

Strawberry Nitrogen Fertilization



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Strawberry transplants

Bare-root transplants



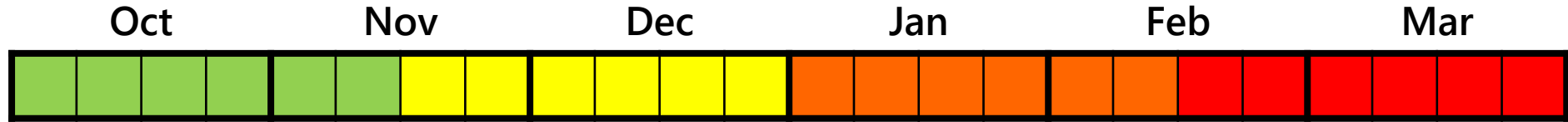
Plug transplants



INTRODUCTION

Strawberry growing season in Florida

Transplanting (Central FL)
Sep 25 – Oct 25



Sprinkler irrigation
(10-14 days)



Establishment



Early harvest



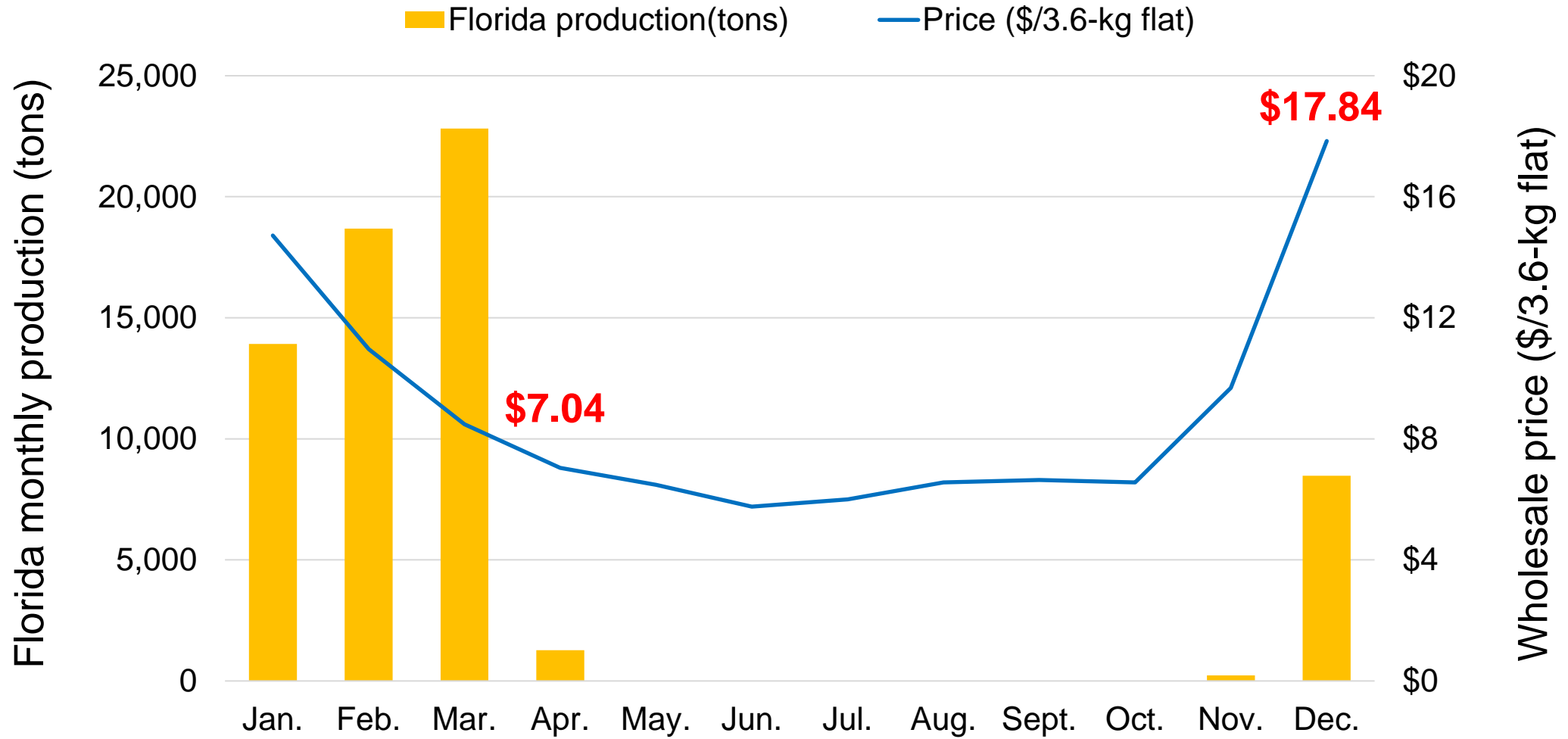
Mid harvest



Late harvest

INTRODUCTION

Strawberry monthly production in Florida and prices



Current IFAS recommendation – Table 5

Table 5. Target pH and nitrogen (N) fertilization recommendations for selected vegetable crops in mineral soils of Florida.

Crops	Target pH	N (lb/acre)
Tomato, pepper, potato, celery, sweet corn, crisphead lettuce, endive, escarole, romaine lettuce, and eggplant	6.0 (potato) and 6.5	200
Snapbean, lima bean, and pole bean	6.5	100
Broccoli, cauliflower, brussels sprouts, cabbage, collards, Chinese cabbage, and carrots	6.5	175
Radish and spinach	6.5	90
Cucumber, squash, pumpkin, muskmelon, leaf lettuce, sweet bulb onion, watermelon, and strawberry	6.0 (watermelon) and 6.5	150
Southernpea, snowpea, English pea, and sweet potato	6.5	60
Kale, turnip, mustard, parsley, okra, bunching onion, leek, and beet	6.5	120

Current IFAS recommendation – Table 8

Table 8. Fertigation¹ and supplemental fertilizer¹ recommendations on mineral soils testing low in potassium (K₂O) based on the Mehlich-3 soil extraction method.

	Preplant ² (lb/A)	Injected ³ (lb/A/day)					Low Plant Content ^{4,5}	Extended Season ^{4,6} (lb/A/day)
Eggplant								
Wk after transplanting ⁷		1–2	3–4	5–10	11–13			
N	0–70	1.5	2.0	2.5	2.0		1.5–2.0	1.5–2.0
K ₂ O	0–55	1.0	1.5	2.5	1.5		1.5–2.0	1.5–2.0
Okra								
Wk after transplanting		1–2	3–4	5–12	13			
N	0–40	1.0	1.5	2.0	1.5		1.5–2.0	1.5–2.0
K ₂ O	0–50	1.0	1.5	2.0	1.5		1.5–2.0	1.5–2.0
Pepper								
Wk after transplanting		1–2	3–4	5–11	12	13		
N	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0
K ₂ O	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0
Strawberry								
Wk after transplanting		1–2	Sept.–Jan.	Feb.–Mar.	Apr.			
N	0–40	0.3	0.6	0.75	0.6		0.6–0.75	0.6–0.75
K ₂ O	0–40	0.3	0.5	0.75	0.6		0.6–0.75	0.6–0.75
Tomato⁸								
Wk after transplanting		1–2	3–4	5–11	12	13		
N	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0
K ₂ O	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0

¹ A=7,260 linear feet per acre (6-foot bed spacing); for soils testing "low" in Mehlich-3 potassium (K₂O), seeds and transplants may benefit from applications of a starter solution at a rate no greater than 10 to 15 lb/A for N and P₂O₅ and applied through the plant hole or near the seeds.
² Applied using the modified broadcast method (fertilizer is broadcast where the beds will be formed only, and not over the entire field). Preplant fertilizer cannot be applied to double/triple crops because of the plastic mulch; hence, in these cases, all the fertilizer has to be injected.
³ This fertigation schedule is applicable when no N and K₂O are applied preplant. Reduce schedule proportionally to the amount of N and K₂O applied preplant. Fertilizer injections may be done daily or weekly. Inject fertilizer at the end of the irrigation event and allow enough time for proper flushing afterwards.
⁴ Plant nutritional status may be determined with tissue analysis or fresh petiole-sap testing, or any other calibrated method. The "low" diagnosis needs to be based on UF/IFAS interpretative thresholds.
⁵ Plant nutritional status must be diagnosed every week to repeat supplemental fertilizer application.
⁶ Supplemental fertilizer applications are allowed when irrigation is scheduled following a recommended method (see *Evapotranspiration-Based Irrigation Scheduling for Agriculture* at <https://edis.ifas.ufl.edu/ae457>). Supplemental fertilizations are to be applied in addition to base fertilization when appropriate. Supplemental fertilization is not to be applied "in advance" with the preplant fertilizer.
⁷ For standard 13-week-long transplanted tomato crop.
⁸ Some of the fertilizer may be applied with a fertilizer wheel through the plastic mulch during the tomato crop when only part of the recommended base rate is applied preplant. Rate may be reduced when a controlled-release fertilizer source is used.

Table 8. Fertigation¹ and supplemental fertilizer¹ recommendations on mineral soils testing low in potassium (K₂O) based on the Mehlich-3 soil extraction method.

	Preplant ² (lb/A)	Injected ³ (lb/A/day)					Low Plant Content ^{4,5}	Extended Season ^{4,6} (lb/A/day)
Strawberry								
Wk after transplanting		1–2	Sept.–Jan.	Feb.–Mar.	Apr.			
N	0–40	0.3	0.6	0.75	0.6		0.6–0.75	0.6–0.75
K ₂ O	0–40	0.3	0.5	0.75	0.6		0.6–0.75	0.6–0.75

Current IFAS recommendation – Table 8 (footnotes)

Table 8. Fertigation¹ and supplemental fertilizer¹ recommendations on mineral soils testing low in potassium (K₂O) based on the Mehlich-3 soil extraction method.

	Preplant² (lb/A)	Injected³ (lb/A/day)	Low Plant Content^{4,5}	Extended Season^{4,6} (lb/A/day)
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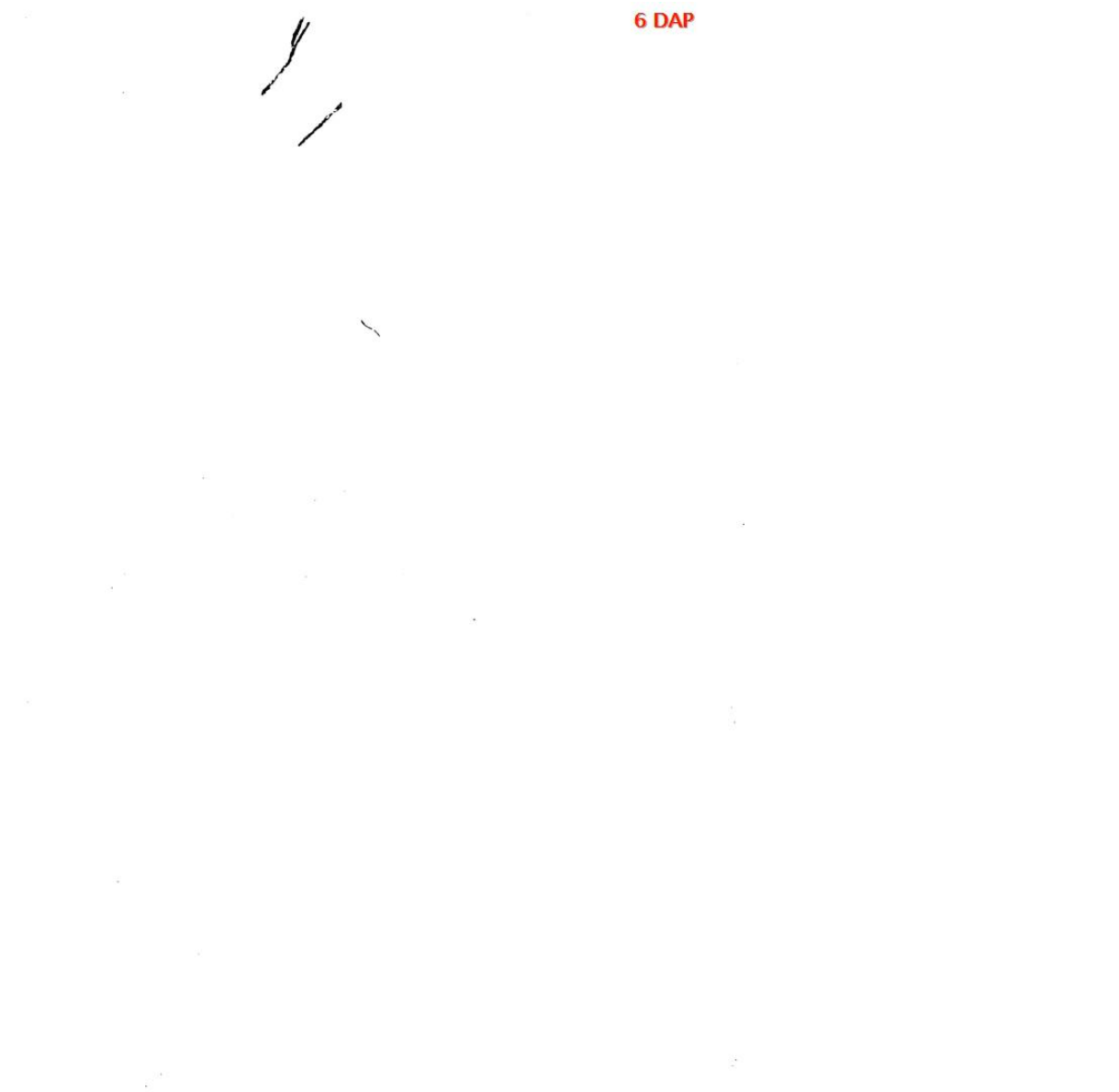
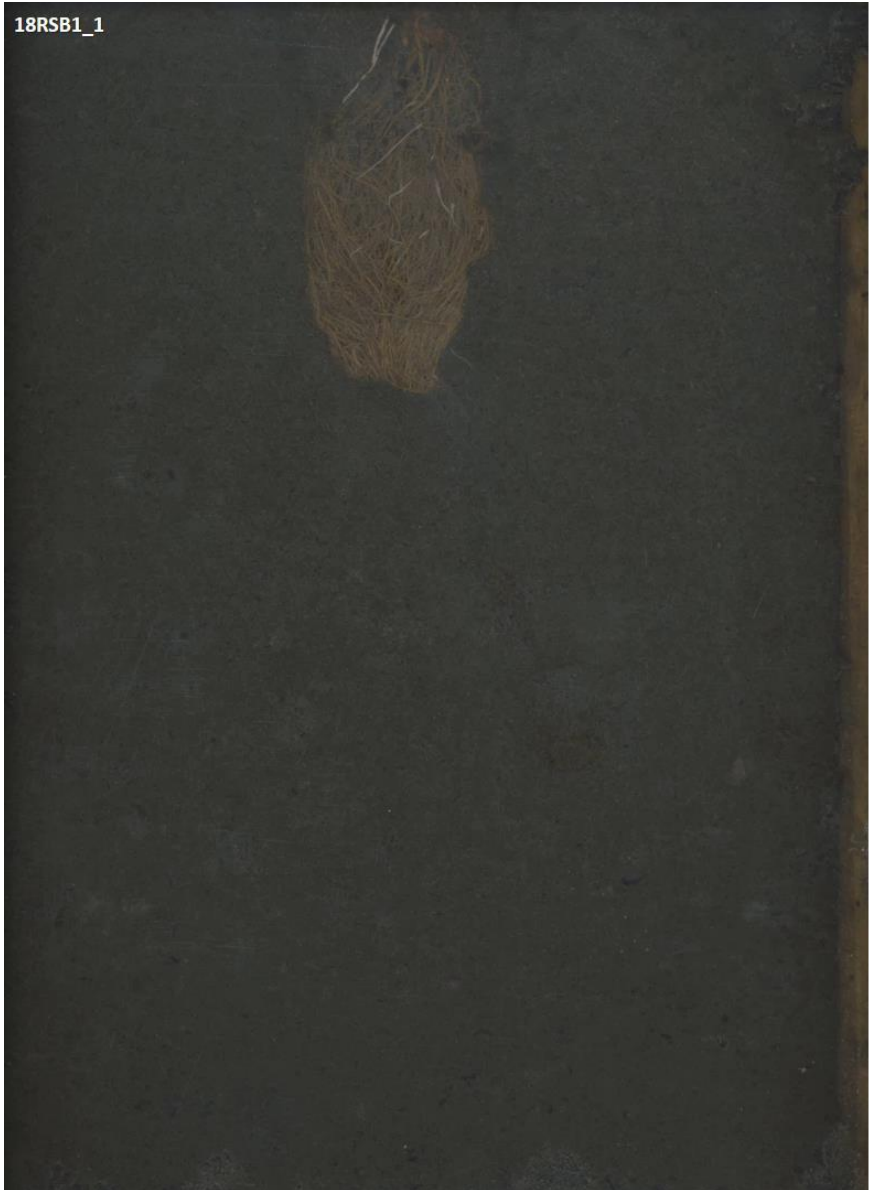
INTRODUCTION

Growers apply N at a higher rate when plants are small – why?



INTRODUCTION

Initial root development – ‘Florida Radiance’ bare-root transplant



Field evaluation of N rates for strawberry

Study 1 (Agehara, 2021, Agronomy) – focus on growth and yield responses

Cultivars	'Florida Radiance' and 'Florida127'
Transplant type	Bare-root
Season	2013–2014 and 2014–2015
Early-season N rate	0.20–1.8 lb/acre/d (0.22–2.0 kg/ha/d) over 54 days
Total N input	85–171 lb/acre (95–192 kg/ha)

Study 2 (Agehara and Nunes, 2021, Agronomy) – focus on fruit quality

Cultivars	'Florida Radiance'
Transplant type	Bare-root
Season	2015–2016 and 2016–2017
Early-season N rate	1.0–2.0 lb/acre/d (1.1–2.2 kg/ha/d) over 21 days
Total N input	137–162 lb/acre (154–182 kg/ha)

METHODS

Field evaluation of N rates for strawberry



Field evaluation of N rates for strawberry

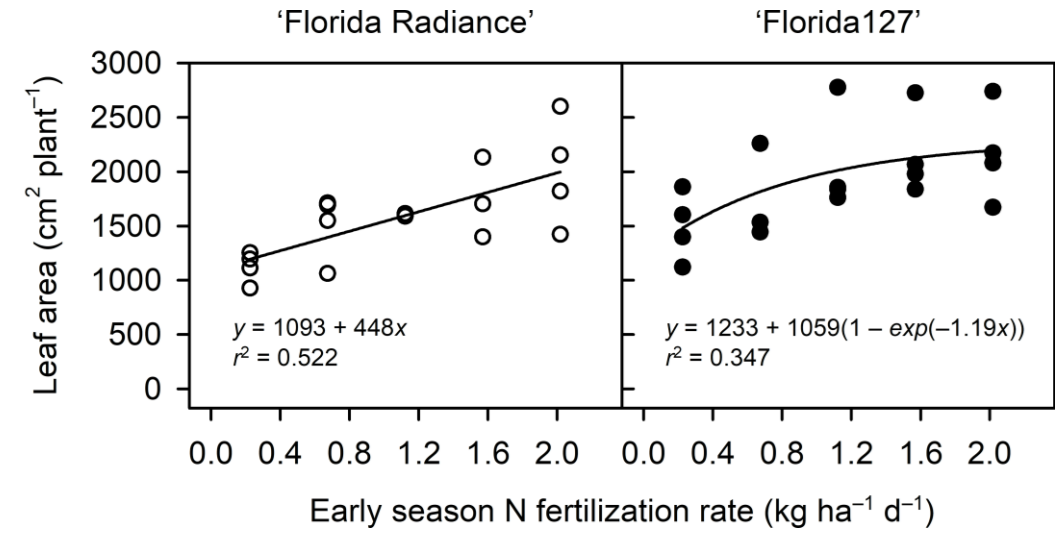
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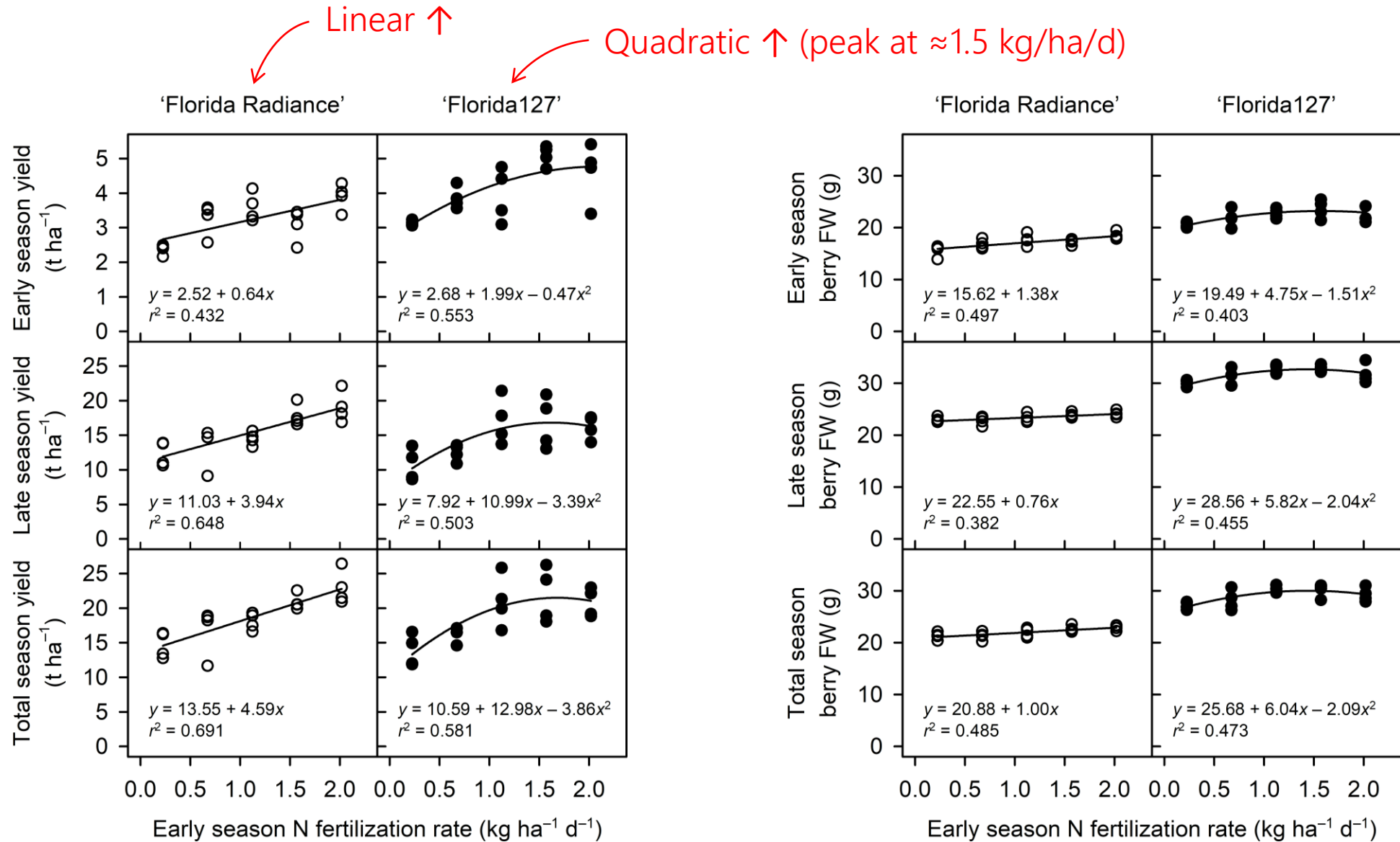
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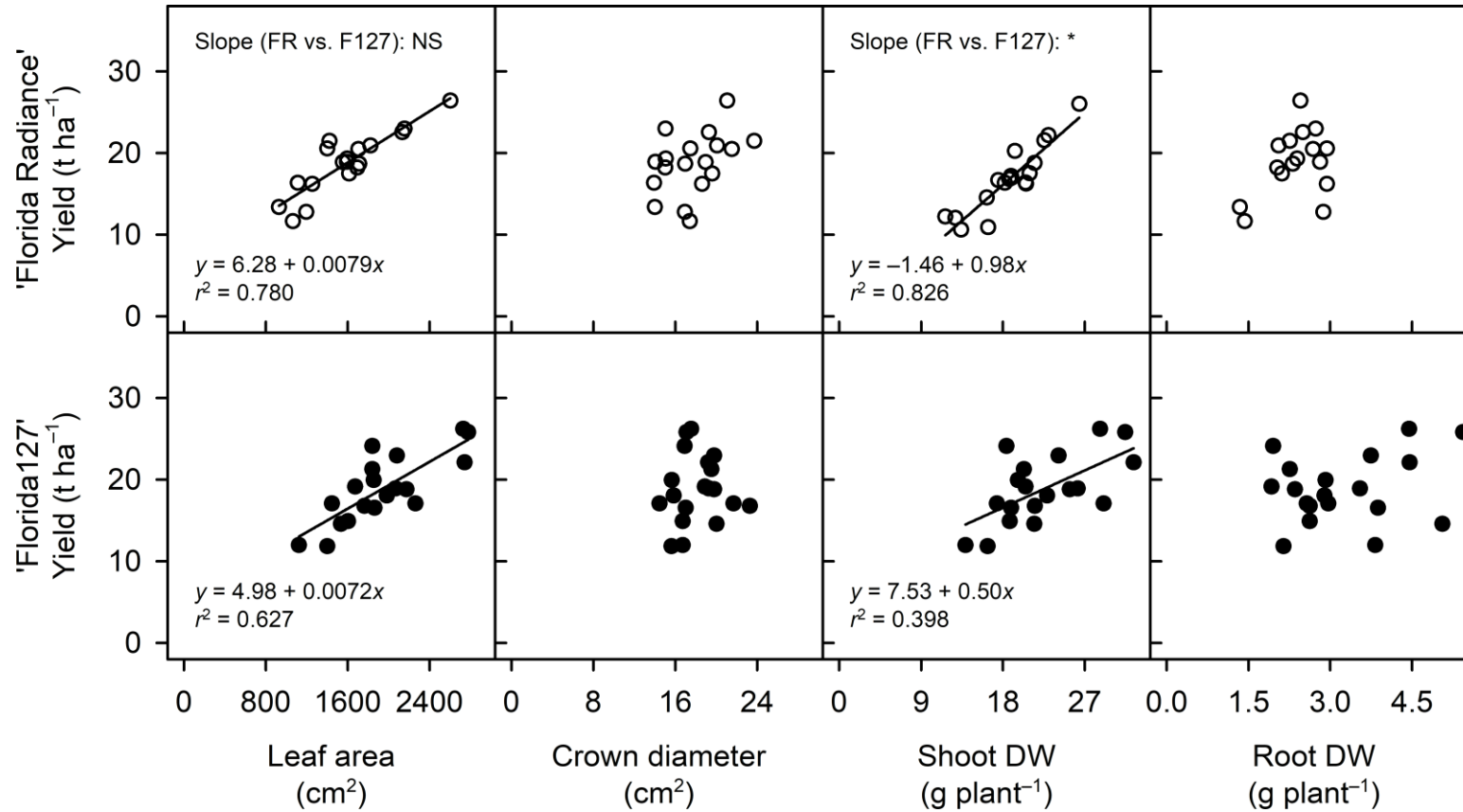
Canopy area



Marketable yield and berry size

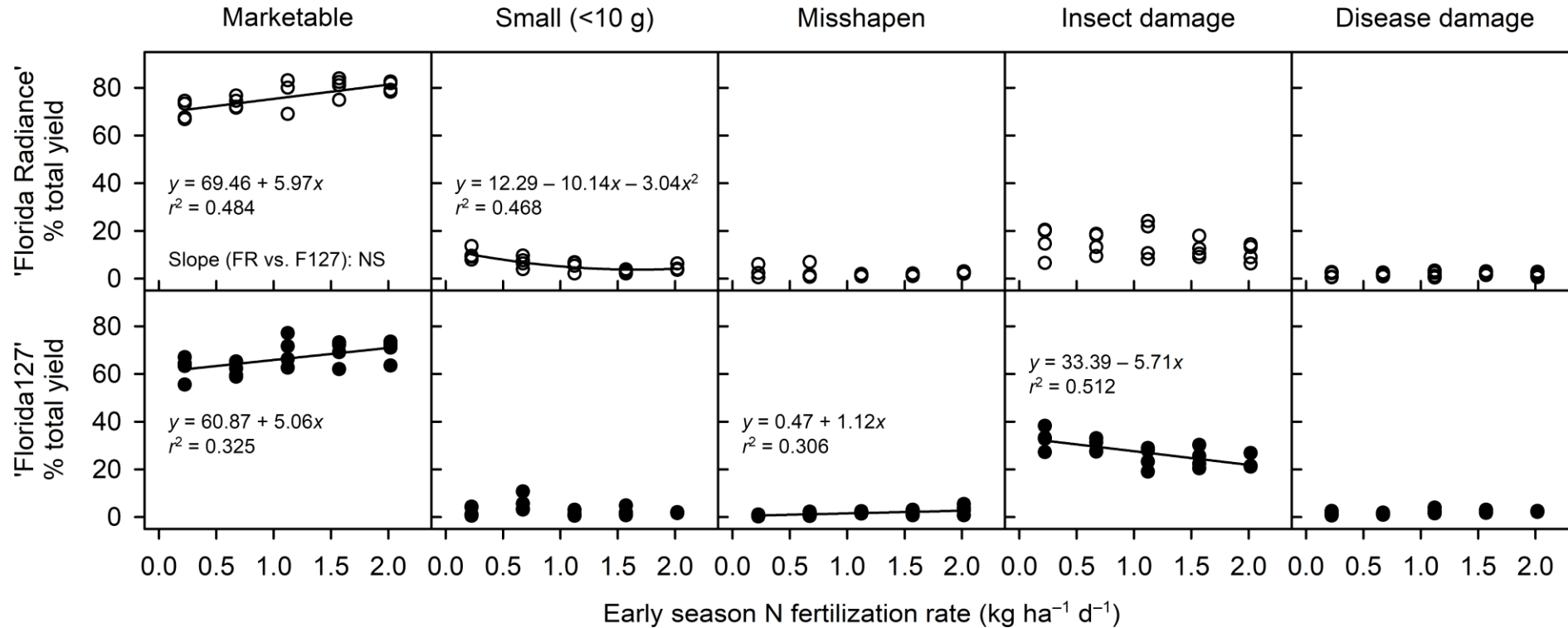


Correlation (growth × yield)



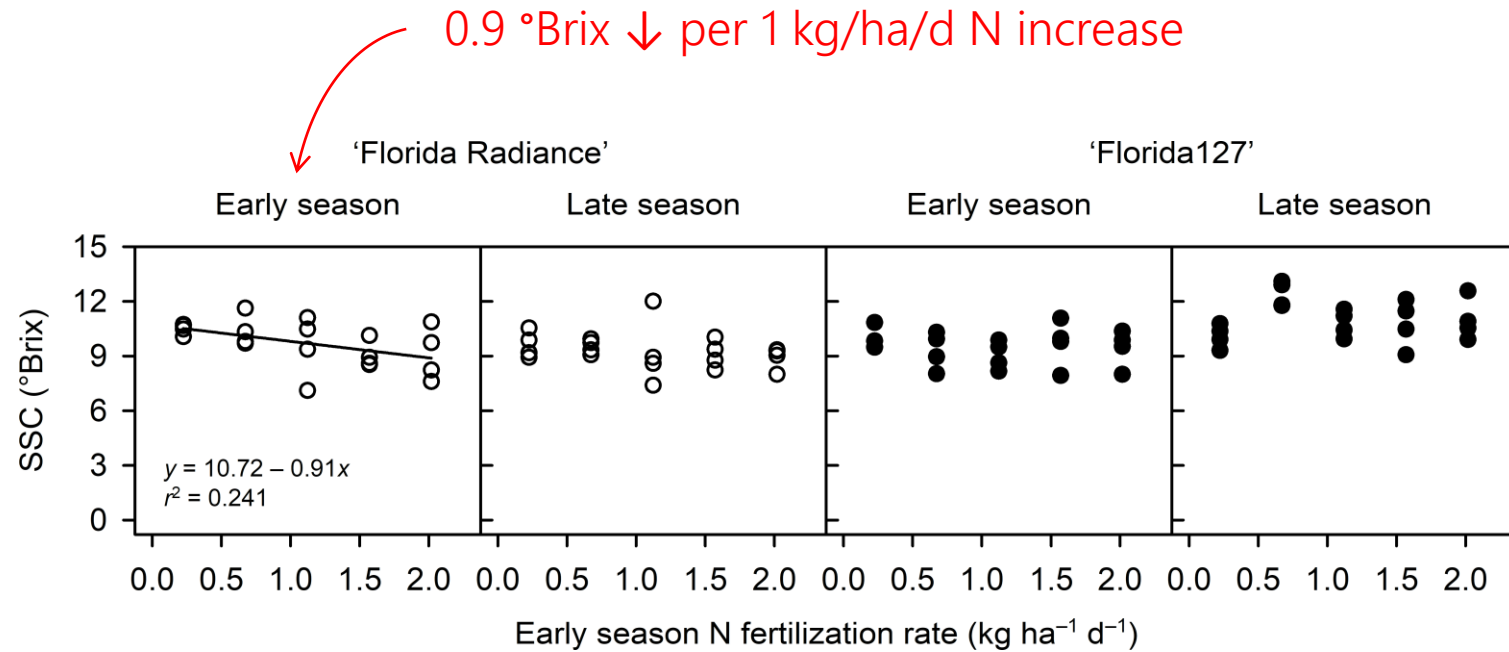
Canopy size ↑ = Yield ↑

% marketable and unmarketable yields



Increasing N rate has no negative impact on % marketable yield.

Brix



Effects of N rate on Brix depend on cultivars and harvest seasons.

Field evaluation of N rates for strawberry

Study 1 (Agehara, 2021, Agronomy) – focus on growth and yield responses

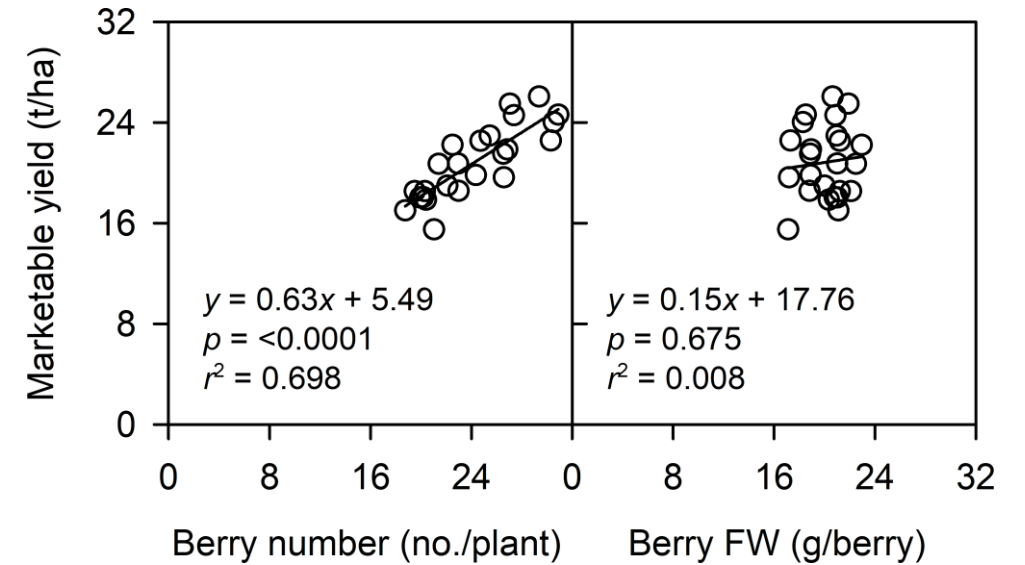
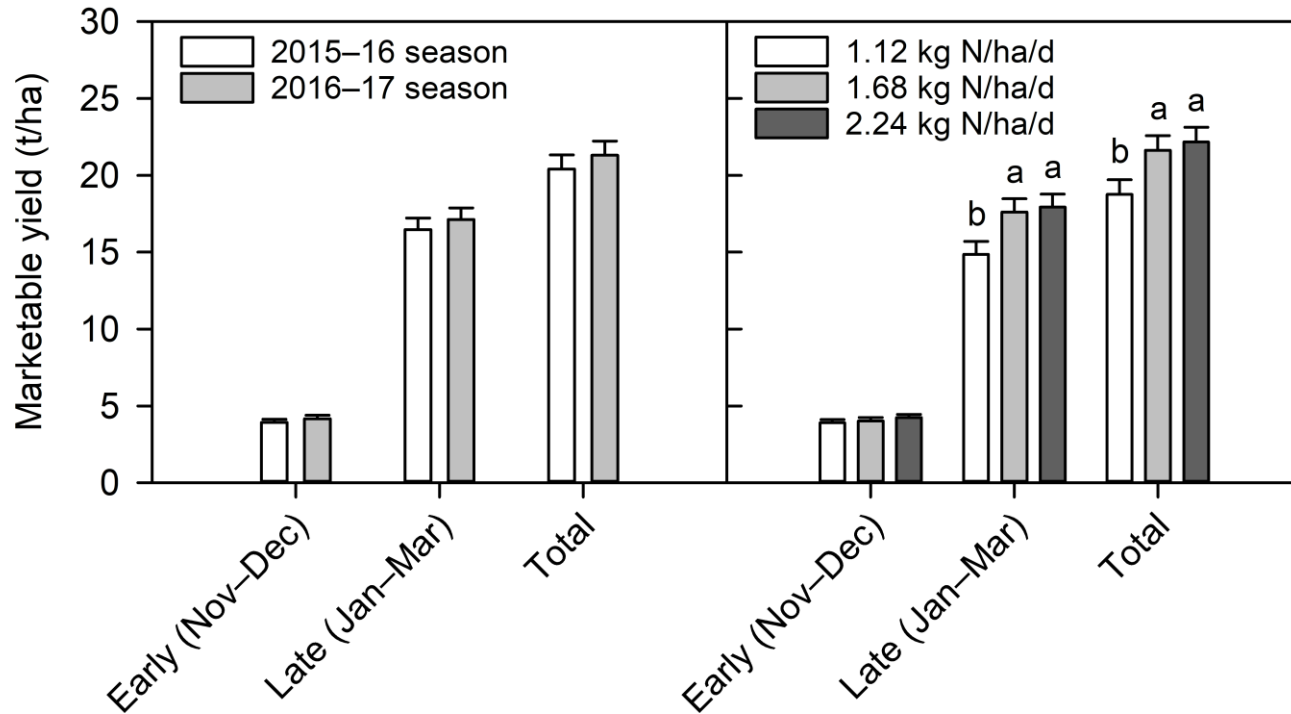
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Marketable yield

Effect	<i>p</i> value		
	Early	Late	Total
Season	0.3443	0.6260	0.5108
Early-season N rate	0.4492	0.0402	0.0302
Season × Early-season N rate	0.0922	0.6304	0.9064



Fruit quality

Season	Early-Season N Rate ² (kg/ha/d)	pH		TA (%)		SSC (%)		SSC/TA		Anthocyanins (mg/100 g FW)		Phenolics (mg/100 g FW)
2015–2016		3.51	b	0.649	b	5.69	b	8.78	a	17.2	a	180
2016–2017		3.58	a	0.864	a	6.32	a	7.36	b	11.7	b	NA
	1.12	3.54		0.768		6.08		8.01		14.7		185
	1.68	3.54		0.758		5.87		7.88		13.9		175
	2.24	3.59		0.795		6.27		8.04		13.4		184
<i>p</i> value												
Season		0.0238		<0.0001		<0.0001		<0.0001		<0.0001		NA
Early-season N rate		0.7292		0.9963		0.1345		0.4706		0.1704		0.3955
Season × Early-season N rate		0.0579		0.5703		0.7763		0.7398		0.2393		NA

¹ Means in a column with the same letter or no letter are not significantly different (Tukey–Kramer test, $p \leq 0.05$). ² Fertilization treatments are as described in Table 1. TA = titratable acidity. SSC = soluble solids concentration. FW = fresh weight. NA = data not available.

Key findings

- Optimum N rate depends on cultivars.
- Strawberry establishment growth and yield are highly responsive to early-season N fertilization.
- Impact of N rate on fruit quality is minimal.

N requirement	Cultivar
High	Florida Radiance (Florida Fortuna) Medallion™
Medium	Florida Brilliance
Low	Florida127 (Sensation®) Pearl™

EDIS to be submitted

Fertilization of Strawberries in Florida

Shinsuke Agehara and George Hochmuth

Introduction

Strawberries are an important crop in Florida, produced as an annual crop on plastic-mulched beds with drip irrigation. The main production area is in west-central Florida, including Hillsborough, Polk, and Manatee counties. Fertilizer is becoming a more significant portion of strawberry production costs, hence, proper fertilizer management is important for minimizing production costs and maximizing yield and fruit quality, while minimizing potential negative impacts on the environment caused by leaching or runoff of excess fertilizer nutrients. This guide summarizes the recent history of strawberry fertilization research and presents the updated research-based fertilizer management recommendations for strawberry production in Florida

Fertilization Recommendations

Preplant fertilization – Phosphorus, Potassium, and other nutrients

Strawberry P and K fertilization recommendations are based on the calibrated Mehlich-3 soil test results and vary according to the soil-test level of P and K (Table 1). A portion of the potassium recommendation (20-25%) may be incorporated in the bed as a preplant application (Figure 1). Rates of K higher than recommended reduced average strawberry

SUMMARY

New N recommendation – Monthly N rate and total-season input

	Preplant (lb/acre)	Daily injection rate (lb/acre/day)								Low content	Total (lb/acre)
		Wk 1-2	Oct	Nov	Dec	Jan	Feb	Mar	Apr		
Old	0–40	0.3	0.6	0.6	0.6	0.6	0.75	0.75	0.6	0.6–0.75	150
New	0	0	1.5–2.0	1.0–2.0	1.0–1.5	0.75–1.0	0.5–1.0	0.5–0.75	0.5–0.75	1.5–2.0	175

- 1) Preplant N: 0–40 lb/acre → 0 lb/acre (controlled-release N is optional for preplant N)
- 2) In-season daily N rate: 0.3–0.75 lb/acre/d → 0.5–2.0 lb/acre/d
- 3) “Low plant content” N rate: 0.6–0.75 lb/acre/d → 1.5–2.0 lb/acre/d
- 4) Total N rate: 150 lb/acre → 175 lb/acre

SUMMARY

New N recommendation – Footnotes

	Nitrogen injection rate (lb/acre/day) ^z							Recommended total season amount (lb/acre) ^x
	Time period in the growing season ^y							
	Oct ^w	Nov	Dec	Jan	Feb	Mar	Apr	
Nitrogen ^y	1.5–2.0	1.0–2.0	1.0–1.5	0.75–1.0	0.5–1.0	0.5–0.75	0.5–0.75	175

- ^z Based on double-row cultural system with beds on 4-ft centers.
- ^y Planting date of October 1 and end-of-harvesting date of April 30. Totals may increase or decrease, depending on length of season. Strawberries can be planted as early as 25 September and harvested as late as the end of April in west-central Florida, depending on cultivars and market prices.
- ^x These are the recommended total seasonal N amounts. Some growers on high-organic matter soils may do well with less than 175 lbs/acre N, and other growers on sandy soils, prone to leaching, may require slightly more, but rarely more than 200 lbs/acre. Extra seasonal N applications should depend on plant leaf or petiole sap testing, leaching rainfall, or extended-season needs.

SUMMARY

New N recommendation – Footnotes

	Nitrogen injection rate (lb/acre/day) ^z							Recommended total season amount (lb/acre) ^x
	Time period in the growing season ^y							
	Oct ^w	Nov	Dec	Jan	Feb	Mar	Apr	
Nitrogen ^v	1.5–2.0	1.0–2.0	1.0–1.5	0.75–1.0	0.5–1.0	0.5–0.75	0.5–0.75	175

- ^w Some growers **may choose to omit N fertilization until 2 weeks after turning off the watering-in irrigation system**, and some growers who double-crop may elect to cease fertigation late in the spring when the strawberry plants are removed, resuming fertigation when the double-crop is planted.
- ^v **Strawberry cultivars have differing N requirements early in the season.** Growers should choose N rates within the ranges shown in the table for the different periods in the season, that are appropriate for the particular cultivar, and that will target 175 lbs/acre N for the season. The lower N amounts in the range are adequate for those cultivars with moderate N demand and would easily become too vegetative with excessive N. Other varieties have a greater N demand, especially early in the season. Rarely is more than 0.5 to 0.75 lb/acre/day N required in the last 60 days of the season when too much N can reduce fruit firmness and shipping quality under the warmer growing conditions.

SUMMARY

Proposed changes in K rates

	Preplant (lb/acre)	Daily injection rate (lb/acre/day)								Low content	Total (lb/acre)
		Wk 1-2	Oct	Nov	Dec	Jan	Feb	Mar	Apr		
Old	0–40	0.3	0.5	0.5	0.5	0.5	0.75	0.75	0.6	0.6–0.75	150
New	0	0	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	150

- 1) Preplant K: 0–40 lb/acre → 0 lb/acre (controlled-release K is optional for preplant K)
- 2) In-season daily N rate: 0.3–0.75 lb/acre/d → 0.6–0.8 lb/acre/d
- 3) “Low plant content” N rate: 0.6–0.75 lb/acre/d → 0.6–0.8 lb/acre/d
- 4) Total N rate: No change (150 lb/acre)