THE ADOPTION OF PRECISION AGRICULTURE TECHNOLOGIES BY FLORIDA GROWERS

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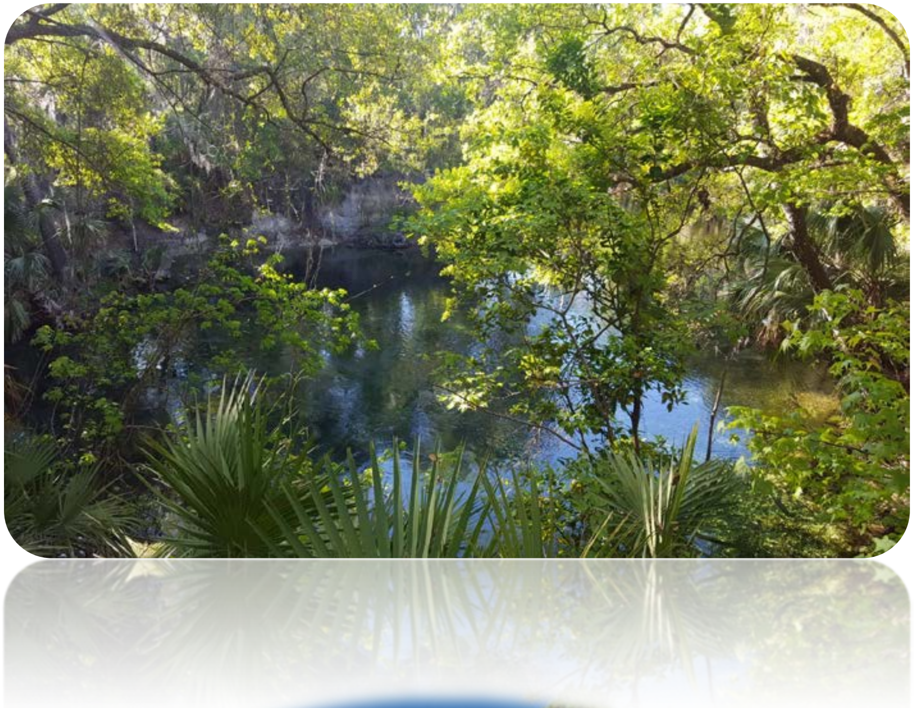
Motivation

- Florida has fragile and diverse ecosystem
- Agriculture can play a larger role in sustaining and improving natural resources
- Technology adoption that is directly tied to positive ecological outcomes can help reduce agriculture's effect on the environment



- ➢ This survey serves as a needs assessment and are the most recent steps to understanding barriers to PA adoption
- ➢ Increasing PA acreage requires an understanding of the socioeconomic factors affecting adoption
- ➢ This can influence:
  - Cost share program design
  - Extension/education programming

Recent Literature

Farm size has a positive effect in PA adoption

- E.g., Kutter et al., 2011; Walton et al., 2010; Isgin et al., 2008

Income or capital expenditure is positively correlated with PA adoption

- Watcharaanantapong et al., 2014; Asare and Segarra, 2018

Education has a positive effect on PA adoption

- E.g., Jenkins et al., 2011; ; Banerjee et al., 2008; Isgin et al., 2008; Alvarez and Nuthall, 2006

Age has a negative effect on PA adoption

- E.g., Castle, Lubben and Luck, 2016; Jenkins et al., 2011; Paxton et al., 2011; Isgin et al., 2008

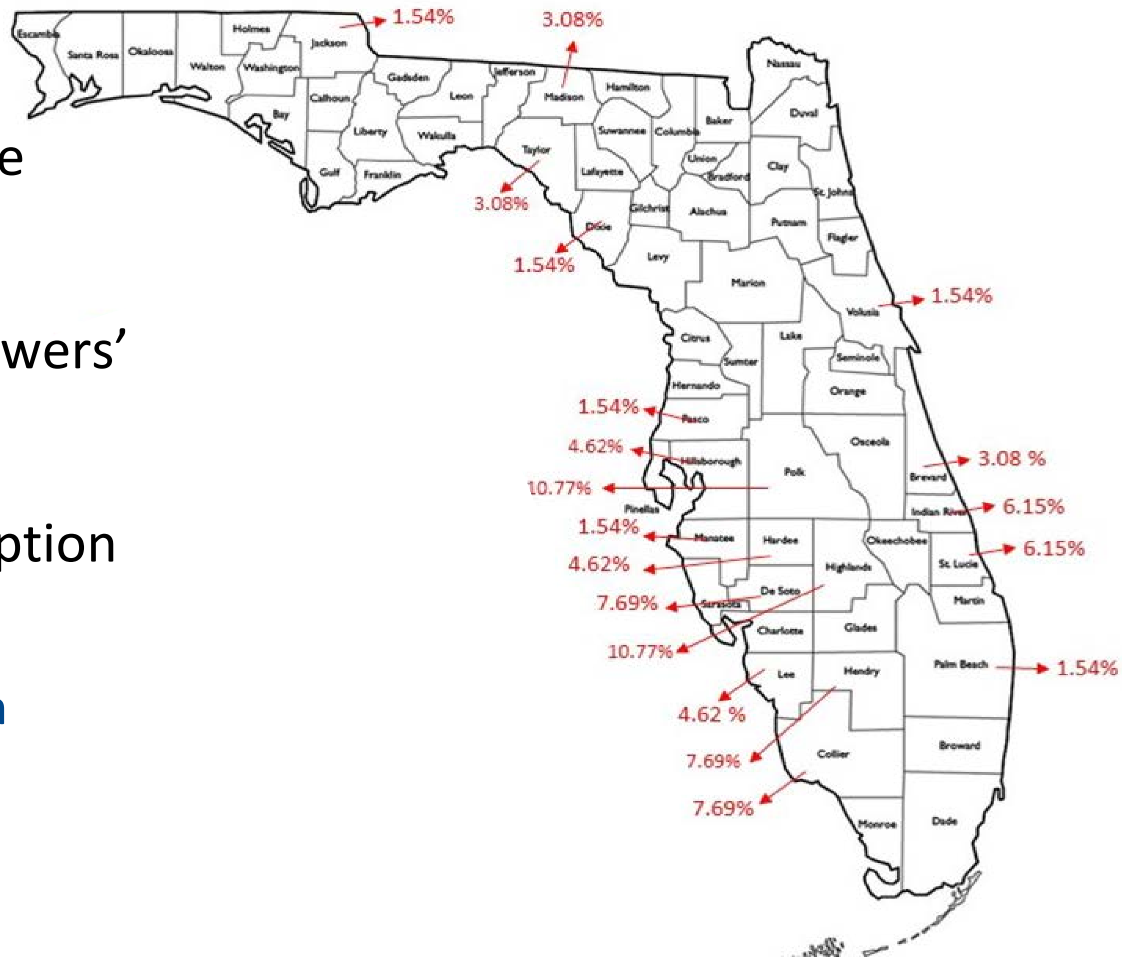
Computer literacy has a positive effect on adoption

- E.g., Castle, Lubben and Luck, 2016; Watcharaanantapong et al., 2014; Paxton et al., 2011; Walton et al., 2010

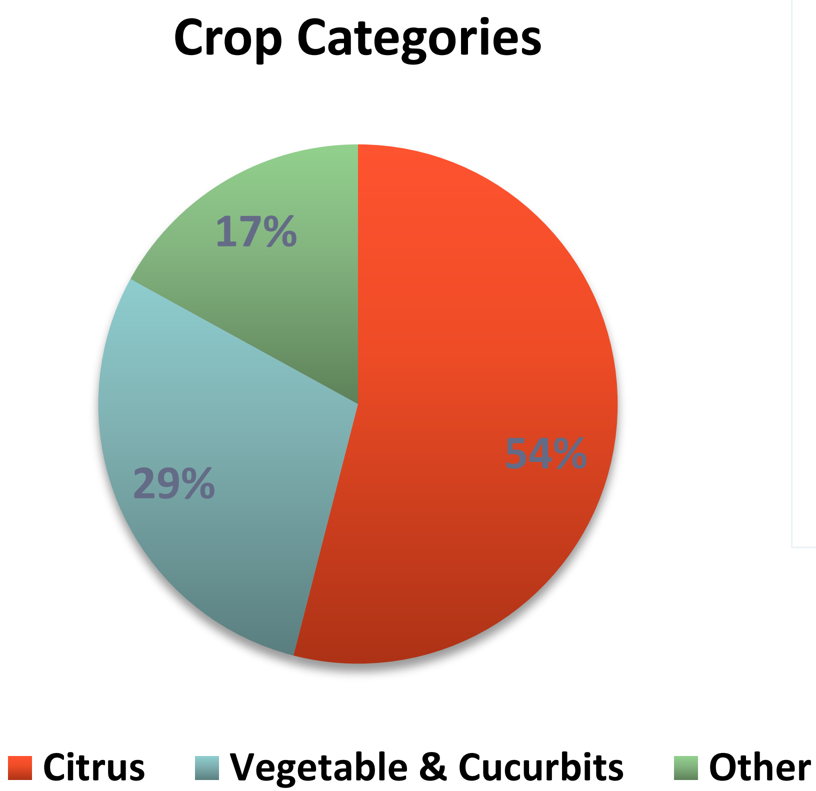
Florida PA Technology Adoption Survey

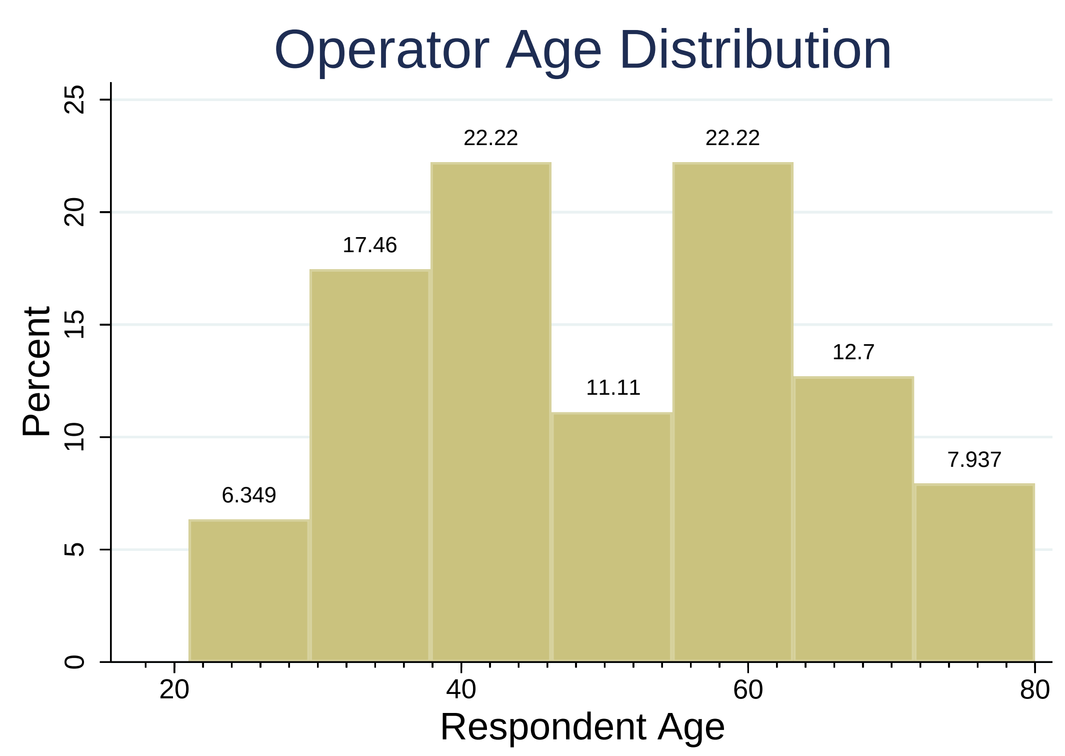
- Statewide electronic and in-person survey
- Provides a comprehensive overview of PA adoption
- Provides insights into growers' attitudes towards PA
- Examines barriers to adoption

- Preliminary results are from
  - ➢ Surveys: 72
  - ➢ Crops: 18
  - ➢ Response rate: 15%



Preliminary Data

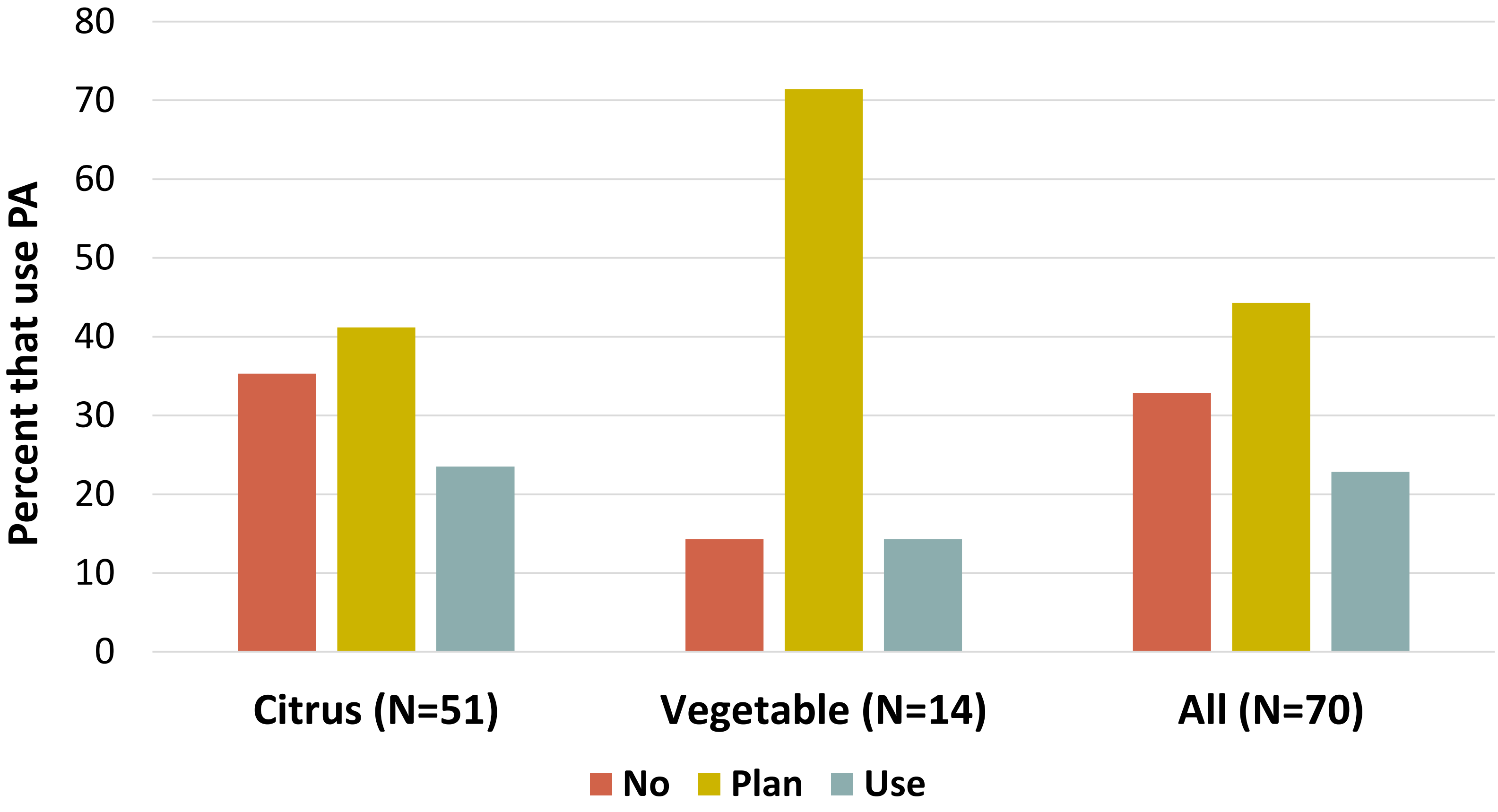




Number of Crops	Number of Growers	Percent of Growers
1	45	63%
2	16	22%
6	6	8%
4	4	6%
8	1	1%

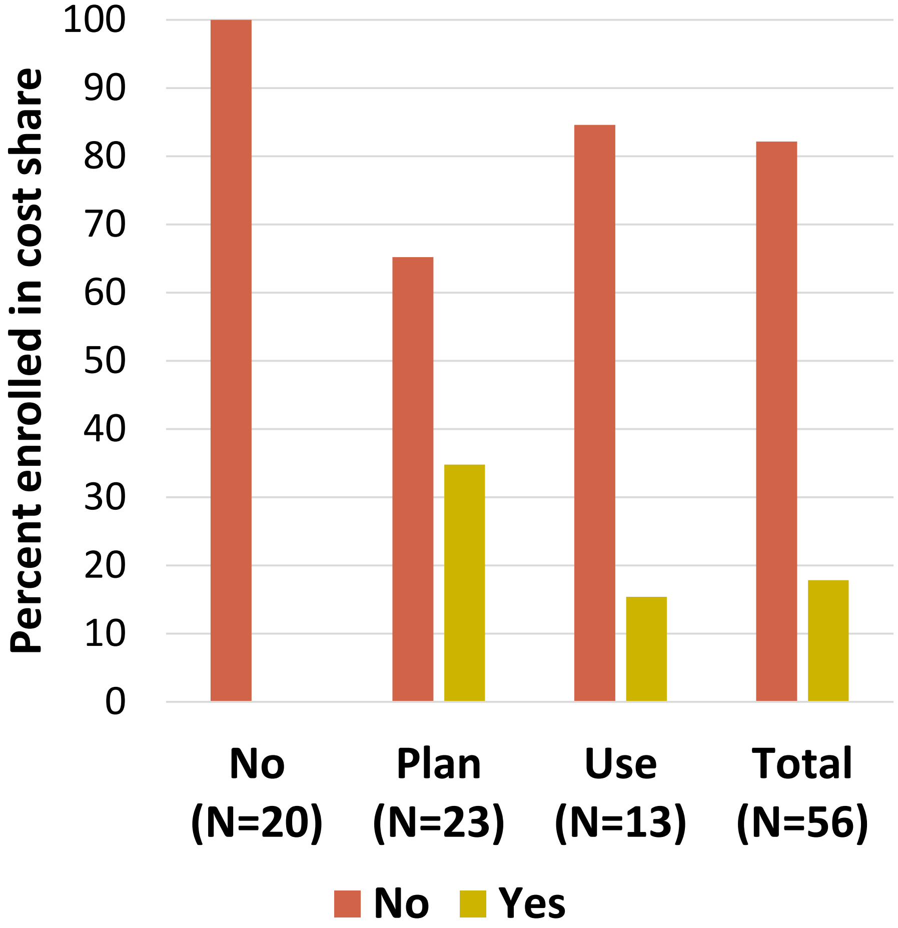
Preliminary Data: PA Adoption

The majority of vegetable and cucurbit growers plan to use PA



Preliminary Data: Cost-Share Programs

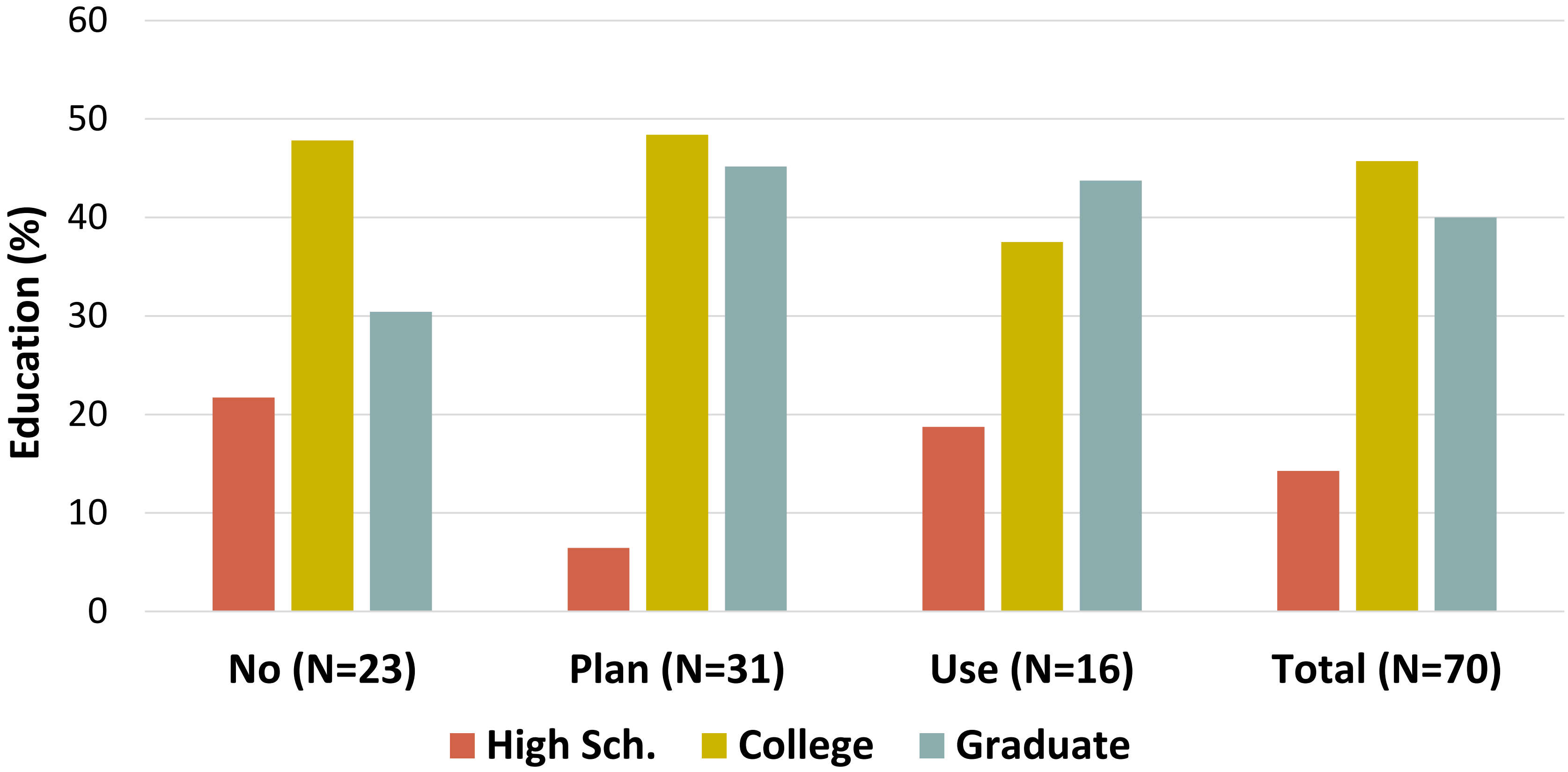
About half of those who plan to use PA are enrolled in cost share programs



Cost Share (ρ = 0.4714)			
Total Acres	**No**	**Yes**	**N**
< 50	100	0	18
50-100	100	0	5
100-200	100	0	1
200-500	100	0	3
500-1000	40	60	5
1000-2000	80	20	5
> 2000	58	58	12
Total	**82**	**18**	**49**

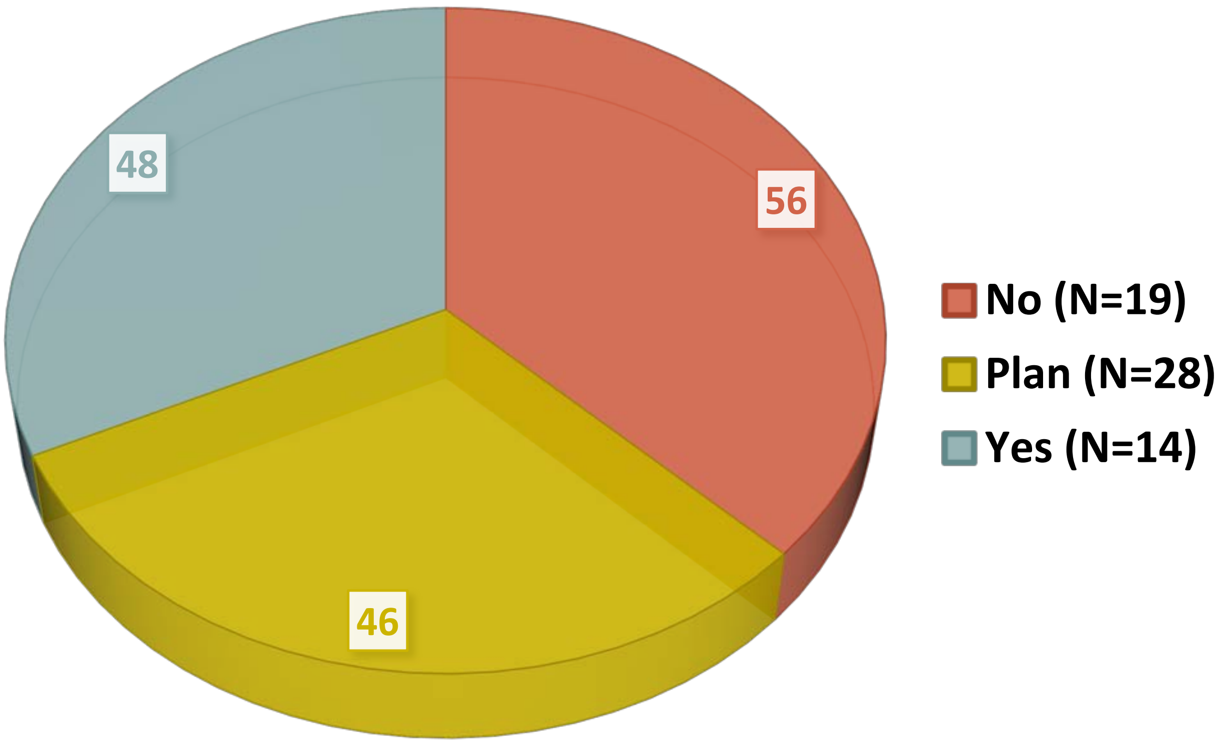
Preliminary Data: Education

The majority of Florida's farm operators are educated



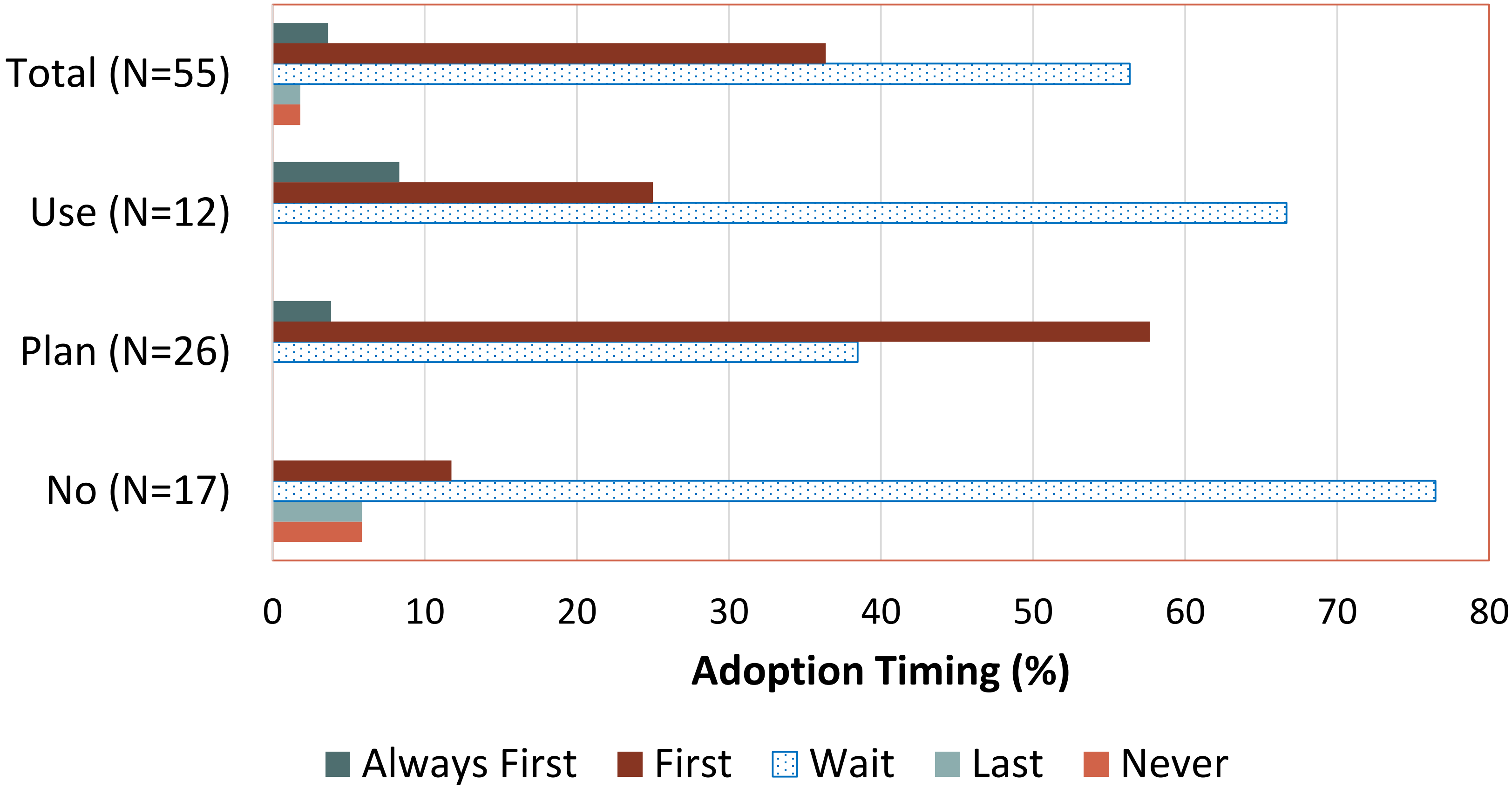
Preliminary Data: Age

Farm operators who use or plan to use PA are on average 9 years younger than operators who do not use PA



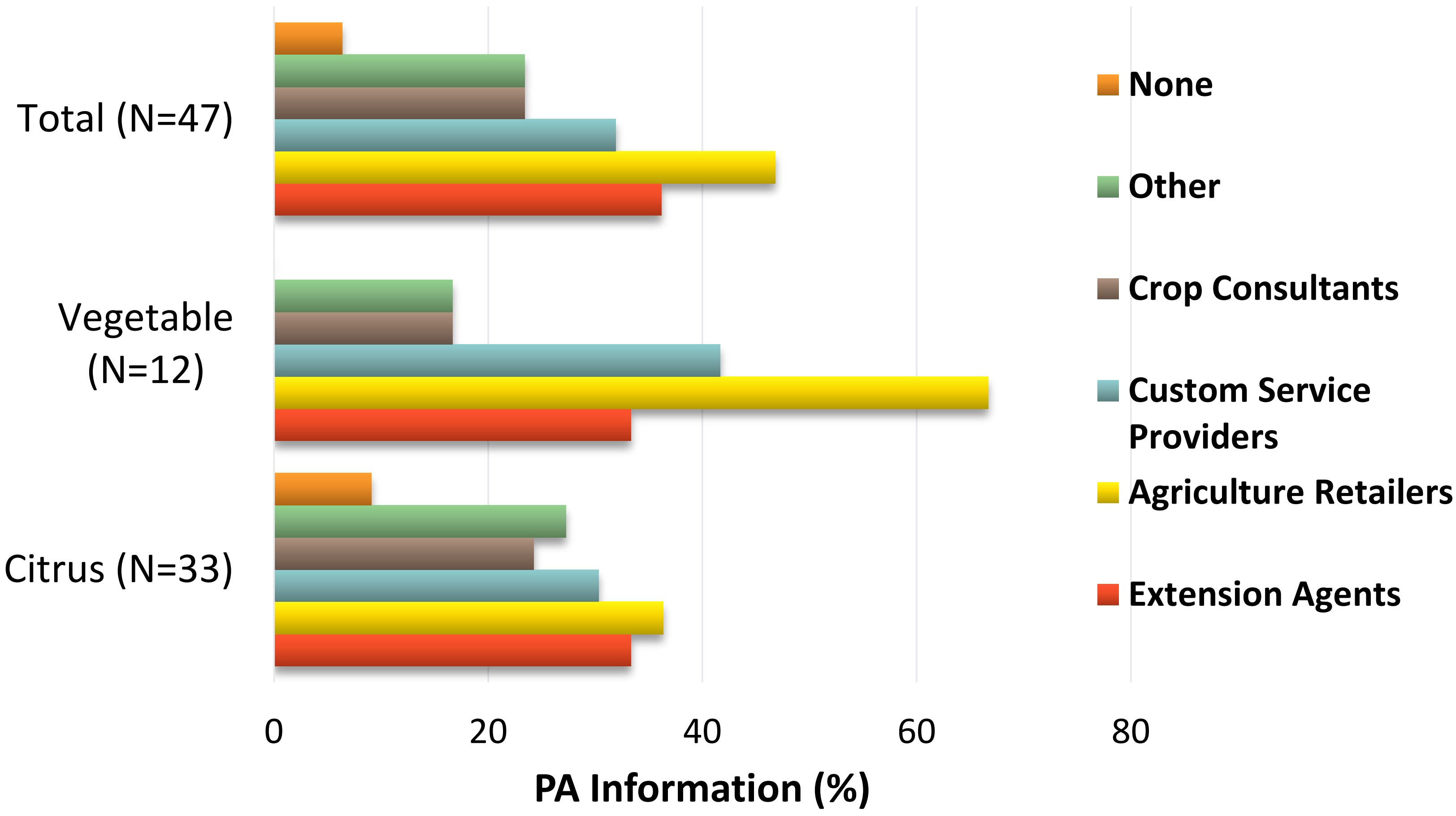
Preliminary Data: Adoption Timing

The majority of PA users wait before adopting



Preliminary Data: Information Sources

Producers who use or plan to use PA primarily get information from agriculture retailers



Economic Model: Random Utility Model

We express utility as the unobserved difference between the utility for PA and other practices, i.e.,

$$y_i^* = U_i^{PA} - U_i^{1-PA}$$

- y_i^* is the unobserved net utility of choosing PA over other practices
- *PA* indicates precision agriculture is in use
- *i* = 1,…, n indexes individual farmers

We write as $y_i^* = \boldsymbol{\beta}'\boldsymbol{X}_i + \varepsilon_i$

- $\boldsymbol{\beta}'\boldsymbol{X}_i$, represents the portion of net utility observed by researchers
- ε_i is the random variable representing the producers' unobserved preference for PA.

However, we observe only the PA decision:

$y_i = 1$ when $y_i^* > 0$; $y_i = 0$ otherwise.

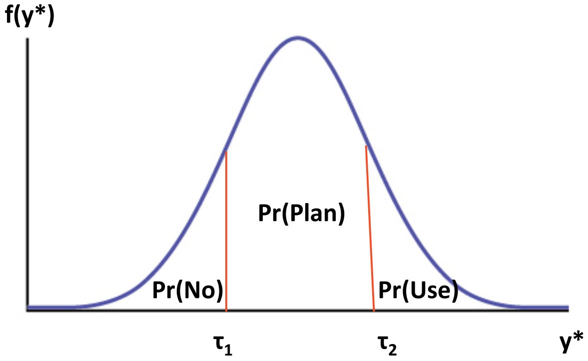
Econometric Model: Ordered Logit Model

Respondent's probability of not using PA(No), planning to use PA(Plan), or using PA(Use) will be estimated using the ordered logit regression.

- Latent variable regression: $y^* = \beta' X + \varepsilon$

NOTE:
NO = 1
PLAN = 2
USE = 3

$y = 1$ if $y^* < \tau_1$
$y = 2$ if $\tau_1 \leq y^* < \tau_2$
$y = 3$ if $y^* \geq \tau_2$



Where β is a vector of parameters, ε is a random error term, and τ_1 and τ_2 are cut-points.

The ordered logit model estimates the probability of choosing each stage of adoption.

Potential Model Specification

Variable	Variable Type	Expected effect on Pr (PA)
Age	Continuous	-
Education	Discrete	+
Farm Size	Discrete	+
Cost-Share Program	Binary	+
Location-WMD	Binary	+
Computer literacy	Binary	+
Perceived yield benefit	Binary	+

Factors that distinguish those who use, plan to use, and do not use PA can be incorporated into adoption program design and educational programs.

Discussion

- Increasing PA use requires a better understanding of the economic drivers of adoption.
- We are missing a clear connection between PA adoption and environmental (or public) benefits.
- Policy questions to consider:
  - *Are current state programs encouraging the use of environmentally benign technologies?*
  - *What level of payments are needed to increase PA use?*
  - *Is the public willing to pay for agriculture incentive programs for technology adoption?*
  - *Could incentive programs have small farms, beginning farmers, and socially disadvantage farmers welfare effects?*

Conclusion

- There is interest in precision agriculture (PA) among FL producers: more than 50% use or plan to use PA.
  - With more data we can report specific technologies producers are interested in.
- Social factors, such as education and age, are important determinants in the decision to adopt PA.
- It is unclear if cost-share is an important driver for PA adoption.
- Cost-share program design may lend itself nicely to larger growers.
- Extension information plays an important role in delivering PA information to growers.

Questions

Feel free to contact us.

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Source: www4.swfwmd.state.fl.us/alafia/birds.php

Citrus	Vegetable and Cucurbits	Other
N = 54	N = 29	N = 17
Oranges	Beans	Blueberries
Grapefruit	Cucumber	Chestnuts
Satsuma	Green beans	Lychee Fruit
	Onions	Macadamia nuts
	Pepper	Mics
	Sweet corn	Olives
	Tomato	Pecans
	Vegetable	Pomegranate
	Watermelon	Sod
		Stone Fruit
		Timber
		Tropical Fruit
		Turf

PA Survey Technology List
Yield Mapping (e.g., GOAT yield monitoring system)
GPS Receiver (e.g., boundary mapping)
Pest Scouting and Mapping (e.g., “EntoNet”)
Weed Scouting and Mapping
Soil Variability Mapping (e.g., Veris mapping)
Soil properties mapping (for N, P, K or soil organic matter, using e.g., precision soil sampling)
Sensor based variable applicator (e.g., “Tree-See”)
Prescription Map based variable applicator (e.g., variable rate fertilization)
Remote Sensing (e.g., UAV-drones, aerial of satellite imagery)
Machinery Auto-Guidance Self-Steering
Water Table Monitoring (e.g., moisture sensor used to automate irrigation scheduling)
Harvesting Logistic (e.g., mapping brix, acid and sugar levels to determine peak harvest time)
Plant tissue sampling
Equipment for side dressing input applications
Equipment for variable rate irrigation