Citrus Growers' Willingness to Pay and Perceptions of Cover Crops

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Introduction

Cover crops have been widely adopted in row crop agriculture. Using cover crops would be particularly beneficial for citrus production, especially in Florida, since they boost soil organic matter, nitrogen, and water holding capacity. In this study, we develop a survey of citrus growers to understand their perceptions on cover crops, and to estimate their willingness to pay (WTP) for cover crops in citrus production. Our study will provide insights which could be used by policy makers to incentivize adoption of conservation practices.

Survey

Adoption of cover crops in citrus production has been low due to two factors – growers' uncertainty in the costs and benefits associated with the practice, and the lack of information available to growers on adopting cover crops in citrus production.

Demographics & Citrus Crops
- Grower demographics.
- Types of citrus fruits grown.

Cover Crops
- Cover crop awareness and use.
- Types used; management practices.
- Levels of (dis)agreement on benefits and drawbacks.
- Ranking attributes of cover crop in citrus production.

WTP questions
- Minimize effect of information bias – 50% respondents asked to read about benefits of using cover crops.
- Whether willing to pay $0 for cover crops
- If yes, whether willing to pay middle price.
- If yes, whether willing to pay higher price.
- If no, whether willing to pay lower price.

Additional questions
- Questions on program participation, availability of credit.
- Questions on farm size and diversity, experience in citrus growing.
- Contact information.

Survey administered through Qualtrics.

Distributed through:
- University of Florida Extension Agents
- Indian River Citrus League
- 2021 Citrus Show at Ft. Pierce, FL
- CA Citrus Research Board newsletter in October 2021
- Florida Grower magazine

Estimation Strategy

- Contingent Valuation (CV) method for estimating WTP (Carson and Hanemann, 2005; Hanemann and Kanninen, 1996). For eliciting respondents' WTP, we use the double bounded dichotomous choice approach:
  - Part 1: A simple dichotomous choice question
  - Part 2: Set of questions contingent upon responses to earlier question.

$$WTP_i = z_i\beta + u_i \quad (1)$$

- A respondent's WTP for cover crops is related to their demographic and farm level factors through equation 1. z_i - vector of explanatory variables & u_i - errors assumed to be Normally distributed.
- 3 step questions – 5 possible outcomes based on the first (middle) price and the second (low or high) price that are offered.
- Interval regression to estimate the probability of a latent variable, WTP_i in equation 1, belonging to specific intervals (StataCorp., 2021).

Data

Table 1. Summary statistics of key variables.

State	Statistic	Own no-till drill (%)	Citrus acres	Cover crop awareness	Citrus experience years	Crop types	Rented land (%)	NCCPI	Market access index
California	Average	0.43	50.75	0.79	16.57	5.00	39.29	0.002	0.91
	Maximum	1	1000	1	50	20	100	0.03	1.00
	Minimum	0	0.5	0	4	1	0	0	0.49
	N	28	28	28	28	28	28	22	22
Florida	Average	0.36	3034.21	0.80	22.71	5.66	15.81	0.02	0.65
	Maximum	1	33000	1	50	18	100	0.07	0.99
	Minimum	0	1	0	1	1	0	0.00	0.18
	N	59	59	59	59	59	59	45	45
Texas	Average	0.6	155.1	0.8	23.0	4.1	34.2	0.1	0.58
	Maximum	1	1000	1	50	12	100	0.33	0.99
	Minimum	0	1	0	2	1	0	0	0.09
	N	20	20	20	20	20	20	20	20
Total	Average	0.42	1715.34	0.79	21.16	5.19	25.39	0.03	0.70
	Maximum	1	33000	1	50	20	100	0.33	1.00
	Minimum	0	0.5	0	1	1	0	0	0.09
	n	107	107	107	107	107	107	87	87

Table 2. State-wise distribution of benefits that were ranked 1 by growers. Percentages given in brackets.

Cover crop benefits	California	Florida	Texas	Total responses
Nutrient retention in soil	12 (43%)	21 (36%)	6 (30%)	39 (36%)
Soil Erosion - prevention	3 (11%)	8 (14%)	1 (5%)	12 (11%)
Maintain Moisture	5 (18%)	5 (8%)	5 (25%)	15 (14%)
Pest control	3 (11%)	12 (20%)	0	15 (14%)
Weed Management	1 (4%)	7 (12%)	4 (20%)	12 (11%)
Increase SOM	4 (14%)	6 (10%)	4 (20%)	14 (13%)
Total	28	59	20	107

Results

- Using the regression coefficients, we predict both the mean and median WTPs (Yu et al., 2014).
- Owning a no-till planter has the highest marginal effect on WTP for growers in CA and FL.
- Mean WTP for Florida growers: $400.6 per acre, median WTP: $509.5 per acre.
- Accounting for market accessibility and NCCPI, mean WTP for FL growers: $449.5 per acre, and median WTP: $476.3 per acre.
- Including geo-spatial variables, however, reduces the sample size and we do not present the results here.

Table 3: Regression results from interval regression for WTP using survey only covariates

	California	Florida	Texas
Constant	422.18*** [163.24]	284.67* [137.21]	1606.90*** [520.64]
Own no till drill %age	530.14*** [165.16]	422.53*** [106.9]	-518.95 [542.07]
Citrus acres	5.34* [2.85]	-0.0009 [0.01]	-1.17* [0.66]
Cover crop awareness	-98.16 [160.77]	-125.09 [142.79]	-279.35 [339.81]
Citrus experience years	-3.15 [4.92]	0.83 [4.29]	-23.87 [14.99]
Crop types	56.8** [24.43]	24.36* [14.7]	24.35 [51.16]
Rented land %age	0.90 [2.25]	1.28 [2.16]	19.93* [9.51]
N	28	59	20

Table 4. Median and mean WTP's with bootstrapped Normal distribution based 95% CI

	Median WTP	95% CI	Mean WTP	95% CI
Callifornia	897.43*** [133.88]	[635.04 1159.82]	1110.58*** [207.82]	[703.25 1517.9]
Florida	400.57*** [48.68]	[305.16 495.98]	509.51*** [27.89]	[454.82 564.19]
Texas	1241.76*** [216.2]	[818.02 7665.5]	1122.48*** [102.76]	[921.08 1323.88]

- The WTPs for California and Texas growers are very high compared to those from Florida, and for a conservation practice such as cover crops.
- The results for Florida are more credible, since the sample acreage is >50% total citrus acreage in the state. For Texas it is 13% and for California it is 0.5%. Moreover, the small sample sizes for the two states reduces statistical power.

Conclusion

- Our study first of its kind to estimate WTP for cover crops in fruit production, specifically for citrus.
- Citrus production in Florida has been devastated by the *Huanglongbing* (HLB) or the Citrus Greening disease. HLB results in decreased and inefficient nutrient absorption and use, and consequently decreased productivity and low-quality fruits (Brodersen et al., 2014).
- Cover crops improve beneficial soil microbial activity and diversity, which positively affect soil organic carbon (SOC) and total nitrogen (Castellano-Hinojosa and Strauss, 2020).
- Availability of technology (no-till drill) is the biggest determinant of the WTP for cover crops.
- Concurrent cost-benefit analysis work shows that costs of cover crops are lower than WTP in Florida.
- Cover crops induce short and long-term savings – no mowing (SR); decreased herbicide use (LR).
- Growers are motivated by several factors for cover crop adoption as seen in table 2.
- Exact practice will be determined by the grower's objectives, soil type, weather, etc. For example, in Florida, cover crop more beneficial than California, since in the latter not mowing CC could contribute to frost, and soil is not sandy type.

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