

UF/IFAS Recommendation Updates for Florida's Crop Production

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IFAS fertilizer recommendations - Topics

- Fertilization philosophies.
- What is a recommendation, exactly?
- History to present day.
- Nutrient management research renaissance.
- Can we achieve consistency and clarity?
- IFAS recommendations and BMPs.

Fertilization philosophies

Use in Florida?

- Buildup and maintenance No
- Basic cation saturation ratios No
- Open hydroponics No
- Crop nutrient requirement Yes

Four pillars of IFAS recommendations

1. Based on:
 - Calibrated soil test.
 - Scientific research/experience with the crop.
2. Advisory.
3. Efficient fertilizer use and environmentally sound nutrient management without loss of yield or crop quality.
4. Developed by IFAS faculty.

What is an IFAS recommendation?

1. Soil test interpretation for the crop.
2. Target soil pH. Lime if needed.
3. Fertilizer:
 - Rates (N, P_2O_5 , K_2O , Mg, other nutrients).
 - Timing.
 - Placement (broadcast, sidedress, banding).
 - Sources (chemical form, water-soluble, CRF, EEF).
4. Water management.
5. Site-specific aspects (coming).

Florida Cooperative Extension Service

UNIVERSITY OF FLORIDA
INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES



AGRONOMY FACTS

December 13, 1977

Number 70

FERTILIZATION OF FIELD AND FORAGE CROPS

Development of fertilization programs for Florida field and forage crops require that consideration be given to nutrient requirements for the given crops, soil nutrient levels, reactions of the soil with added nutrients, and ability of the soil to retain and deliver nutrients and water. These factors are used to determine rates, placement and timing of fertilizer applications.

TABLE 1. RECOMMENDATIONS FOR FERTILIZATION OF FLORIDA FIELD AND FORAGE CROPS ON BASIS OF SOIL-TEST RESULTS OF MINERAL SOILS

			Recommended Fertilizer Application on Basis of Soil Test Results for						N		
			P ₂ O ₅			K ₂ O			Basic ^{1/}	Supplementary	
			L	M	H	L	M	H		No.	Appl.
Lbs. per acre to apply											
<u>Field Crops</u>											
Non-irrigated Corn	10,000 plants/A		80	40	20	80	40	20	20	1	100 ^{7/}
	12,500 plants/A		100	50	25	100	50	25	30	1	120 ^{7/}
	15,000 plants/A		120	60	30	120	60	30	40	1	140 ^{7/}
Irrigated Corn -	15,000 plants/A		120	60	30	120	60	30	40	1	140 ^{7/}
	20,000 plants/A		140	70	35	140	70	35	50	1	160 ^{7/}
	25,000 plants/A		160	80	40	160	80	40	60	1	180 ^{7/}
Grain Sorghum			100	50	25	100	50	25	30	1	120 ^{7/}
Small Grains - for Grain			80	40	20	80	40	20	30	1	40
Cotton			90	60	30	100	70	30	20 ^{2/}	1	70
Peanuts			80	40	20	80	40	20	0 ^{2/}	-	0
Soybeans			80	40	20	80	40	20	0 ^{2/}	-	0
Tobacco, flue-cured ^{3/}			80	60	40	160	120	80	40	1	40
Sugarcane for syrup			80	40	20	80	40	20	30	1	60
<u>Forage Crops-Annuals</u>											
Pearlmillet			80	40	20	80	40	20	30	3-4 ^{4/}	50
Sorghum-sudangrass			80	40	20	80	40	20	30	3-4 ^{4/}	50
Forage sorghum, for silage			120	80	60	120	80	60	30	1 ^{4/}	120
Small Grains, for grazing			80	40	20	80	40	20	30	2 ^{4/}	50
<u>Forage Crops-Perennials</u>											
<u>Perennial grass pastures</u>											
New Plantings			80	40	20	80	40	20	40	1	60
Established stands-grazing			80	40	20	80 ^{5/}	40 ^{5/}	20 ^{5/}	60	1	60
Established stands-hay			80	40	20	80 ^{6/}	40 ^{6/}	20 ^{6/}	80	2-4 ^{4/}	80
Clover-grass pastures			100	60	30	160 ^{6/}	120 ^{6/}	80 ^{6/}	0	-	0

^{1/}Basic nitrogen fertilizer should be applied prior to or at planting, the same as for phosphorus and potassium.

^{2/}Up to 30 pounds of nitrogen may be included with the phosphorus and potash.

CONTINUED -----



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notes in Soil Science



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No. 38
SS-SOS-907

IFAS Standardized Fertilization Recommendations for Vegetable Crops

This publication presents in abbreviated form the fertilization recommendations for vegetable crops based on soil tests performed by the IFAS Extension Soil Testing Laboratory (ESTL). It contains the basic information from which ESTL soil-test reports and fertilization recommendations are generated. For more complete coverage of the subject, refer to IFAS Extension Circular 817, *Soil, Container Media, and Water Testing Interpretations and IFAS Standardized Fertilization Recommendations*.

Soil testing is a tool in crop fertilization management. Its successful use requires that: (1) you send to the lab soil samples which represent your field or management unit, (2) the laboratory use legitimate methods for predicting fertility, and (3) the fertilizer recommendations you get are based on measured crop responses.

The ESTL extracts phosphorus (P), potassium (K), magnesium (Mg), and calcium (Ca) with the Mehlich-I extractant and bases fertilization recommendations for those nutrients on the test results. Nitrogen (N) fertilization is not based on soil tests but rather is based on crop needs as documented in research literature. Liming recommendations are based on the Adams-Evans lime requirement test, a calibration equation developed for Florida soils, and the target pH for the crop for which the recommendation is being made.

Table 2. Target pH, and recommended N, P₂O₅, and K₂O fertilizer rates for commercial vegetable production. Phosphorus and K rates are based on interpretation of a Mehlich-I soil test (IFAS Circular 806).

CROP CODE	CROP DESCRIPTION	TARGET pH	----- pounds/acre/cropping season -----												FOOTNOTES	REFERENCES ¹
			N lb/A	P ₂ O ₅				K ₂ O								
				VL	LO	MED	HI	VH	VL	LO	MED	HI	VH			
200	TOMATO or PEPPER	6.5	160	160	130	100	0	0	160	130	100	0	0	250 251 354		Cir 98C & 225C
201	MULCHED TOMATO	6.5	160	160	130	100	0	0	160	130	100	0	0	250 350 351 352 353 354		Cir 98C & 225C
202	MULCHED PEPPER	6.5	160	160	130	100	0	0	160	130	100	0	0	250 350 351 352 353 354		Cir 102E & 225C
203	EGGPLANT	6.5	120	160	130	100	0	0	160	130	100	0	0	250 251 354		Cir 102E & 225C
204	MULCHED EGGPLANT	6.5	120	160	130	100	0	0	160	130	100	0	0	250 350 351 352 353 354		Cir 225C
205	MUSKMELON	6.5	120	160	130	100	0	0	160	130	100	0	0	250 251 354		Cir 122C & 225C
206	MULCHED MUSKMELON	6.5	120	160	130	100	0	0	160	130	100	0	0	250 350 351 352 354		Cir 122C & 225C
207	HEAD CABBAGE	6.5	120	160	130	100	0	0	160	130	100	0	0	250 251 354		Cir 117E & 225C
208	MULCHED HEAD CABBAGE	6.5	120	160	130	100	0	0	160	130	100	0	0	250 350 351 352 354		Cir 117E & 225C
209	LETTUCE and ENDIVE	6.5	110	150	120	90	0	0	150	120	90	0	0	250 251 354		Cir 123 & 225C
210	CUCUMBER, SQUASHES, or SPINACH	6.5	90	120	100	80	0	0	120	100	80	0	0	250 251		Cir 101E, 103D, & 225C
211	MULCHED CUCUMBER or SQUASH	6.5	90	120	100	80	0	0	120	100	80	0	0	250 350 351 352 354		Cir 101E, 103D, & 225C
212	BROCCOLI or CAULIFLOWER	6.5	110	150	130	100	0	0	150	130	100	0	0	250 251 354		Cir 555 & 225C
213	MULCHED BROCCOLI or CAULIFLOWER	6.5	110	150	130	100	0	0	150	130	100	0	0	250 350 351 352 354		Cir 555 & 225C
214	CELERY	6.5	200	300	200	100	0	0	300	200	100	0	0	250 251 354		Bul 757 & Cir 225C
215	IRISH POTATO	6.0	150	120	120	60	0	0	140	140	70	0	0	250 251 253		Cir 118 & 225C, SSSAJ 47:266-270, & SCSSFP 41:192-195
216	BUSHBEANS, SOUTHERN, or ENGLISH PEAS	6.5	60	80	80	60	0	0	80	80	60	0	0	250 251		Cir 100, 225C, & 478
217	LIMA or POLE BEANS	6.5	90	120	120	80	0	0	120	120	80	0	0	250 251		Cir 100 & 225-C
218	SWEET POTATO	6.5	60	120	120	80	0	0	120	120	80	0	0	250 251		Cir 440-II, 551, & 225C
219	RADISH	6.5	90	120	120	80	0	0	120	120	80	0	0	250 251 252		Cir 225C
220	SWEET CORN	6.0	120	120	120	80	0	0	120	120	80	0	0	250 251		Cir 99D & 225C
221	WATERMELON	6.0	120	160	160	100	0	0	120	100	80	0	0	250 251 354		Cir 96G, 122, & 225C
222	MULCHED WATERMELON	6.0	120	160	160	100	0	0	120	100	80	0	0	250 350 351 352 354		Cir 96G, 122, & 225C
223	ONION	6.5	120	120	100	80	0	0	120	100	80	0	0	250 350 354		Cir 176E, 225C, & Bul 238
224	MULCHED STRAWBERRY	6.5	120	160	160	100	0	0	160	160	100	0	0	250 350 352 353 354 355		Cir 142 & 225C
225	MUSTARD or TURNIP	6.5	110	150	130	100	0	0	150	130	100	0	0	250 251		Cir 225C
226	CHINESE CABBAGE or CARROTS	6.5	110	150	130	100	0	0	150	130	100	0	0	250 251		Cir 225C
227	OKRA or COLLARD	6.5	110	150	130	100	0	0	150	130	100	0	0	250 251		Cir 225C
228	BEETS	6.5	90	120	120	80	0	0	120	120	80	0	0	250 251		Cir 492
90	VEGETABLE GARDEN	6.5	100	140	140	70	0	0	140	140	70	0	0	901 through 909		Cir 104P & VCF 74-3

¹ Cir = Circular
Bul = Bulletin
SSSAJ = Soil Science Society of America Journal
SCSSFP = Soil & Crop Science Society of Florida Proceedings
VCF = Vegetable Crops Fact Sheet

Table 3. Footnotes used with vegetable crops.

250 Indicated fertilizer amounts, and the nutrients already in the soil, will satisfy the crop nutrient requirement for this cropping season. Fertilizer and water management are linked. Maximum fertilizer efficiency is achieved only with close attention to water management. Supply only enough irrigation water to satisfy crop requirements. Excess irrigation may result in leaching of N and K, creating possible plant deficiencies.

For subsurface irrigation, maintain a constant water table between 15 and 18 inches below the top of the bed.

On soils that have not been in vegetable production within the past 20 years, or where micronutrients are known to be deficient, apply 5 lbs of Mn, 3 lb Zn, 4 lb Fe, 3 lb Cu, and 1.5 lb B/A. Use soil testing to monitor micronutrient status every 2 years. When deciding about micronutrient applications, consider micronutrients added to the crop via fungicides. Some micronutrients can build up in the soil -- avoid micronutrient toxicity.

251 Fertilizer should be applied in split applications to reduce leaching losses and lessen danger of fertilizer burn. Broadcast all P_2O_5 and micronutrients, if any, and 25 to 50% of the N and K_2O in the bed at planting. Apply remaining N and K_2O in sidedress bands during the early part of the growing season.

In cold soil or following fumigation, apply 20 to 25% of the recommended N in the nitrate form.

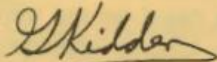
Additional, supplemental sidedress applications of 30 lb N/A and 20 lb K_2O/A should be applied only after rainfall/irrigation amounts exceed 3 inches within a 3-day period or exceeds 4 inches within a 7-day period. Avoid mechanical damage to plants when applying fertilizers.

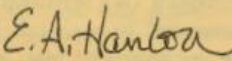
252 The amounts suggested are generally sufficient for 2 or 3 crops in succession.

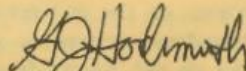
253 Where scab-resistant cultivars are grown, a pH between 6.0 and 6.5 is optimum. Where scab-susceptible cultivars are grown, the pH should be below 5.2 or above 7.2.

350 Supply 25 to 50% of the N in the nitrate form if soils were treated with multi-purpose fumigants.

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UF/IFAS Standardized Nutrient Recommendations for Vegetable Crop Production in Florida¹

Rao Mylavarapu, George Hochmuth, and Guodong Liu²

Introduction

This publication presents the fertilization recommendations for vegetable crops based on soil tests performed by the IFAS Extension Soil Testing Laboratory (ESTL). It contains the basic information from which ESTL soil test reports and fertilization recommendations are generated. Additional information on nutrient recommendations is presented in the Vegetable Production Handbook of Florida, 2017–2018. Similarly, UF/IFAS Standardized Nutrient Recommendations for Agronomic Crops can be found in SL129 (<http://edis.ifas.ufl.edu/ss163>) (Mylavarapu 2015).

requirements, and (3) the fertilizer recommendations you get are based on measured crop responses.

The ESTL extracts phosphorus (P), potassium (K), Mg, Ca, copper (Cu), manganese (Mn), and zinc (Zn) from soil samples with the Mehlich-3 extractant and bases fertilizer recommendations for those nutrients on the test results. The use of the Mehlich-3 extractant enhances the extraction of micronutrients and allows for a broader range of applicability (most normal soil pH ranges) when compared to the Mehlich-1 extractant. Other advantages of the Mehlich-3 extractant include improved extraction of P in soils with high iron and aluminum (Al) accumulations by facilitating

Table 1. Mehlich-3 soil test interpretations used for vegetable crops on mineral soils.

Element	Mehlich-3, mg/kg ⁻¹ (ppm)		
	Low	Medium	High
P	≤25	26–45	>45
K	≤35	36–60	>60
Mg	≤20	21–40	>40
Source: Mylavarapu, Obreza, Morgan, Hochmuth, Nair, and Wright (2014)			

Table 2. Interpretations of Mehlich-3 soil test for micronutrients.

Interpretations	Soil pH (mineral soils only)		
	5.5–5.9	6.0–6.4	6.5–7.0
	Test level (parts per million)		
Test level below which there may be a crop response to applied copper.	0.7–1.0	1.0–1.3	1.3
Test level above which copper toxicity may occur.	3.5–5.0	5.0–8.0	8.0
Test level below which there may be a crop response to applied manganese.	10.3–12.7	12.7–15.1	15.1–17.6
Test level below which there may be a crop response to applied zinc.	1.7	1.7–2.2	2.2–4.2
From “Notes in Soil Science” No. 9 1983, and Mylavarapu et al. 2002.			

Crop Description	Target pH	Pounds/Acre/Cropping season							Footnotes	References
		N (lb/Ac)	P ₂ O ₅			K ₂ O				
			L	MED	HI	L	MED	HI		
ONION Bulb	6.5	150	120	100	0	120	100	0	250 251 350 351 354 356	HS711, CV296
ONION Bunching, Leek	6.5	120	100	100	0	100	100	0	250 251 350 356	HS711, CV296
PARSLEY	6.5	120	120	100	0	120	100	0	250 251 350 356	HS638, HS711, CV296
PEA Southern, Snow, English	6.5	60	80	60	0	80	60	0	250 251 350 356	HS711, CV296
PEPPER Bell, Specialty	6.5	200	120	100	0	120	100	0	250 251 350 351 352 353 354 356	HS859, HS711, CV296
POTATO	6.0	200	120	60	0	150	150	150	250 253 350 356	HS945, HS711, CV296
RADISH	6.5	90	100	80	0	100	80	0	250 251 252 350 356	HS711, CV296
SPINACH	6.5	90	100	80	0	100	80	0	250 251 350 356	HS711, CV296
SQUASH Summer, Winter, Pumpkin	6.5	150	100	80	0	100	80	0	250 251 350 356	HS861, HS711, CV296
STRAWBERRY	6.5	150	120	100	0	120	100	0	250 350 352 353 354 355 356	HS956, HS1116, HS711, SL344, CIR1141, CV296
SWEET POTATO	6.5	60	100	80	0	100	80	0	250 251 350 356	HS711, CV296
TOMATO Slicing, Cherry, Plum	6.5	200	120	100	0	125	100	0	250 251 350 351 352 353 354 356	HS858, HS711, CV296
WATERMELON	6.0	150	120	100	0	120	100	0	250 251 350 351 352 353 354 356	HS711, CV296

Producer Soil Test Report

To:

Water pH
Buffer pH

For more information contact:
Halbritter, Alicia
Baker County Coop Extn Service
1025 W. Macclenny Ave
Macclenny FL, 32063-4433
Tel: 904-259-3520

Client Identification: J3

Crop: Corn, sweet

Set Number: E76937 Lab Number: E197295

Report Date: 22-Nov-23

Soil Test Results and Their Interpretations

Target pH: 6.0 This is the pH at which the above crop will grow at its optimum
pH (1:2 Sample:Water): 5.6 This is the pH of your sample in water medium
A-E Buffer Value:7.64 Buffer pH is the pH of your soil in Adams-Evans Buffer(A-E Buffer). This is done to determine the lime requirement, which will help increase the soil pH to the target pH level desired by the crop. If the pH is higher than Target pH, Buffer pH will not be determined

Soil Nutrients Mehlich-3 Extractable

Nutrients	Level mg/kg or ppm	Interpretation	Nutrients	Level mg/kg or ppm	
Phosphorus (P)	110	HIGH	Sulfur (S)	8.8	} *For these nutrients see directions on the following pages
Potassium (K)	32	LOW	Copper (Cu)	0.4	
Magnesium (Mg)	25	MEDIUM	Manganese (Mn)	18.1	
			Zinc (Zn)	1.6	
Calcium (Ca)	143	Ca is typically adequate in Florida soils			

Mehlich 3 soil test results

Fertilizer and lime rates

Lime and Fertilizer Recommendations


Crop: Corn, sweet

Lime: **665 lbs per acre**
Use Dolomitic lime
Nitrogen(N): **200 lbs per acre**
Phosphorus(P₂O₅): **0.00 lbs per acre**
Potassium(K₂O): **120 lbs per acre**
Magnesium(Mg): **20 lbs per acre**

We do not test soil for N as there is no meaningful soil test for predicting N availability. Thus, the N recommendation was developed from research that measured response of the indicated crop to applied N fertilizer. If you expect significant nutrient release from organic sources such as crop residues or organic amendments, estimate the amount mineralized and subtract that amount from the fertilizer recommendations given below to arrive at crop needs.
IMPORTANT: Please read the directions on the following page(s) carefully, if any nutrient applications are made. If you have any questions, please call the county extension agent listed above.

These interpretations and recommendations are based upon soil test results and scientific research/experience with the specified crop under Florida's growing conditions.
UF/IFAS fertilizer and lime recommendations are advisory in nature, emphasize efficient fertilizer use, and environmentally sound nutrient management without losses of yield or crop quality. It is generally assumed that the nutrients will be supplied from purchased, commercial fertilizer and that expected crop yields and quality will be typical of economically viable production. Growers should consider UF/IFAS recommendations in the context of their entire management strategy, such as return on investment in fertilizer and the benefits of applying manure or biosolids (sewage sludge) to their land.

Fertilizer sources,
timing, placement...
plus water



Directions

Sample Number: 197295

Crop: Corn, sweet

General

- Indicated fertilizer amounts, and the nutrients already in the soil, will satisfy the crop nutrient requirement for this cropping season. Fertilizer and water management are linked. Maximum fertilizer efficiency is achieved only with close attention to water management. Supply only enough irrigation water to satisfy crop requirements. Excess irrigation may result in leaching of N and K creating possible plant deficiencies. Overfertilization has been shown to reduce vegetable quality.

For subsurface irrigation, maintain a constant water table between 18 (at planting) and 24 inches (near harvest) below the top of the bed. Monitor water table depth and do not fluctuate, else N can be "scrubbed" from the root zone.

On soils that have not been in vegetable production within the past 2 years, or where micronutrients are known to be deficient, apply 5 lb Mn, 3 lb Zn, 4 lb Fe, 3 lb Cu, and 1.5 lb B/A. Use soil testing to monitor micronutrient status every 2 years. When deciding about micronutrient applications, consider micronutrients added to the crop via fungicides. Some micronutrients can build up in the soil -- avoid micronutrient toxicity.

Up to 35 lb/acre Mg might be needed when soil test is medium or lower in Mg. Mg can be supplied in fertilizer or from dolomitic limestone, when liming is recommended.

Calcium concentrations are typically adequate in most soils used continuously for vegetable production. Calcium is added during liming activities and from calcium carbonate present in irrigation water drawn from aquifers in Florida. These sources should be considered in the determination of Ca fertilizer needs.

- Use this rate of fertilizer per 100 linear bed feet even if you are using different bed spacing. For more information on fertilizer management and the use of Linear Bed Feet, see the following UF/IFAS publications SSP177 and HS743. These publications are available on the web at <http://edis.ifas.ufl.edu/CV001> and <http://edis.ifas.ufl.edu/WQ112>, or from county Extension offices.

Lime

- It is generally not practical to apply less than 2000 lbs per acre (or 1 ton per acre) of agricultural lime per acre. Since the lime need is small, you may elect to either apply no lime or to apply 2000 lbs per acre (or 1 ton per acre) this year. A soil test taken in alternate years will help monitor soil pH and insure proper lime management.

Lime Requirement

- Recommendations are based on the Adams-Evans lime requirement test which is run on all mineral soils. When the recommended amount of lime is incorporated in the surface 6 inches of soil, soil pH should adjust to a level above which additional liming benefit is not expected. Excessive applications of lime can result in nutritional disorders.

Management for crops grown on bare ground

- For unmulched crops, fertilizer should be applied in split applications to reduce leaching losses and lessen danger of fertilizer burn. Broadcast all P2O5 and micronutrients, if any, and 25 to 30% of the N and K2O in the bed at planting. Apply remaining N and K2O in sidedress bands during the early part of the growing season. Additional, supplemental sidedress applications of 30 lb Nitrogen per Acre and 20 lb K2O/A should be applied only if rainfall/irrigation amounts exceed 3 inches within a 3-day period or exceeds 4 inches within a 7-day period. Avoid mechanical damage to plants when applying fertilizers.
- Supply 25 to 50% of the N in the nitrate form if soils were treated with multi-purpose fumigants or if the soil temperature will stay below 60F for up to one week following transplanting or germination.

Sulfur

- Application of sulfur is not required if test value is greater than 6.0 mg/kg or ppm. If the soil test value is less than 6.0 mg/kg or ppm apply sulfur as shown below:

Fertilizer should contain 15 to 20 lb sulfur/A. Apply as a sulfate (eg. gypsum, ammonium sulfate, magnesium sulfate,

Nutrient management renaissance

Why now?

1. Producer concerns to IFAS.
2. Update the research base:
 - Commercial production practices.
 - Modern crop varieties.
 - Site-specific recommendations.
3. Recommendations becoming regulations???
(SB 712)
4. Common support from producers, legislators, and IFAS leadership.

Nutrient management resources!

- Legislative allocations to IFAS:
 - 2021: \$1.6 million
 - 2022: \$8.76 million
 - 2023: \$6.2 million
 - 2024: ???
- Goal: Update IFAS recommendations!

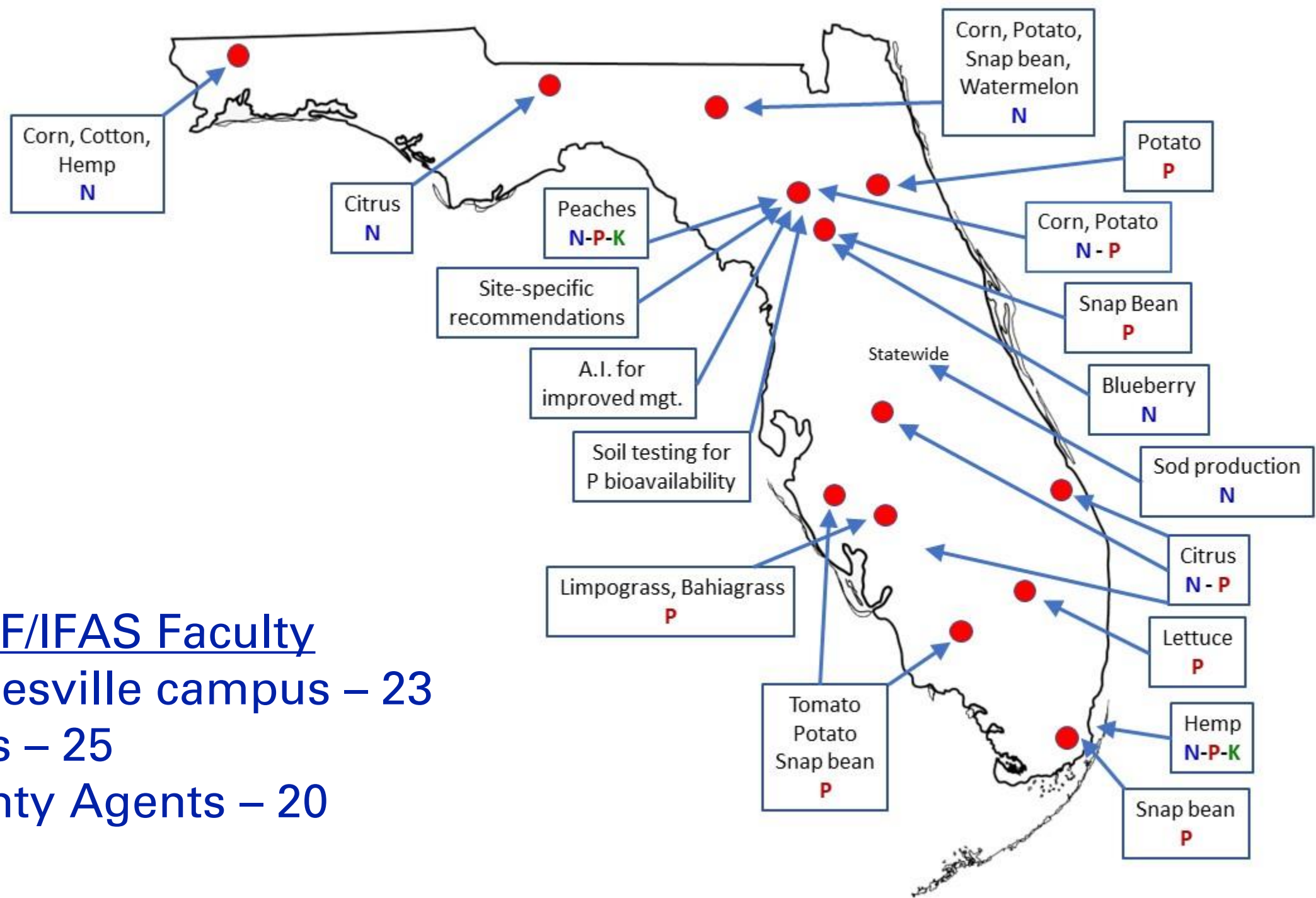
Legislative intent

- **HB 5001**
 - Fertilizer rates: tomato, potato, citrus, corn, snap beans... plus “any other crop.”
 - Normal and economical crop production.
 - Maximize crop yield and quality.
 - Minimize nutrient inefficiencies.
- **SB 1000**
 - Develop recommendations for site-specific nutrient management.

What crops to work on?

2021 FL crop acreage (not including muck sugarcane)

Crop	Planted acres	
Forages	Very high	✓
Citrus (harvested acres)	369,500	✓
Peanuts	165,000	
Sugarcane on sand	100,000	
Grain/silage corn	95,000	✓
Cotton	92,000	✓
Cucurbits	58,700	✓
Sweet corn	34,400	
Snap bean	27,000	✓
Tomato	23,000	✓
Potato	21,000	✓
Pepper	11,200	
Strawberry	10,400	
Cabbage	8,900	
Blueberry	5,700	✓



68 UF/IFAS Faculty
Gainesville campus – 23
RECs – 25
County Agents – 20

Plans of work

- Focus on N, P, and “4Rs plus 1.” **Right Water** is the 5th R.
- Rates: Testing the current IFAS recommendation.
- Sources: Water soluble, solution, CRF, EEF.
- Timing: Preplant, split applications, fertigation.
- Placement: Broadcast, sidedress, banding

Crop	Nutrients	Rate	Source	Timing	Placement	Environ fate
Horticulture						
Tomato	P	✓	✓			✓
Potato	P	✓	✓	✓	✓	✓
Snap Bean	P	✓	✓	✓		
Citrus	N, P	✓	✓	✓		✓
Watermelon	N		✓	✓		✓
Peach	N, P, K	✓				
Blueberry	N	✓				✓
Lettuce	P	✓				✓
Sod	N, P	✓				✓
Agronomy						
Corn	N	✓	✓		✓	✓
Cotton	N	✓	✓		✓	✓
Limpograss	N, P	✓				✓
Bahiagrass	P	✓	✓			✓
Hemp	N, P, K	✓	✓	✓		✓

Advanced concepts

- Soil test methods and calibration.
- What is a site-specific recommendation?
- Artificial intelligence: Modeling crops and soils.



Observations: Corn (N)

- Dry soluble, CRF, EEF – mixed results.
- Banding = better fertilizer efficiency.
- Testing non-irrigated (180) and irrigated (240) IFAS rates.
- Law of diminishing returns.
- Site-specific response.
- Yield-based recommendation?

Observations: Tomato/Potato/Snapbean (P)

- P fertilizer response at “High” soil test P.
 - Calibration, methods, labs.
- Row position affected fertilizer response.
 - “Ditch effect.”
- Dry vs. liquid P fertilizer source effect (bean).

November 1, 2022 (70 days after planting – first harvest)

P_2O_5 application rate

0 lb/acre

50 lb/acre

100 lb/acre

150 lb/acre

200 lb/acre



November 22, 2022 (34 days after planting)

P_2O_5 application rate

0 lb/acre

40 lb/acre

80 lb/acre

120 lb/acre



Observations: Watermelon (N)

- Dry soluble, fertigation, CRF.
- Sensor-based drip irrigation management is critical.
- “Correct” CRF + proper irrigation = greater yield, less N/K leaching, lower N rates.
- Cost offsets needed when choosing CRF.

150 lbs N/acre



All CRF
683 cwt/acre

Soluble dry + liquid
724 cwt/acre



All liquid
739 cwt/acre

CRF + liquid
725 cwt/acre

Road to a clear, holistic, adaptable IFAS recommendation

1. Soil test info.
2. Soil pH/lime.
3. Fertilizer 4Rs.
4. The fifth R: Water management.
5. Site-specific recommendations.

UF/IFAS Nutrient Management Recommendation Series: Hemp

Zachary Brym, Lakesh Sharma, Thomas Obreza, Rao Mylavarapu

This publication presents the official UF/IFAS nutrient management recommendations for hemp based on crop nutrient requirements determined by the UF/IFAS hemp program and soil tests performed by the UF/IFAS Extension Soil Testing Laboratory.

General Information

- UF/IFAS fertilization and liming recommendations are advisory in nature and emphasize efficient fertilizer use and environmentally sound nutrient management without losses of yield or crop quality.
- Recommendations assume that nutrients will be supplied from commercial fertilizer and expected crop yields and quality will be typical of economically viable production.
- Recommendations assume straight fertilizers (single nutrient sources) will be used to apply nutrients. If multi-nutrient fertilizers will be used, the fertilizer analysis should align with recommended nutrient rate ratios.

- Consider UF/IFAS recommendations in the context of the overall nutrient management strategy. Evaluate fertilizer rates, timing, placement, and source for efficiency and consider return on fertilizer investment.
- If organic soil amendments are applied, understand and account for nutrient contributions and other benefits of adding organic matter.
- For best results, follow these recommendations in their entirety. The UF/IFAS recommendation is a holistic combination of fertilizer rates plus nutrient management aspects including irrigation.

Soil Test Interpretations for Hemp

Table 1. For crop production on acidic, mineral soils. Extractant: Mehlich 3.

Nutrient	Interpretation (mg/kg)		
	Low	Medium	High
P	≤25	26 – 45	>45
K	≤35	36 – 60	>60
Mg	≤20	21 – 40	>40

- Anderson, S.L. II, B. Pearson, R. Kjellgren, and Z. Brym. 2021. Response of essential oil hemp (*Cannabis sativa* L.) growth, biomass, and cannabinoid profiles to varying fertigation rates. *PLoS ONE* 16(7): e0252985. <https://doi.org/10.1371/journal.pone.0252985>
- Kaur, N., Z. Brym, L. A. M. Oyola, and L. K. Sharma. 2023. Nitrogen fertilization impact on hemp (*Cannabis sativa* L.) crop production: A review. *Agronomy Journal*, 00, 1–14. <https://doi.org/10.1002/agj2.21345> 5L476 "Hemp Fertilization: Current knowledge, gaps and efforts in Florida: A 2020 Report." (<https://edis.ifas.ufl.edu/publication/S5689>)

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Table 2. For crop production on calcareous soils of Miami-Dade County. Extractant: Mehlich 3.

Nutrient	Interpretation (mg/kg)		
	Low	Medium	High
P	≤76	77 – 104	>104
K	≤85	86 – 150	>150

Fertilizer Rates

Table 3. Target pH range and recommended annual N, P₂O₅, and K₂O fertilizer rates for hemp. Phosphorus and potassium rates are based on interpretation of a Mehlich-3 soil test.

Crop	Plants/acre	Target pH	lbs/acre/cropping season						
			N	P ₂ O ₅			K ₂ O		
				Low	Med	High	Low	Med	High
Hemp for fiber	300,000 plants/acre	6.25 – 7.5	50	30	15	0	50	50	50
	750,000 plants/acre	6.25 – 7.5	150	30	15	0	100	100	100
Hemp for seed	100,000 plants/acre	6.25 – 7.5	50	30	15	0	50	50	50
	300,000 plants/acre	6.25 – 7.5	150	30	15	0	100	100	100
Hemp for flower	3,000 plants/acre	6.25 – 7.5	150	30	15	0	50	50	50
	15,000 plants/acre	6.25 – 7.5	150	30	15	0	100	100	100

- Maximum uptake of vigorous hemp crops has been demonstrated in trials outside of Florida to be 225 lbs N, 50 lbs P₂O₅, and 300 lbs K₂O per acre (Kaur et al., 2023). Uptake of N at rates above those listed in the table have been demonstrated to be excessive under Florida conditions and result in a plateau or decline in plant production and crop quality.
- Fertilizer applications of sulfur, calcium, magnesium, and other micronutrients may be identified through soil or leaf tissue tests. If sulfur is required, apply 15–20 lbs S/acre.

Fertilizer Timing

- Apply all the P₂O₅, 30% of the K₂O, and 30% N in a preplant or at-planting application.
- Apply the remaining K₂O and N in one or two more side-dressings, spaced approximately 4 weeks apart.
- Liquid fertigation can also be applied in weekly dosing for flower production under plasticulture up to 150 lbs N/acre equivalent.

Fertilizer Placement

- Consider banding the P₂O₅ next to the plant row.

Fertilizer Sources

- N applications have been studied as granular fertilizer, though operation efforts have been deployed in other trials involving enhanced efficiency (controlled release) fertilizer. Use of liquid fertilizer has also been effective (Anderson et al., 2021).
- Apply S as sulfate (e.g., gypsum, ammonium sulfate, magnesium sulfate, potassium sulfate, potassium magnesium sulfate) because elemental S will convert to sulfate too slowly to supply the sulfur needs of the current crop.
- Apply Mg using potassium magnesium sulfate or magnesium sulfate.

Water Management

- Seeds and transplants require adequate moisture at planting for optimum establishment.
- Well-drained soils are preferred for hemp cultivation. Flooding exceeding 12–18 hours may substantially damage the crop and further expose it to disease.
- Based on operational experience, ½- to 1-inch irrigation per week is appropriate for fiber and seed crops by overhead and flower crop through drip. Consider using a soil moisture meter and increasing irrigation as needed per plant growth and soil moisture.

IFAS Recommendations and BMPs

- Producers tend to connect IFAS recs and FDACS BMPs.
- IFAS holds the IFAS recommendations.
- FDACS develops and adopts BMPs by rule.
- Is the IFAS recommendation the BMP?

PLANT NUTRIENT RESEARCH AND EDUCATION



UF/IFAS NUTRIENT MANAGEMENT

bmp.ifas.ufl.edu

Crop recommendations

Research info

PNOC info

UF/IFAS PLANT NUTRIENT RESEARCH & EDUCATION PROGRAM

Florida's growers need fertilizer recommendations that are up-to-date and specific to sites where they grow their crops. UF/IFAS is conducting state-funded research into the application of nutrients (fertilizers) to agronomic, vegetable, and fruit crops in order to update IFAS nutrient management recommendations using a '5Rs' concept: Right rate, Right source, Right timing, Right placement, and Right water management. IFAS recommendations are tied to Best Management Practices (BMPs) implemented by producers to grow their crops efficiently while minimizing environmental impacts.

The UF/IFAS Plant Nutrient Research and Education Program website is designed to be a one-stop-shop for all information relating to the latest nutrient research and updated IFAS recommendations.

