

IXth Carinata Biomaterials Summit

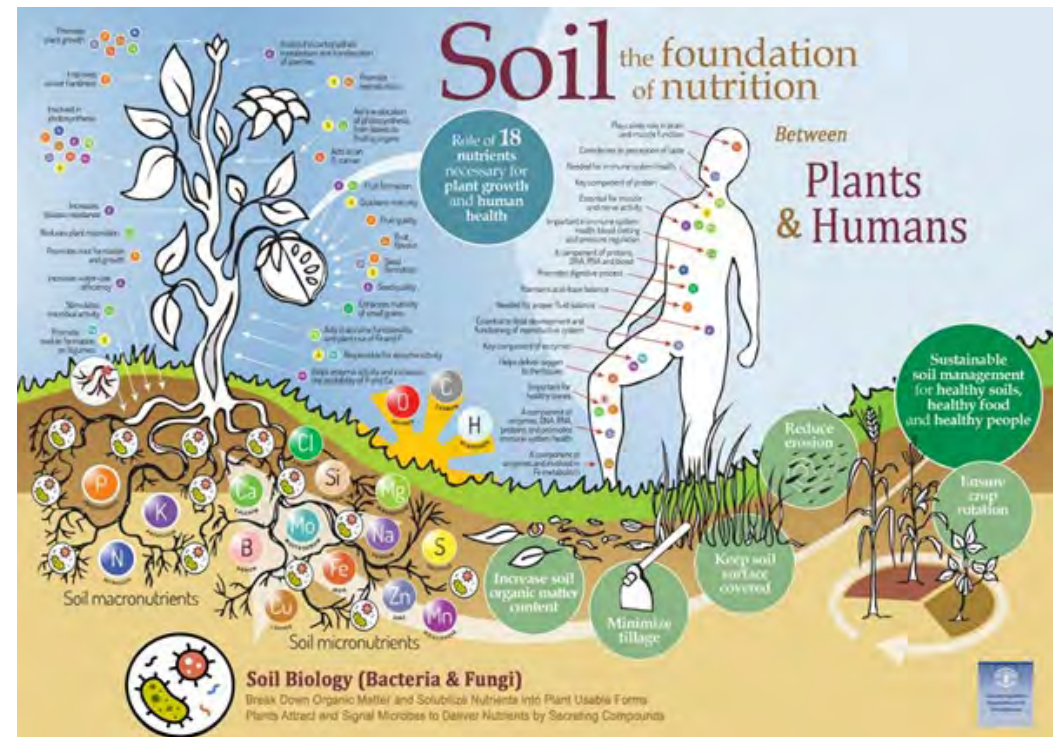


Sustainable Nutrient Management in Carinata Cropping Systems

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**UNIVERSITY OF
GEORGIA**



Training goals

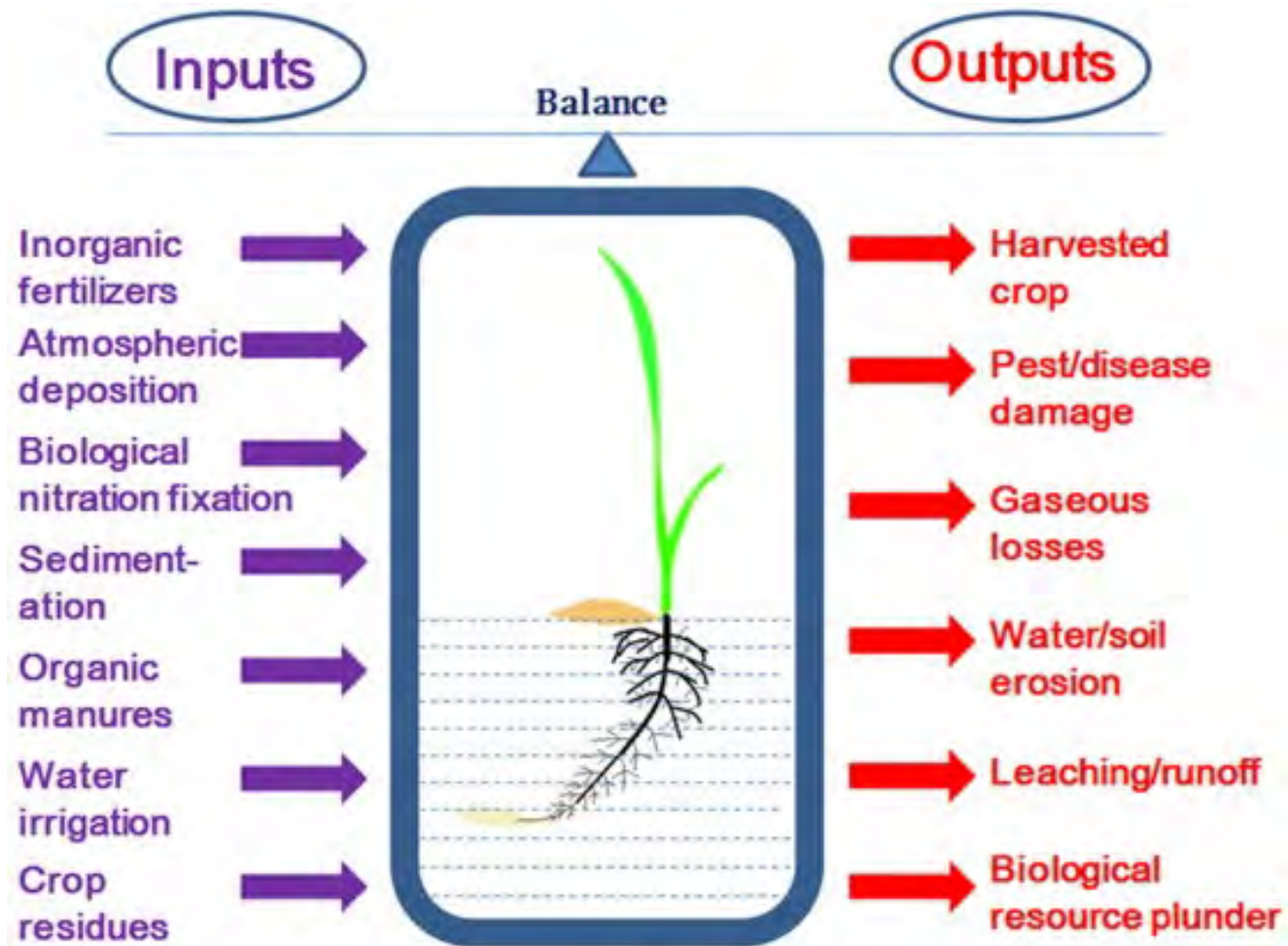
- Overview of IPNM
- N rate × tillage method
- N rate × S rate
- N timing × planting date
- Poultry manure as nutrient source
- Questions

Overview of IPNM

- **Defining IPNM:**

- *The science and art directed to link soil, crop, weather and hydrologic factors with cultural, irrigation and soil and water conservation practices to achieve the goals of optimizing nutrient use efficiency, yields, crop quality, and economic returns, while reducing off-site transport of nutrients that may impact the environment (Delgado, 2016).*

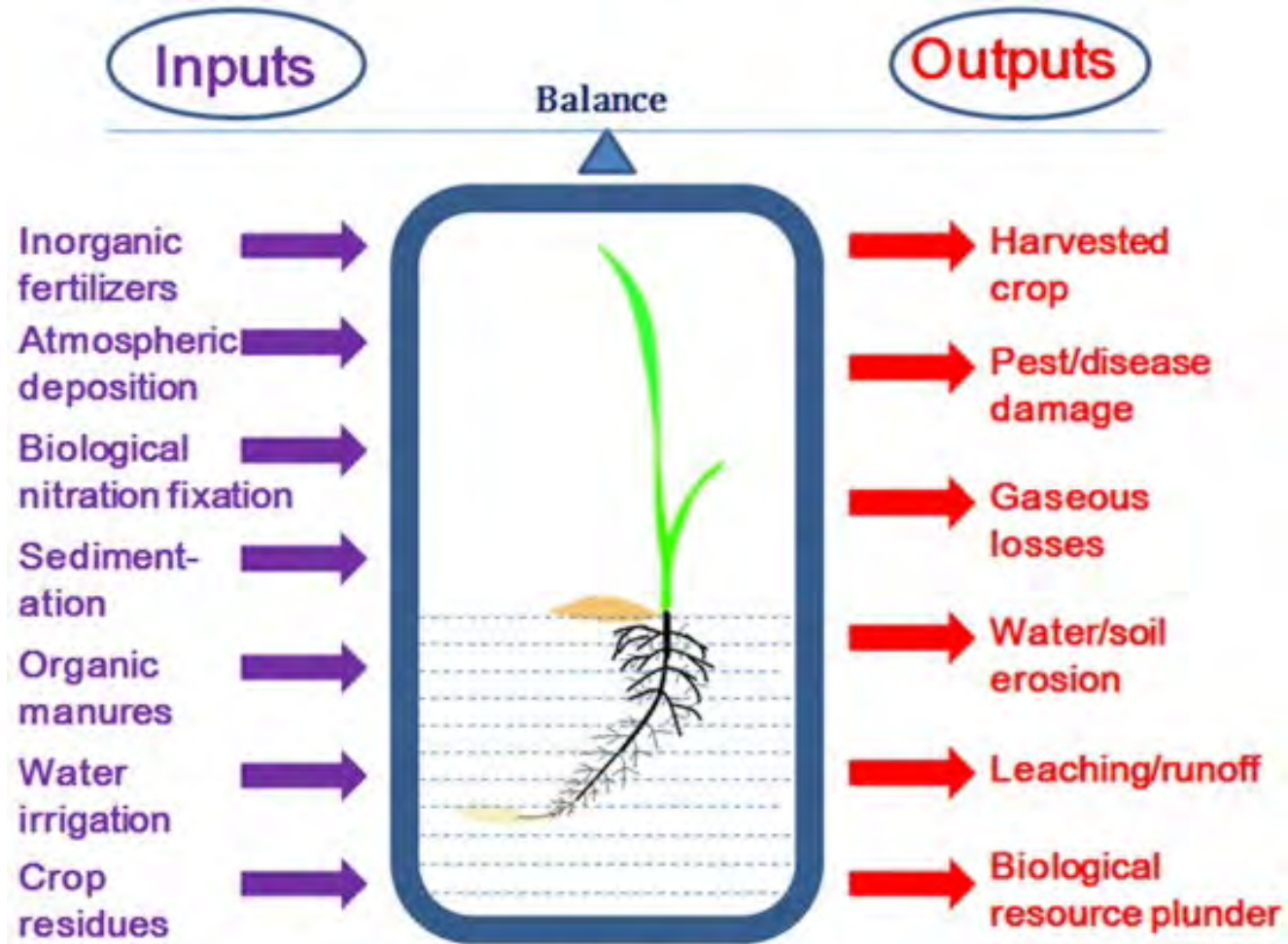
IPNM by input-output system



INN method based on inputs and outputs:

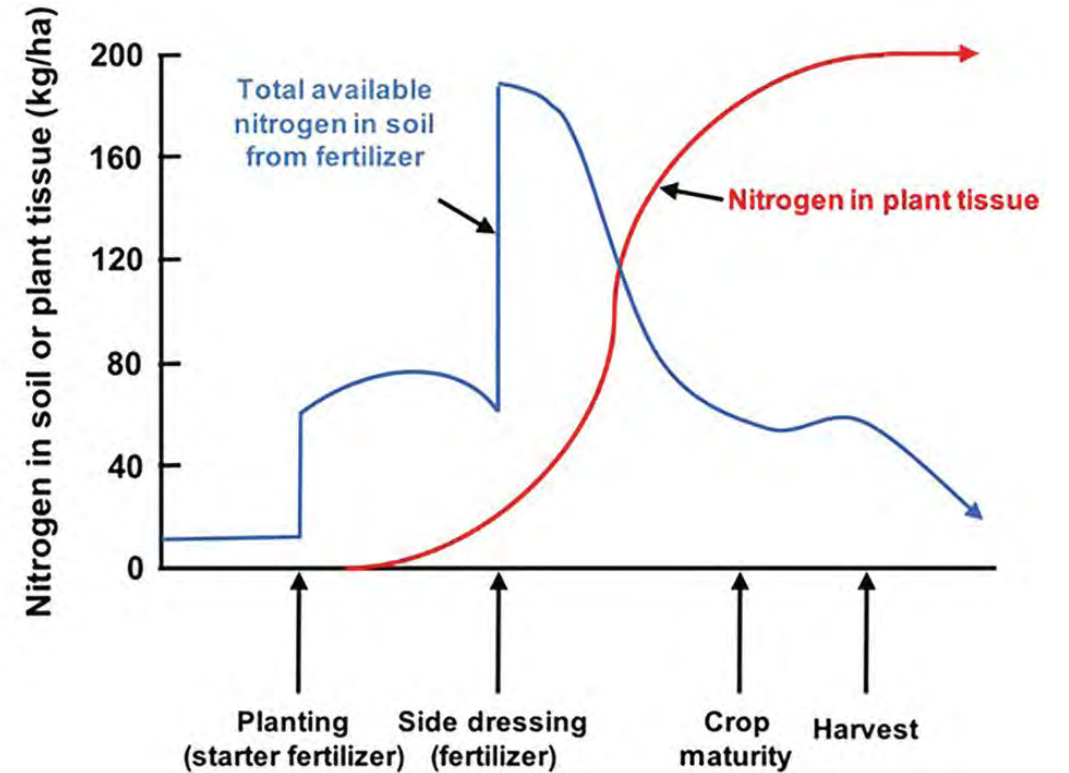
- Matching the quantity with demand of the crop
- Synchronizing in term of time with crop growth

IPNM by input-output system



INN method based on inputs and outputs:

- Matching the quantity with demand of the crop
- Synchronizing in term of time with crop growth



IPNM based on 4R Principle



The 4Rs promote best management practices (BMPs) to achieve cropping system goals while minimizing field nutrient loss and maximizing crop uptake.

4R Principles of Nutrient Stewardship



RIGHT SOURCE

Matches fertilizer type to crop needs.



RIGHT RATE

Matches amount of fertilizer to crop needs.



RIGHT TIME

Makes nutrients available when crops need them.



RIGHT PLACE

Keeps nutrients where crops can use them.

N rate × tillage method

Seepaul et al. 2014; ASA-CSSA-SSSA Annual Meeting

Experimental setup

- **Factorial combination of N rate and tillage method**
 - *N rate (0, 45, 90, and 135 kg N ha⁻¹)*
 - *Tillage method (Disk and Chisel)*
- **Applied 280 kg ha⁻¹ 5-15-30 on Oct. 14, 2014**
- **Planted Nov. 13, 2014**
- **N treatment fertilizer on Dec. 2, 2014**
- **Proline[®] at 0.42 L ha⁻¹ on Dec. 17, 2013 and Jan 13 2014**
- **Harvested June 3, 2014 (202 DAP)**

Freeze damage

January 15, 2014

0 kg N ha⁻¹



45 kg N ha⁻¹



Freeze damage

January 15, 2014

0 kg N ha⁻¹

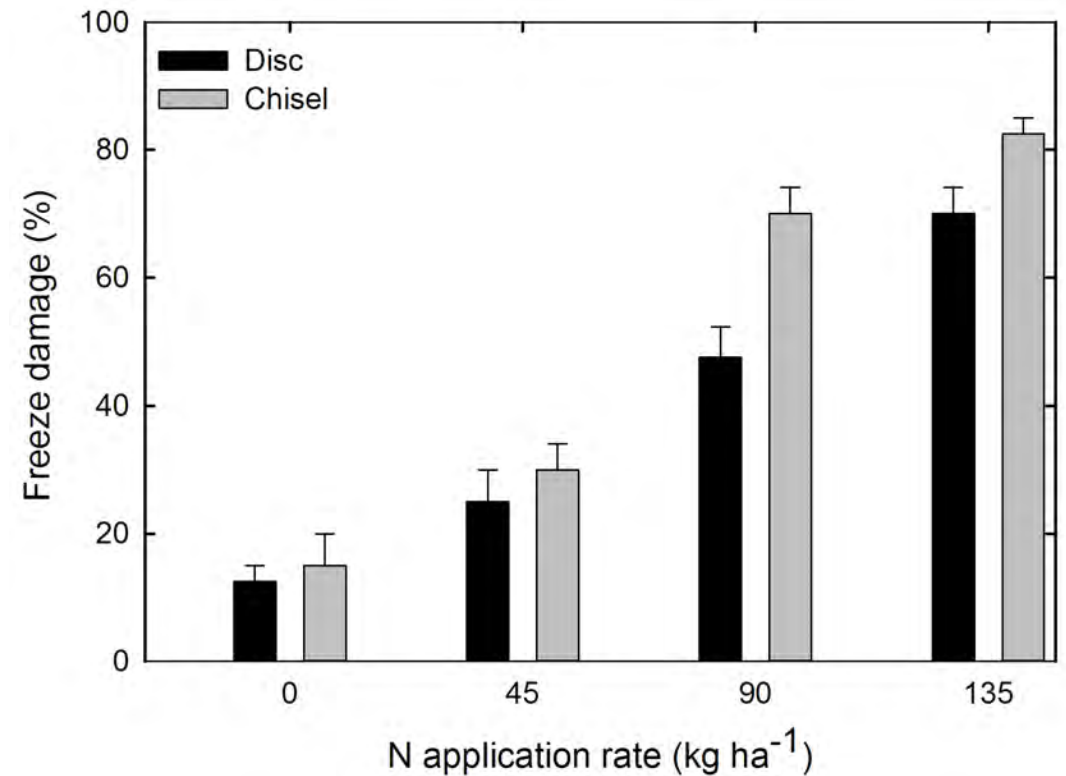


90 kg N ha⁻¹

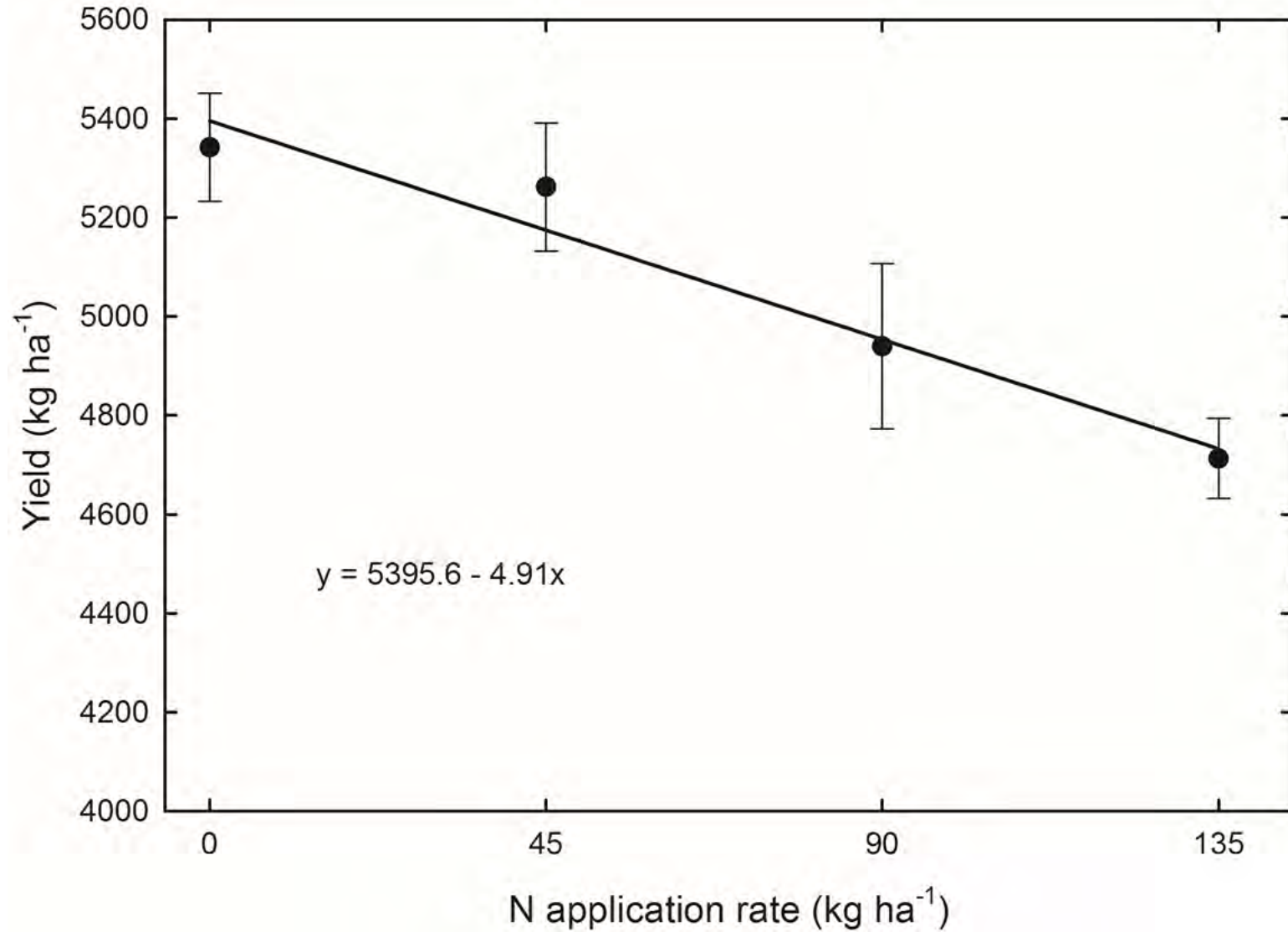
45 kg N ha⁻¹



135 kg N ha⁻¹



Seed yield



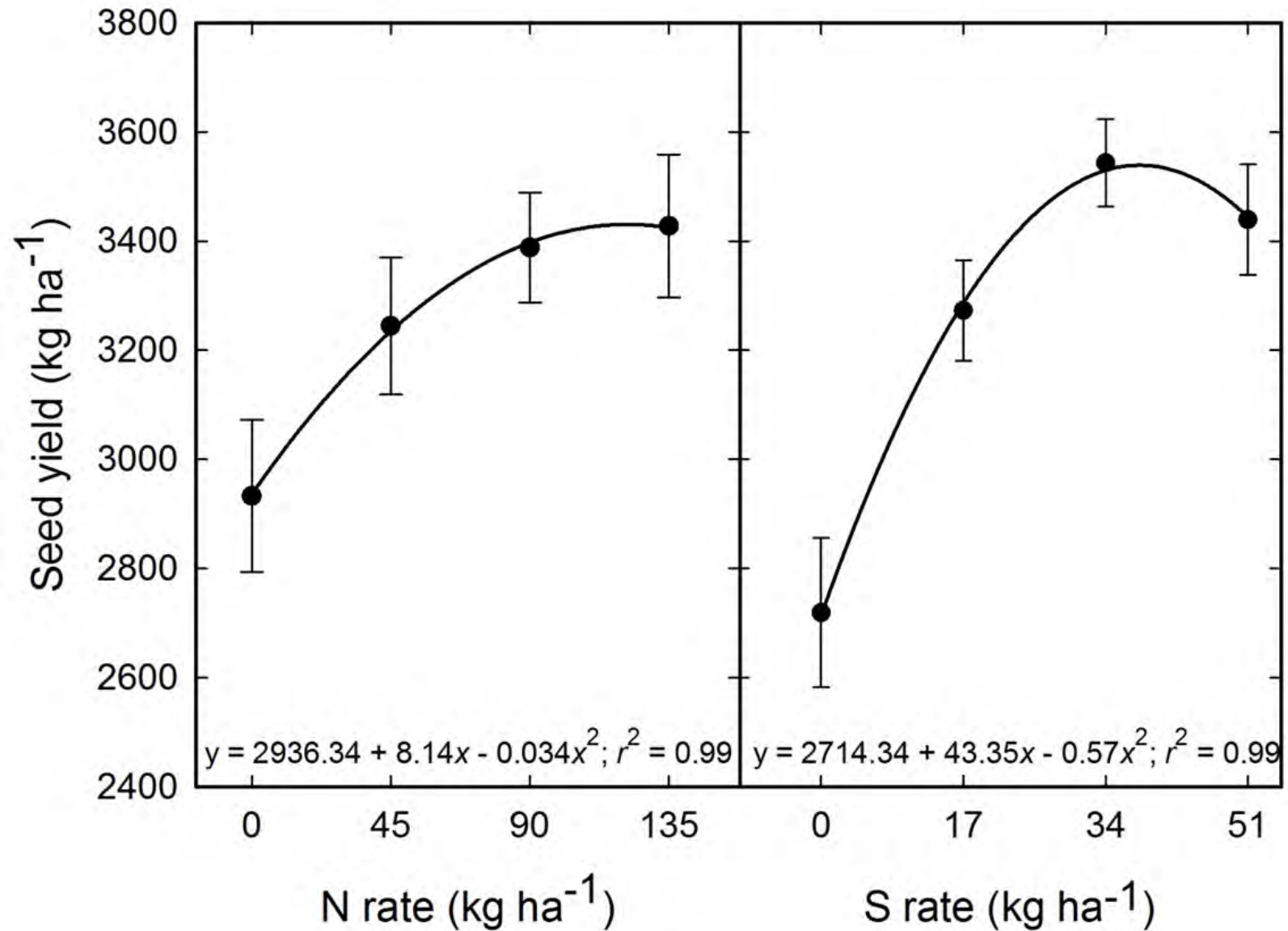
N rate × S rate

Seepaul et al. 2016

Experimental setup

- **Factorial combination of N rate and S rate**
 - *N rate (0, 45, 90, and 135 kg N ha⁻¹)*
 - *S rate (0, 17, 34, and 51 kg S ha⁻¹)*
- **N applied at planting (25%), bolting (50%) and flowering (25%) and S applied at planting (50%) and bolting (50%)**
- **N source: ammonium nitrate (34-0-0)**
- **S source: sulphate of potash (0-0-50-17); S level were corrected with muriate of potash (0-0-60)**
- **Planted Agrisoma 110994EM on Dec 1, 2015**

Seed yield



N timing × planting date

Seepaul et al. 2016; Southern ASA Meeting

Experimental setup

- **Planting dates (12/4/14 and 1/29/15)**

- 1 0N control
- 2 100% ESN at planting
- 3 100% at planting
- 4 100% at bolting
- 5 100% at flowering
- 6 50% at planting + 50% at bolting
- 7 50% at planting + 50% at flowering
- 8 50% at bolting + 50% at flowering
- 9 50% at planting + 25% at bolting + 25% at flowering
- 10 25% at planting + 50% at bolting + 25% at flowering
- 11 25% at planting + 25% at bolting + 50% at flowering

100% N is 90 kg N ha⁻¹

Seed yield

N timing	Plant density		Yield	
	12/4/14	1/29/15	12/4/14	1/29/15
	plants m ⁻²		kg ha ⁻¹	
0N Control	34 a	123 a	2137 g	712 e
100% ESN P	33 a	101 a	3047 de	1670 a
100% P	33 a	107 a	3088 de	1473 a
100% B	41 a	101 a	3174 dc	877 de
100% F	43 a	117 a	2501 f	817 de
50% P + 50% B	40 a	123 a	3377 bc	1433 ab
50% P + 50% F	41 a	114 a	3084 de	1220 bc
50% B + 50% F	36 a	107 a	2852 e	1085 dc
50% P + 25% B + 25% F	43 a	106 a	3684 a	1319 bc
25% P + 50% B + 25% F	37 a	113 a	3498 ab	1356 bc
25% P + 25% B + 50% F	42 a	117 a	3079 de	1309 bc
LSD	15	33	277	292

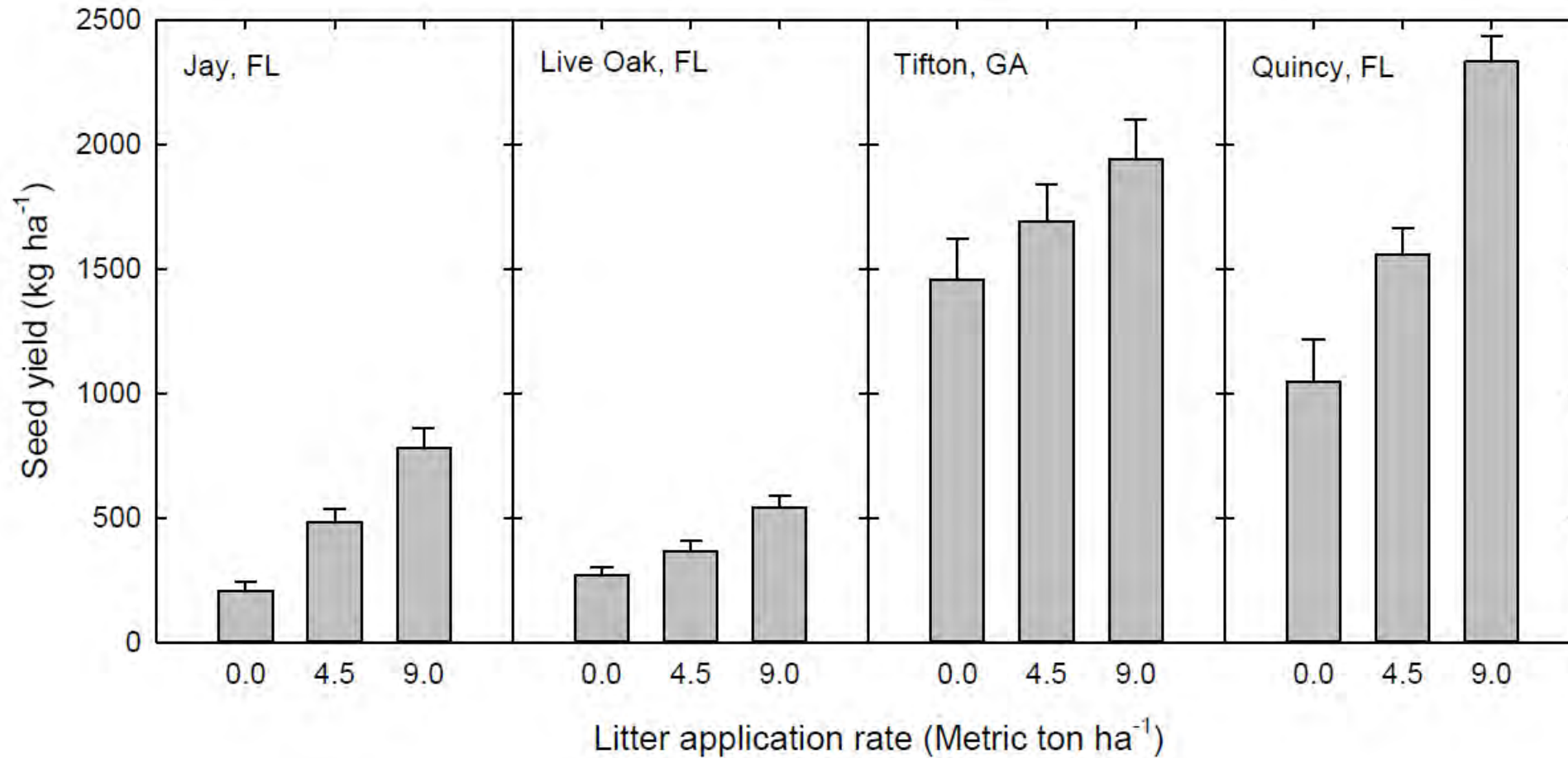
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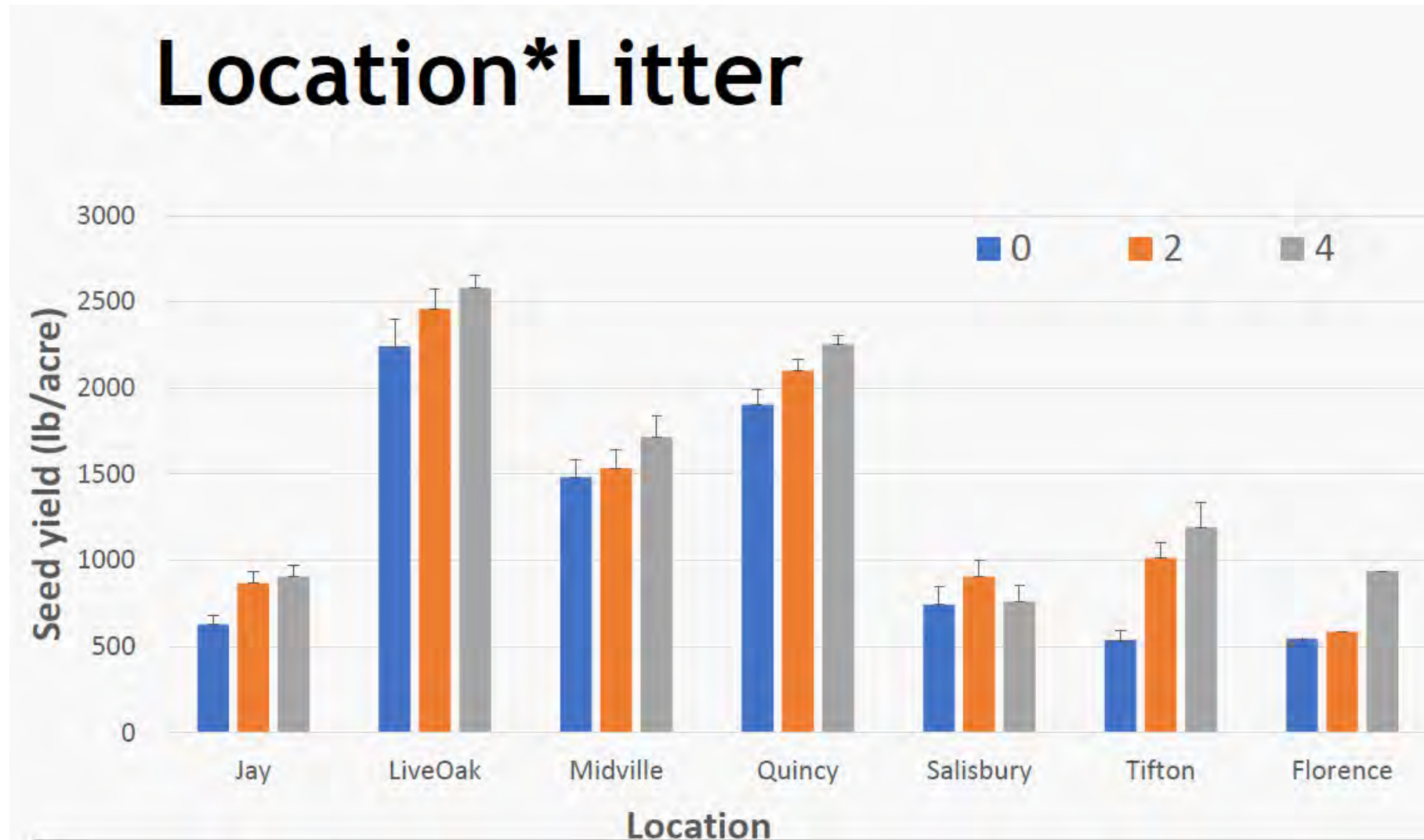
Poultry manure as nutrient source

Seepaul et al. 2020 and 2021

Seed yield in 2020



Seed yield in 2021



Chicken manure source in FL and NC

	Estimate of Nutrients Available	
	FL, GA	NC
Total Nitrogen	20.7	28.3
Ammonia Nitrogen	8.4	
Nitrate		
Total P ₂ O ₅	44.6	57.6
Total K ₂ O	73.8	51.2
Sulfur	920	17.1
Boron	0.2	0.07
Zinc	0.6	1.13
Manganese	0.8	1.22
Iron	0.8	6.1
Copper	1.2	0.82
Calcium	36.2	48
Magnesium	10.6	11.4
Sodium	11.4	15.7
Aluminium	1.0	5.99
Organic Nitrogen	15.3	
pH	8.5	

Chicken manure source in GA

Analyte	Percent (%) (As-Is Basis)	Percent (%) (Dry Basis)	Pounds per Ton (As-Is Basis)	Estimate of Nutrients Available (lbs/Ton)
Nitrogen-Total	3.25	3.976	65	26
P2O5-Total	3.09	3.78	61.8	61.8
K2O-Total	3.97	4.857	79.4	79.4
Sulfur	1.29	1.578	25.8	25.8
Boron	0.01	0.012	0.2	0.2
Zinc	0.03	0.037	0.6	0.6
Manganese	0.03	0.037	0.6	0.6
Iron	0.35	0.428	7	7
Copper	0.04	0.049	0.8	0.8
Calcium	2.88	3.523	57.6	57.6
Magnesium	0.75	0.918	15	15
Sodium	1.25	1.529	25	25
Aluminum	0.29	0.355	5.8	5.8

Questions