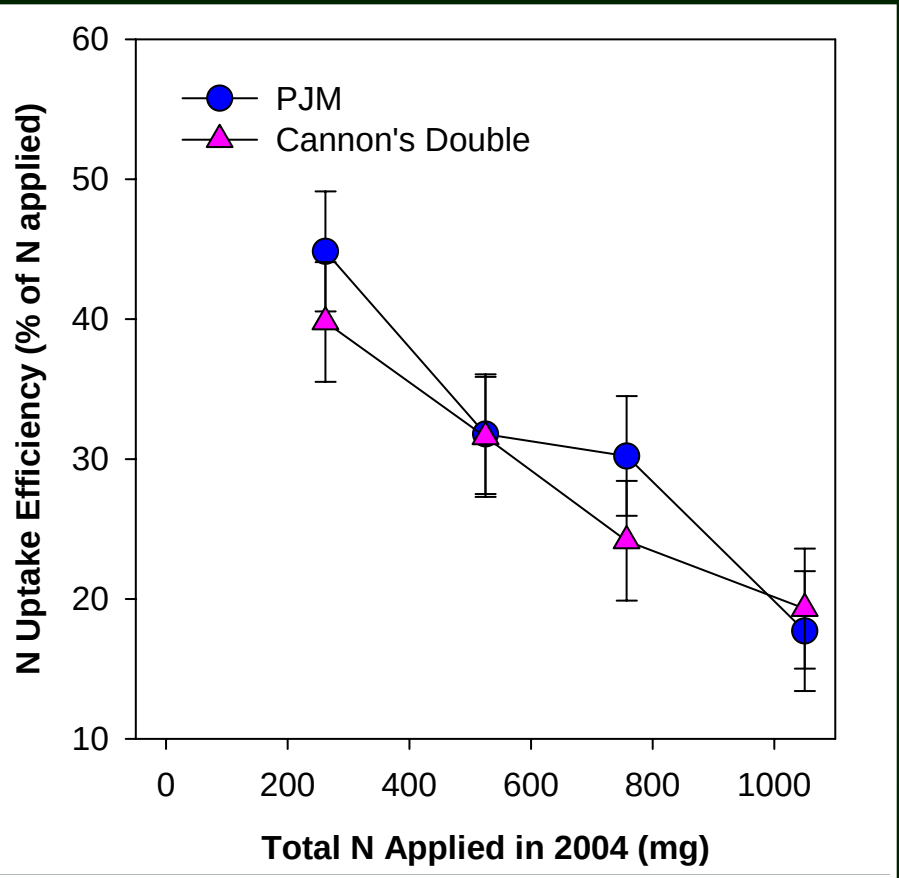


- **Autumn foliar urea improved spring growth and flowering.**
- **Autumn foliar urea decreased dependence on N in spring.**

Bi 2006

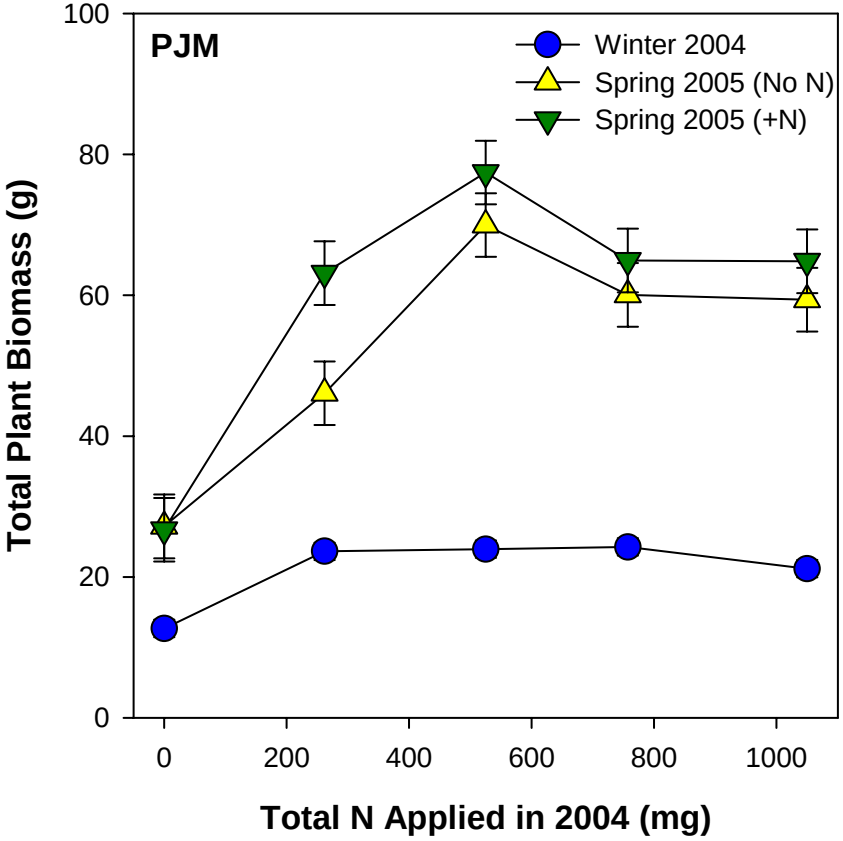
TOO MUCH OR TOO LITTLE NITROGEN

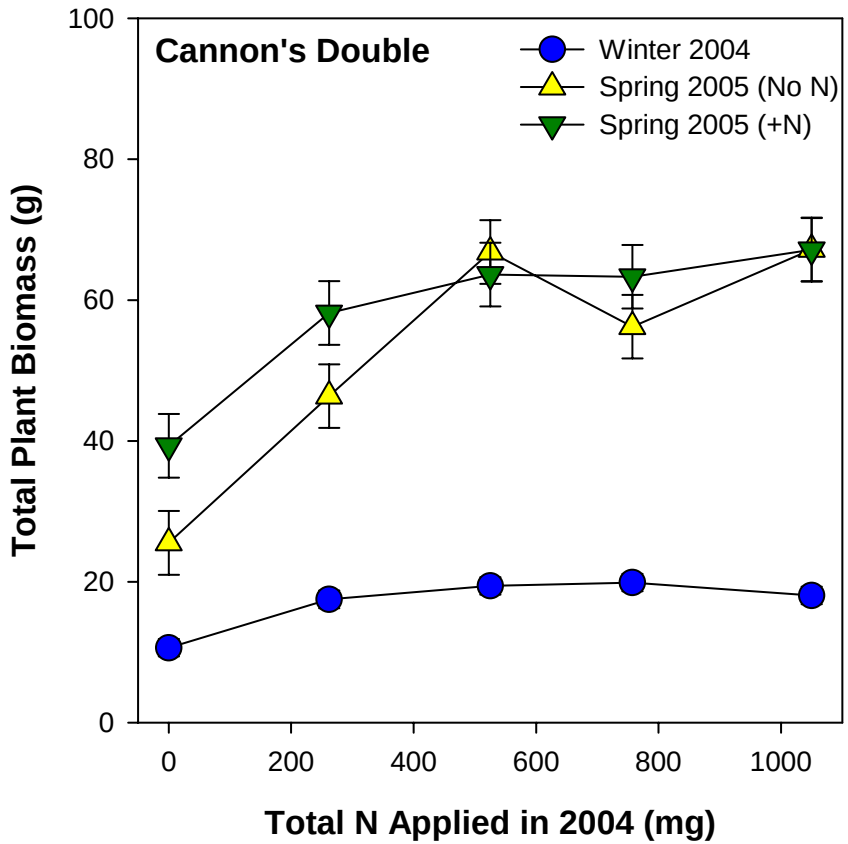




- **PJM - Uptake greatest ~800 mg N**
- **Cannon's Double – Uptake increased with increasing N**
- **BUT efficiency of uptake decreases with increasing N**

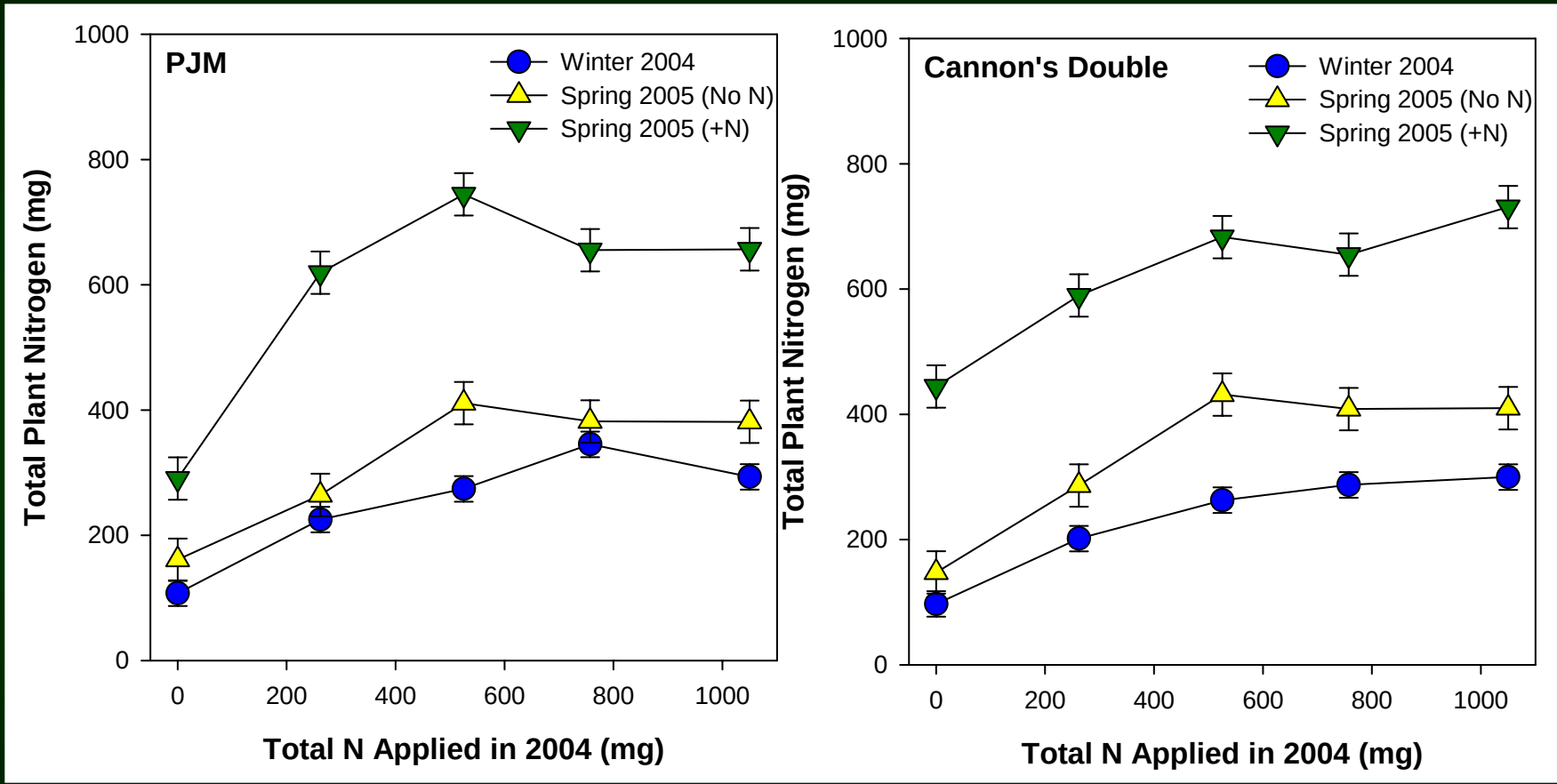
TOO MUCH OR TOO LITTLE NITROGEN





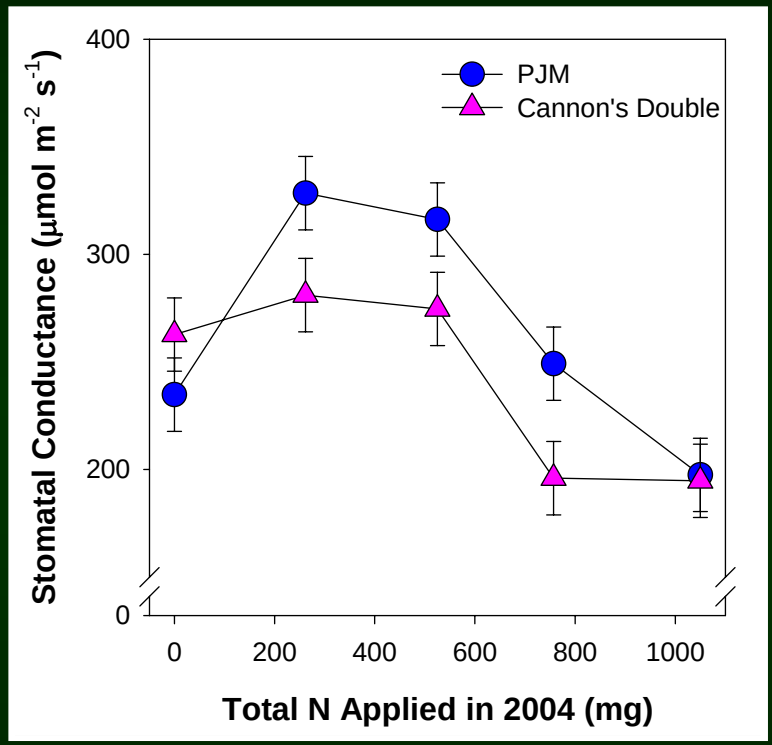
- **2004: Little difference in growth when N>200 mg**
- **2005: Best growth when N ~500 mg in 2004**
- **2005: >500 mg in 2004, growth less dependent on N in spring**

TOO MUCH OR TOO LITTLE NITROGEN



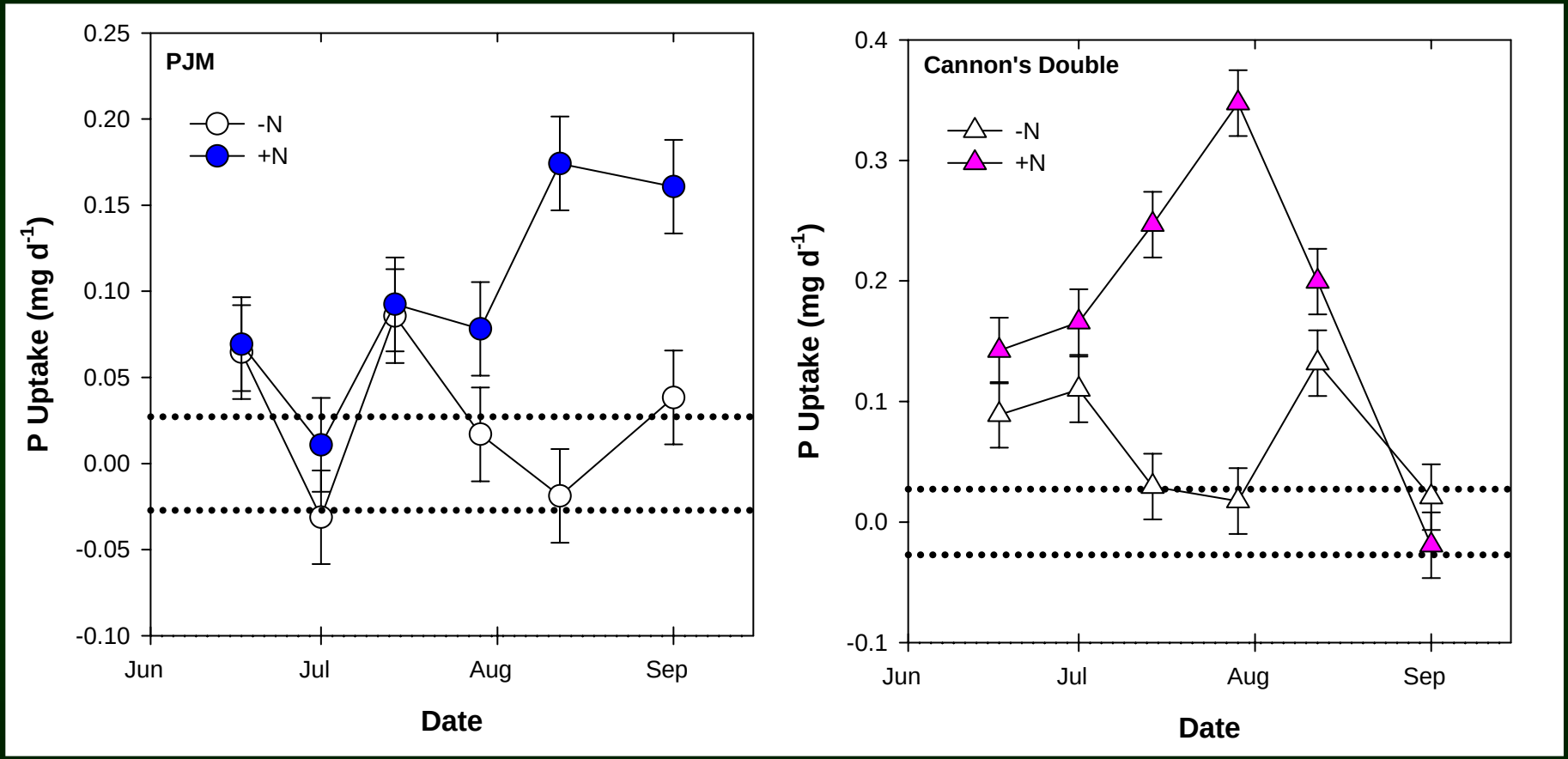
- **2004 & 2005: Little difference in N content when N>500 mg**
- **2005: N deficient PJM in 2004 less capable of N uptake in 2005.**

TOO MUCH OR TOO LITTLE NITROGEN



- **Plants at higher N rate are more susceptible to water stress**

THE WORLD DOES **NOT** REVOLVE AROUND NITROGEN



- **Uptake of other nutrients have a season pattern.**
- **Demand for P, K, S, Mg, Ca, and Zn changes with N availability.**
- **Demand for B, Cu, Fe, and Mn does not change with N availability.**

THE WORLD DOES **NOT** REVOLVE AROUND NITROGEN

PJM	June		July		August	
	Early	Late	Early	Late	Early	Late
Carbon Gain (mg/d)	14.24	39.69	44.48	61.94	62.78	35.14
N Uptake (mg/d)	0.65	1.33	1.57	2.08	2.54	1.05
P Uptake (mg/d)	0.01	0.07	0.09	0.08	0.17	0.16
K Uptake (mg/d)	0.28	0.75	1.92	1.84	0.69	-0.04
S Uptake (mg/d)	0.03	0.16	0.24	0.19	0.06	0.09
Ca Uptake (mg/d)	0.12	0.43	0.74	0.40	0.48	0.20
Mg Uptake (mg/d)	0.13	0.24	0.23	0.21	0.23	0.17
B Uptake (ug/d)	13.35	2.88	6.85	1.78	3.02	0.74
Cu Uptake (ug/d)	4.00	2.25	-10.83	0.19	0.18	0.61
Fe Uptake (ug/d)	69.7	30.3	30.8	23.8	4.6	17.9
Mn Uptake (ug/d)	32.16	29.21	25.50	30.56	20.74	30.92
Zn Uptake (ug/d)	3.60	1.31	1.09	1.17	1.05	1.62

- **Seasonal changes in uptake can be used to develop nutrient management based on nutrient demand.**
- **Carbon gain for PJM associated with demand for N, P, K, and Ca**

THE WORLD DOES **NOT** REVOLVE AROUND NITROGEN

Cannon's Double	June		July		August	
	Early	Late	Early	Late	Early	Late
Carbon Gain (mg/d)	64.35	57.10	100.75	78.42	67.85	64.38
N Uptake (mg/d)	2.26	2.00	4.87	3.86	6.51	-1.77
P Uptake (mg/d)	0.14	0.16	0.25	0.35	0.19	0.20
K Uptake (mg/d)	1.43	1.08	2.91	1.73	2.35	1.76
S Uptake (mg/d)	0.21	0.19	0.23	0.41	0.13	0.17
Ca Uptake (mg/d)	0.48	0.49	1.25	1.47	1.82	1.19
Mg Uptake (mg/d)	0.23	0.24	0.47	0.39	0.85	0.51
B Uptake (ug/d)	9.50	4.71	7.52	6.87	1.61	2.34
Cu Uptake (ug/d)	6.34	2.46	6.98	4.24	1.13	0.34
Fe Uptake (ug/d)	49.5	40.1	44.1	58.9	29.8	-9.2
Mn Uptake (ug/d)	10.35	16.81	11.33	32.25	50.50	16.75
Zn Uptake (ug/d)	8.08	9.27	3.45	10.32	0.52	-3.44

- **Carbon gain for Cannon's Double associated with demand for N, P, K, S, Ca, and Mg**