Estimated
AGRICULTURAL LOSSES
Resulting from
HURRICANE IDALIA

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INTRODUCTION

The tropical system that would eventually become Hurricane Idalia became a tropical depression on August 26, 2023 as it moved across the western Caribbean Sea. Later, it rapidly intensified, strengthening into a hurricane on August 29, briefly attaining Category 4 (Cat. 4) strength prior to making landfall at Keaton Beach, FL (Taylor County) as a Cat. 3 hurricane. Hurricane Idalia then moved northeast, impacting a broad swath of northern Florida and crossing into southeast Georgia as a Cat. 2 hurricane. Afterwards, it continued to travel northeast through the state, subsequently impacting South Carolina and North Carolina as a tropical storm (TS) before re-entering the Atlantic Ocean.

Tropical cyclones, such as Hurricane Idalia, can significantly impact production agriculture. Producers can experience both losses (changes in economic flows) resulting from a change in the level or value of sales or a change in input costs and they can also experience damages (changes in economic stocks) that require repair or replacement. Agricultural losses might result from situations such as wind-damaged field and row crops, crop losses due to high winds in a pecan grove, water quality or mortality issues for shellfish aquaculture operations, lower milk production at a dairy farm due to stressed dairy cattle or the need to dump milk due to issues with cold storage during a power outage, or even a lower sales price for a beef cattle rancher that had cattle that were not able to get the appropriate nutrition due to stress or damaged grazing lands. Agricultural assets at risk for damages include fencing, irrigation systems, farm homes, farm buildings, greenhouse and nursery structures, machinery/equipment, other infrastructure, livestock animals, and perennial plantings such as pecan or citrus trees and vineyards.

The University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Economic Impact Analysis Program (EIAP) began collecting information on agricultural losses and damages resulting from tropical cyclone events in 2016 in the wake of Hurricane Irma and has been improving databases and methods for these types of analyses ever since. On August 28th, 2023, The UF/IFAS EIAP distributed a survey titled “Assessment of Losses and Damages to Florida Agriculture from Hurricane Idalia” to begin assessing losses and damages associated with Hurricane Idalia. This survey instrument (IRB202300976) was developed to assist Florida’s Cooperative Extension System in collecting information on the impacts of natural disasters using the Qualtrics® survey system, which is a licensed survey platform recognized for its robust data security, analytics, and logical control programming features. The online survey instrument collects information directly from the owners/operators of farms, ranches, and other production agriculture operations, or via representatives of Florida Cooperative Extension and/or local, state, or federal government agencies, allowing for more timely and accurate reports on observed losses and damages.

This report summarizes the findings of the UF/IFAS EIAP’s efforts to assess state-level and county-level losses for specific commodity groups due to Hurricane Idalia. This will be the final report associated with rapid assessment for this event.

EVENT DATA

The wind swath of Hurricane Idalia, as published by the National Oceanic and Atmospheric Administration (NOAA) National Hurricane Center (NHC), is shown in Figure 1. Hurricane conditions impacted nine counties in northern Florida: Suwannee, Madison, Hamilton, Lafayette, Taylor, Dixie, Columbia, Gilchrist, and Levy. A larger swath of the Florida peninsula experienced tropical storm force winds, which extended as far south as Charlotte County.

Data representing the 7-day cumulative precipitation amounts (August 27 - September 2, 2023) are shown in Figure 2, indicating over 15 inches of rain fell during this period in some areas. The intense rainfall is not aligned with the storm center’s path, occurring only in areas impacted by tropical storm conditions, specifically Hardee County, Madison County, and other nearby counties. Most areas experienced precipitation totals of less than 5 inches.

Simulated flood inundation depths in Florida on August 31st are displayed in Figure 3 using data available from the Pacific Northwest National Laboratory’s Rapid Infrastructure Flooding Tool. The simulated results suggest that storm surge associated with Hurricane Idalia exceeded 15 feet on the barrier islands and coastline of west Florida and in parts of southeast Florida. Some areas experienced inland flooding in or downstream of areas with heavy precipitation.

To quantify the comprehensive impacts of Hurricane Idalia in terms of wind, rainfall, and flooding, a Hurricane Composite Intensity Index (HCII) was derived. The HCII level is calculated as the sum of the intensity index of wind, rainfall, and flooding, which are all classified into 6 levels based on wind speed (mph), cumulative precipitation (inches), and flood depth (ft), as shown in Table 1.

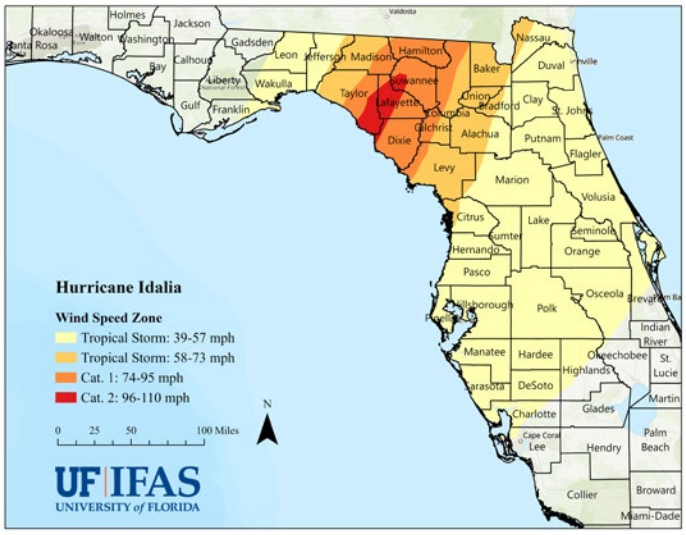


Figure 1. *Wind swath pattern of Hurricane Idalia as it impacted Florida.*

Source: Geospatial data on the wind swath of Hurricane Idalia are derived from modeled results produced by Applied Research Associates for the National Institute of Standards and Technology (NIST) under Contract 1333ND22PNB730388.

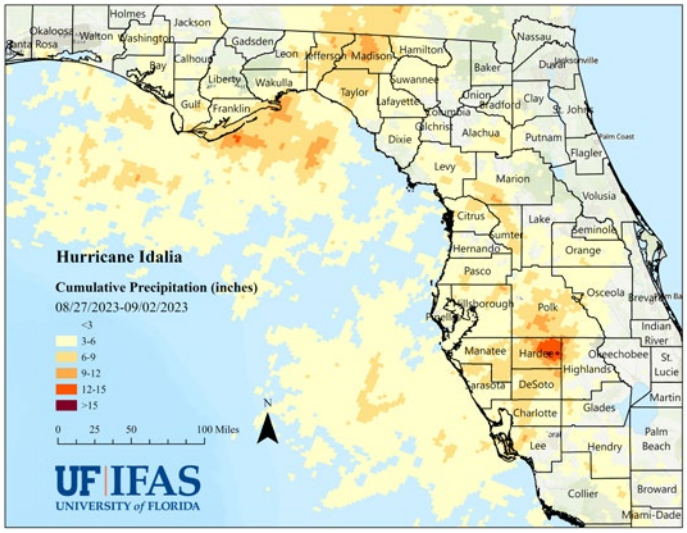


Figure 2. *Cumulative precipitation totals in Florida (August 27 - September 2, 2023).*

Source: Precipitation data are derived from the Advanced Hydrologic Prediction Service (AHPS) from NOAA National Weather Service (https://water.weather.gov/precip/download.php).

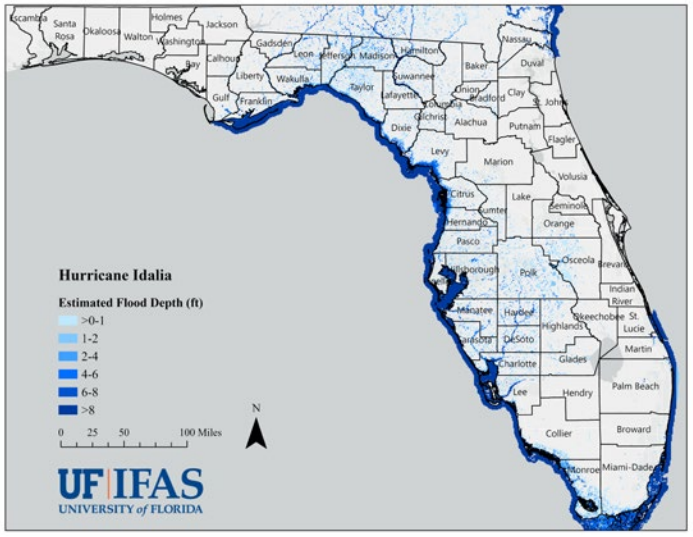


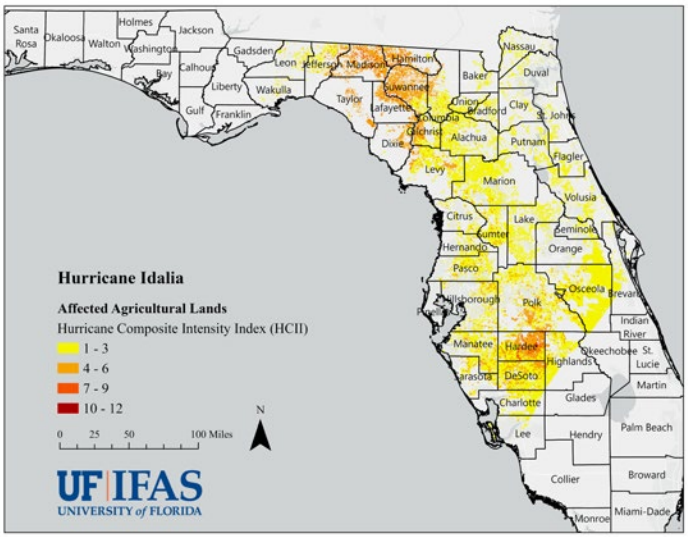
Figure 3. *Simulated flood inundation depth caused by Hurricane Idalia in Florida.*

Source: Simulated flood inundation data are retrieved from Pacific Northwest National Laboratory's Rapid Infrastructure Flooding Tool. (https://open-rift-pnnl.hub.arcgis.com/maps/06fcd64c007d4f66b5a6501f34a4408c/about).

Table 1. *Definition of intensity indices for wind, rainfall, and flooding associated with tropical cyclone events, which are components of the UF/IFAS EIAP's Hurricane Composite Intensity Index.*

Intensity Index	Wind Speed (mph)	Precipitation (inches)	Flood Depth (ft)
1	TS1: 39-57	3-6	› 0-1
2	TS2: 58-73	6-9	1-2
3	Cat. 1: 74-95	9-12	2-4
4	Cat. 2: 96-110	12-15	4-6
5	Cat. 3: 111-129	15-18	6-8
6	Cat. 4 & up: › 130	› 18	› 8

IMPACTED AGRICULTURAL LANDS



Using geographic information systems (GIS) software (ArcGIS Pro), the hurricane wind swath, cumulative precipitation, and flood depth map shapefiles were overlaid on a geospatial database of agricultural lands in Florida to determine the wind, rainfall, and flooding intensity that each parcel of affected agricultural land experienced. The geospatial database of agricultural lands in Florida is the Florida Statewide Agricultural Irrigation Demand (FSAID) Agricultural Lands Geodatabase (ALG) developed by the Florida Department of Agriculture and Consumer Services (FDACS). The HCII level was calculated for each parcel of affected agricultural land, as shown in Figure 4. Table 2 summarizes the impacted acreage of agricultural lands by commodity group and HCII level in Florida.

Figure 4. *Hurricane Composite Intensity Index (HCII) level of impacted agricultural lands in Florida for Hurricane Idalia.*

Source: The agricultural lands geospatial data are from the Florida Statewide Agricultural Irrigation Demand (FSAID) Agricultural Lands Geodatabase (ALG) developed by the Florida Department of Agriculture and Consumer Services (FDACS) (https://www.fdacs.gov/Agriculture-Industry/Water/Agricultural-Water-Supply-Planning).

Table 2. *Estimated acreage of impacted agricultural lands by commodity group and HCII level for Hurricane Idalia.*

Commodity Group	Hurricane Composite Intensity Index (HCII)				Total
	1-3	4-6	7-9	10-12	
Animals and Animal Products[1]	2,243,254	452,516	36,563	2,889	**2,735,222**
Field and Row Crops[2]	252,356	178,430	10,645	1,228	**442,659**
Citrus[3]	150,406	56,212	-	-	**206,617**
Vegetables, Melons, and Potatoes	54,340	9,820	682	257	**65,099**
Greenhouse/Nursery	32,219	5,791	259	-	**38,269**
Fruit and Tree Nuts[4]	5,887	2,017	223	33	**8,159**
Total	**2,738,462**	**704,784**	**48,377**	**4,407**	**3,496,028**

Notes: [1] Animals and Animal Products acreage includes grazing land. [2] Field and Row Crops acreage includes field crops, hay, and sugarcane. The acreage of cotton is adjusted with the county level harvested acres of cotton from USDA 2022 Census data. [3] Citrus acreage includes non-bearing acreage and was adjusted to reflect the 2022 Commercial Citrus Inventory Preliminary Report from USDA NASS. [4] The acreage of pecan is adjusted with the county level bearing and non-bearing acres of pecan from USDA 2022 Census data.

County-level impacted acreage of agricultural lands by commodity group are shown in Table A-1 in the appendix. Information on the percentage of agricultural lands affected in each county of Florida are shown in Table A-3. Thirty-eight (38) of the 46 affected counties had 100% of their agricultural lands affected.

Nearly 3.5 million acres of agricultural lands were affected by Hurricane Idalia, of which over 75% was grazing land. Across all commodity groups, over 78% of impacted acreage experienced low-intensity weather conditions (HCII levels 1-3), around 21.5% of impacted acreage experienced medium-intensity conditions (HCII levels 4-9), and only 0.13% of impacted acreage experienced high-intensity weather conditions (HCII levels 10-12). The commodity groups that were most affected (in terms of overall acreage impacted) by Hurricane Idalia (not including grazing land) were Field and Row Crops (including hay and sugarcane, 442,659 acres), Citrus (206,617 acres), and Vegetables, Melons, and Potatoes (65,099 acres).

Table 3 shows the estimated annual value of production on the affected acreage areas by commodity group and HCII level. Data published by the United States Department of Agriculture National Agricultural Statistics Service (USDA-NASS) on price and yield were used to estimate value per acre in Florida for individual crops within commodity groups for the years 2018-2022, where available. When

not available, value per acre was estimated using data on commodity-level price and yield at the national level or using the average value per acre of the relevant commodity group. The resulting five-year average of value per acre is used to estimate the value of production on affected acreage by commodity group and HCII level. For Greenhouse/Nursery and Animals and Animal Products, the shares of the agricultural area in each county affected by different HCII levels were used to allocate the sales revenues (five-year averages of 2018-2022 from IMPLAN, converted to 2023 dollars) to estimate the value of production on impacted acreage. County-level estimates of annual value of production by commodity group and HCII level are shown in Table A-2.

Table 3. *Estimated value of annual production (2023$, Thousands) on impacted acreage by commodity group and HCII level.*

Commodity Group	Hurricane Composite Intensity Index (HCII)				Total
	1-3	4-6	7-9	10-12	
Animals and Animal Products	$832,780	$423,346	$30,709	$2,993	**$1,289,827**
Greenhouse/Nursery	$1,100,453	$106,440	$1,963	$-	**$1,208,855**
Vegetables, Melons, and Potatoes	$730,743	$110,918	$7,909	$3,585	**$853,155**
Citrus	$352,352	$131,685	$-	$-	**$484,038**
Field and Row Crops	$174,681	$130,880	$7,829	$811	**$314,200**
Fruit and Tree Nuts	$20,857	$3,534	$328	$44	**$24,763**
Total	**$3,211,866**	**$906,803**	**$48,743**	**$7,432**	**$4,174,839**

Hurricane Idalia impacted agricultural lands that produce over $4 billion dollars of agricultural products (crops, livestock, aquaculture, etc.) throughout a calendar or marketing year, some across multiple growing seasons (e.g., Vegetables, Melons, and Potatoes) and others that might produce year-round (e.g., Greenhouse/Nursery and Animals and Animal Products). Considering impacts of all intensities, the commodity groups that were most affected in terms of "annual value at risk" by Hurricane Idalia include Vegetables, Melons, and Potatoes, Greenhouse/Nursery, and Animals and Animal Products. A majority, 77%, of the estimated value of annual production across all commodities, was impacted by low-intensity conditions (HCII levels 1-3). The annual value of agricultural products grown or raised in areas experiencing high-intensity conditions (HCII levels 10-12) is estimated to be $7.4 million, including, Vegetables, Melons, and Potatoes ($3.6 million), Animals and Animal Products ($3.0 million), and Field and Row Crops ($0.8 million).

AGRICULTURAL LOSSES IN FLORIDA

On December 20, 2023, completed survey responses from both the English- and Spanish-language version of the UF/IFAS "Assessment of Losses and Damages to Florida Agriculture from Hurricane Idalia" were downloaded and prepped for analysis by investigators from the UF/IFAS EIAP. The investigators compiled the survey information for all commodities in each county affected by the disaster.

The survey tool collects information on county and zip code of the agricultural operation associated with each response but does not ask for an address or exact location. Also, a survey respondent can complete the survey by detailing impacts to one agricultural operation that spans multiple parcels, and in some cases, multiple counties. Due to difficulties related to knowing the exact location of each survey respondents' operation, and in turn, the exact hurricane conditions that they experienced at their operation, the project team calculated an HCII level for each impacted county to relate respondents' reported damages and losses with a weighted average of hurricane conditions on agricultural parcels at the county level.

The event data shapefiles (e.g., wind, precipitation, and flooding) were overlaid on the Florida county boundary shapefile from the U.S. Census Bureau to determine the wind, precipitation, and flooding index for each agricultural parcel respectively, as well as the percentage of the agricultural lands in each county affected by the different wind, precipitation, and flood index categories. Then an area-weighted method was used to respectively calculate the composite index of wind, precipitation, and flooding for each county. In other words, the HCII of each affected

county was calculated as the sum of the area-weighted wind index, the area-weighted precipitation index, and the area-weighted flood index of the county, as shown in Figure 5 and listed in Table A-3.

The area-weighted HCII level of each affected county was used to connect with the results of the survey data analysis as well as observations from previously analyzed tropical cyclone events (Irma [2017], Michael [2018], Sally [2020], and Ian [2022]) to estimate the production loss percentage (%) of different commodity groups at different HCII levels. Table 4 displays the estimated annual production loss percentages (%) by commodity group and HCII level. Production loss estimates ($) in Table 4 convey the percentage of annual production (calendar year 2023 or marketing year 2023-24) that has been lost due to Hurricane Idalia. Considerations related to multiple growing seasons are reflected in these annual production loss estimates.

These estimates of percentage production loss by commodity group and HCII levels were then combined with the estimated value of annual production on impacted agricultural lands to determine estimated losses. Estimated production losses for agricultural producers in Florida resulting from Hurricane Idalia are over $276 million.

Table 4. *Estimated annual production loss by commodity group for different HCII levels based on analysis of survey data for Hurricane Idalia along with observations from previously analyzed tropical cyclone events (Irma [2017], Michael [2018], Sally [2020], and Ian [2022]).*

Commodity Group	Hurricane Composite Intensity Index (HCII)			
	1-3	4-6	7-9	10-12
Citrus	0%	10%	30%	40%
Field and Row Crops	0%	20%	30%	40%
Fruit and Tree Nuts	0%	20%	50%	75%
Greenhouse/Nursery	0%	10%	15%	25%
Animals and Animal Products	5%	10%	10%	15%
Vegetables, Melons, and Potatoes	15%	20%	25%	30%

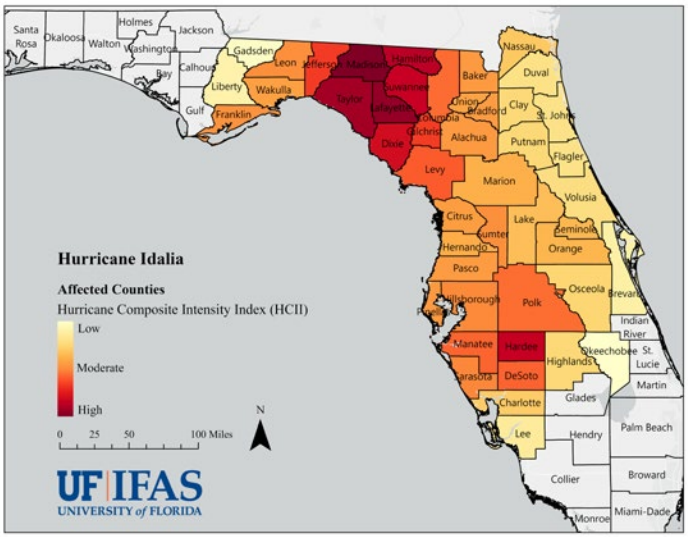


Figure 5. *Area-weighted HCII levels of affected counties in Florida.*

Agricultural Losses by Commodity Group

The estimated agricultural losses by commodity group and HCII level are displayed in Table 5. The commodity groups that were most affected in terms of production losses are Vegetables, Melons, and Potatoes ($135 million), Animals and Animal Products ($87 million), and Field and Row Crops ($29 million).

Production losses for operations within the Vegetables, Melons, and Potatoes commodity group in the affected area vary by crop and are heavily dependent on the time since planting as well as the ability (or inability) to harvest prior to the hurricane event or to replant damaged or destroyed crops after the event. There were reports of significant impacts to some vegetable operations in the panhandle (Haire, 2023); however, many growers of Vegetables, Melons, and Potatoes crops in regions impacted by only lower strength tropical storm conditions reported minimal to no losses, but low-level losses on a large number of acres of high value crops can add up quickly.

Production losses associated with animal operations (beef and dairy cattle, poultry, shellfish aquaculture, etc.) and producers of animal products (milk, eggs, honey) in the affected area are in part a result of damaged fencing, damaged livestock sheds (barns, poultry houses, etc.) and watering points, damaged aquaculture structures, widespread power outages, and loss of feed. Examples of this include reported losses of millions of chickens due to damage to the raised houses they are grown in, drowning, and the resulting heat stress from power outages (Lynch, 2024). For example, dairy operations can experience production losses from a combination of stored milk that has to be dumped due to power losses and resultant losses in refrigeration, skipped milkings, and drops in milk production from stress whereas beef cattle operations can experience production losses from stressed or injured cattle and lower quality feed, and shellfish aquaculture operations might experience production losses due to shellfish mortality, salinity issues, or water quality issues (Petit, 2023).

Field and Row Crop production losses in the affected area are partially attributable to wind damaged crops and damage to infrastructure. Hay crop losses and the transfer via wind of armyworms from other locations was reported (Florida Farm Bureau Federation, 2023). The infrastructure damage can impede tending or harvesting crops, and includes impacts to irrigation equipment, tractors and other machinery, and storage structures. There were also reports that fallen trees and debris associated with physical damages of Hurricane Idalia impeded the ability of producers to tend or harvest some fields.

There were no reports of significant or widespread losses for citrus crops due to Hurricane Idalia but the result of low level production losses across a wide swath of citrus acreage that experienced tropical storm force winds and heavy rainfall conditions summed to $13 million. Estimated production losses for other types of fruits and tree nuts (i.e., Fruit (non-citrus) and Tree Nuts commodity group) in the affected area ($0.9 million) are due to damages from wind. Within this commodity group, there were several reports of significant losses to pecans, even in the areas that experienced only tropical storm conditions.

Estimated production losses associated with Greenhouse/Nursery operations in the affected area are due to damaged hoop houses, greenhouse structures, and nursery infrastructure as well as widespread loss of electricity, which is critically important for cooling and irrigation. Some citrus nursery operations experienced greenhouse roof failures, exposing the trees to the environment, which jeopardizes the ability to sell within the state and prohibits sales across state lines (Florida Farm Bureau Federation, 2023).

Table 5. *Estimated agricultural losses (2023$, Thousands) due to Hurricane Idalia by commodity group and HCII level.*

Commodity Group	Hurricane Composite Intensity Index (HCII)				Total
	1-3	4-6	7-9	10-12	
Vegetables, Melons, and Potatoes	$109,611	$22,184	$1,977	$1,075	**$134,848**
Animals and Animal Products	$41,639	$42,335	$3,071	$449	**$87,493**
Field and Row Crops	$-	$26,176	$2,349	$324	**$28,849**
Citrus	$-	$13,169	$-	$-	**$13,169**
Greenhouse/Nursery	$-	$10,644	$294	$-	**$10,938**
Fruit and Tree Nuts	$-	$707	$164	$33	**$904**
Total	**$151,250**	**$115,214**	**$7,857**	**$1,882**	**$276,201**

Note: Authors' calculations based on analysis of survey data along with observations from previously analyzed tropical cyclone events (Irma [2017], Michael [2018], Sally [2020], and Ian [2022]).

Agricultural Losses by County

The top five counties in terms of agricultural losses were Manatee ($70 million), Suwannee ($30 million), Madison ($18 million), Hardee ($18 million), and DeSoto ($16 million), as shown in Figure 6. Losses were generally higher in counties experiencing more intense hurricane conditions, counties where the value of agricultural production in the path of the storm was high, or where both of these conditions were met. County-level losses by commodity group are shown in Figure 7. The counties with the highest Vegetables, Melons, and Potatoes losses were Manatee ($67 million), Hillsborough ($11 million), Charlotte ($9 million), DeSoto ($7 million), and Hamilton ($6 million). The top five counties with the highest Animals and Animal Product losses were Suwannee ($17 million), Hardee ($7 million), Lafayette ($7 million), Madison ($6 million), and Marion ($6 million). The highest losses associated with Field and Row Crops were in Suwannee ($7 million), Madison ($7 million), Hamilton ($3 million), Lafayette ($3 million), and Gilchrist ($3 million). County-level losses for all commodity groups and HCII levels are provided in Table A-4.

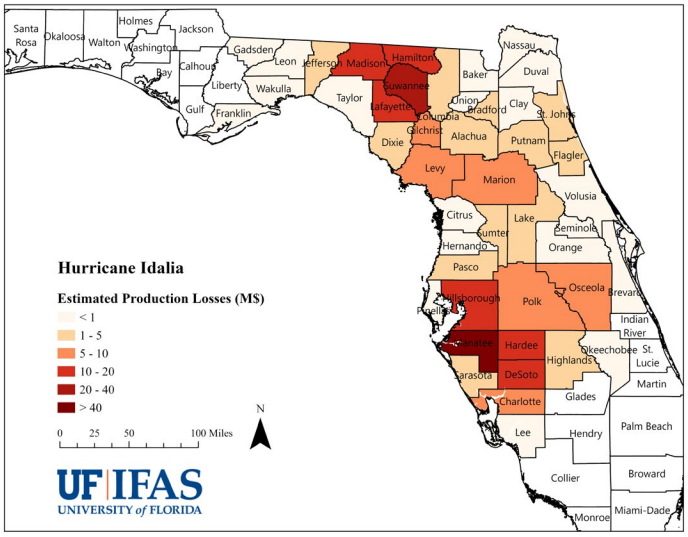


Figure 6. *Estimated total county-level agricultural production losses due to Hurricane Idalia (2023$, Millions).*

Note: Authors' calculations based on analysis of survey data along with observations from previously analyzed tropical cyclone events (Irma [2017], Michael [2018], Sally [2020], and Ian [2022]).

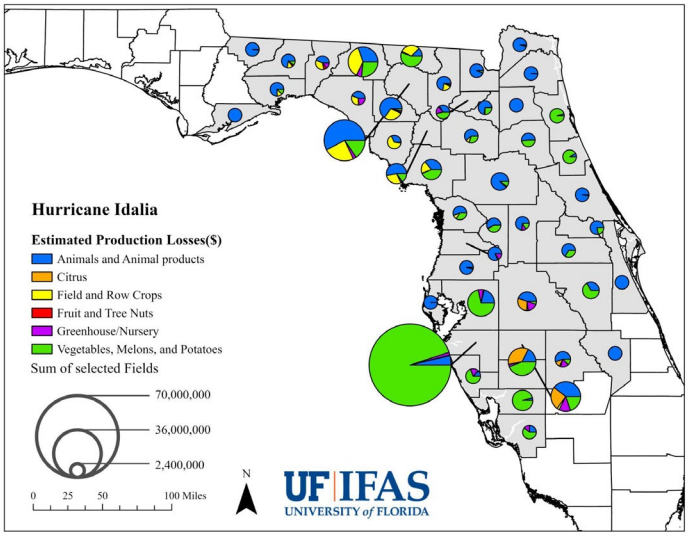


Figure 7. *Estimated county-level agricultural production losses due to Hurricane Idalia by commodity group (2023$,*

Note: Authors' calculations based on analysis of survey data along with observations from previously analyzed tropical cyclone events (Irma [2017], Michael [2018], Sally [2020], and Ian [2022]).

Additional Considerations

This report focuses on a rapid assessment of statewide production losses for calendar year 2023 or marketing year 2023-24 for agricultural operations in Florida due to Hurricane Idalia. The value of the following categories of damages or losses are not included in these estimates and should be considered in addition to production losses suffered by impacted agricultural producers:

- Value of damages to agriculture-related infrastructure (including perennial plantings and lost/deceased animals that are used to produce animal products) that will need to be repaired or replaced.
- Value of stored inputs (seed, fertilizer, etc.) or stored harvested products that were damaged or destroyed.
- Expenses related to Hurricane Idalia-specific preparations ahead of the storm and expenses related to clean-up after the storm.
- Value of production losses that might carry over into calendar year 2024, marketing season 2024-2025, or beyond due to damages to agriculture-related infrastructure or other effects of the storm.
- Production losses for agricultural operations that specialize in post-harvest processing, packing, or distribution that might be impacted as a result of impacts to production agriculture operations (e.g., operations specializing in peanut drying, cotton ginning, seafood packaging and distribution, etc.).
- Value of timber- or forestry-related losses, which were assessed by the Florida Forest Service at $64.7 million. The preliminary Florida Forest Service report has been published by the Florida Forestry Association (Florida Forest Service, 2023).
- Value of production losses to capture fisheries; however production loss estimates in this report do include shellfish and finfish aquaculture as these operations are considered agriculture.

It is also important to note that the estimates of production losses represent the estimated total value of agriculture-related production losses due to Hurricane Idalia and do not account for the fact that some crop losses might be eligible for or covered by crop insurance or other risk management tools available to producers.

AGRICULTURAL DAMAGES IN FLORIDA

Agricultural damages include asset damages and production damages. Asset damages could include damages to agricultural structures, lost perennial plantings, lost/deceased animals, and damages to other infrastructure assets and equipment that will require repair or replacement. Production damages include damages to stored inputs such as fuel for farm equipment, fertilizer, and other agricultural chemicals, and previously harvested crops that were stored on-farm and not yet sold. Currently, data limitations associated with baseline conditions (current number, location, type, and value) on agriculture-related infrastructure (buildings, fencing, machinery, and equipment) as well as stored inputs and harvested products cannot support an estimate of the exact (or close to exact) hurricane conditions experienced by each building, machine equipment, stored products, etc., preventing an accurate assessment on the caused agricultural damages.

The survey for Hurricane Idalia has questions on agricultural damages (agricultural infrastructure, stored inputs, and harvested products) as a supplementary section, which comes after collecting information on production losses. Respondents were asked to share additional information on agricultural damages only if they affirmed their willingness to complete this supplementary section of the survey. Therefore, not all respondents provide information on damages to agricultural infrastructure, stored inputs, or harvested outputs. The reported damages to infrastructure include perennial plantings, storage structures, aquaculture structure (bags/cages/floats), irrigation systems, greenhouses and other growing structures, livestock sheds (poultry, cattle, equine, etc.), homes, pallets, farm equipment (tractors, implements, vehicles, greenhouse heating/cooling, etc.), fences, and livestock watering points. The reported damages to stored agricultural inputs include fertilizer, honey bee feed, feed grain, and seeds. The reported damages to stored harvested products from the survey include corn, wheat, rye, hay, haylage, silage, and peanut.

AGRICULTURAL INFRASTRUCTURE

Current information is not enough to extrapolate to area-, county-, or state-wide estimates of the value of damaged/destroyed infrastructure or associated repair/replacement costs; however, some publicly available data do exist related to the quantity and potential value of agricultural infrastructure in Florida, which provide some level of understanding of the potential enormity of the issue of damages to agricultural infrastructure due to Hurricane Idalia.

Structure Footprint Data

The Federal Emergency Management Agency's (FEMA) USA Structures geospatial data, which includes an inventory of all structures with a footprint larger than 450 square feet, provides a data source for estimating the number and square footage of agricultural structure footprints within the path of Hurricane Idalia. These data can provide an estimate of the square footage of structure "at risk" of significant damage during this event. A summary of the square footage of agricultural structure footprints by HCII level is provided in Figure 8. Note that the square footage represents only the structures' footprints and does not account for square footage on floors above the first level in multi-story structures.

As many agricultural structures are single-story structures, we assume that the square footage of the agricultural structure footprints is a reasonable proxy for overall square footage of agricultural structures. The footprint of structures on the Florida agricultural lands impacted by stronger conditions (HCII level 4-12) are 26.2 million square feet for HCII level 4-6 and 2.1 million square feet for HCII level 7-12, respectively. As a comparison, this 28.3 million square feet footprint of agricultural structures in the path of Hurricane Idalia is nearly 20 times larger than the footprint of The Pentagon in Arlington, VA, including the area encompassed by the central courtyard. Since there are many different types of structures on agricultural lands with a wide variety of values and the FEMA USA Structures geo-database does not provide information on the type of agricultural structure, it is not possible to accurately convert from area (square feet) to estimated current value (or to estimated repair/replacement costs).

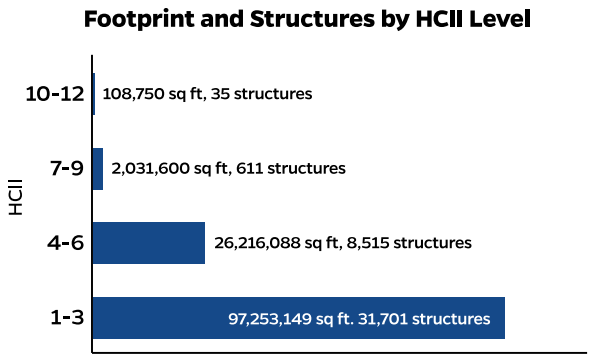


Figure 8. *Number of structures and footprint of structures on Florida agricultural lands HCII level.*

Note: Square footage represents the building footprint only and does not account for square footage on floors above the first level in multi-story structures. Structures with a footprint of less than 450 square feet are not included in the database.
Source: FEMA USA Structures geospatial data (https://gis-fema.hub.arcgis.com/pages/usa-structures).

Data on Value of Agriculture-Related Buildings and Machinery/Equipment

The 2022 Census of Agriculture, published by the USDA, contains county- and state-level data on the current value (2022$) of land and buildings, machinery and equipment on farms as of 2022. The value of buildings was estimated using the average ratio of the value of improvements and lands in Florida, as detailed in the parcel tax database (2021) released by the Florida Department of Revenue. Combined with the weather data of Hurricane Idalia, these data can be used to estimate the value of buildings, machinery, and equipment that were at risk of damage/destruction in areas experiencing strong wind, heavy rainfall, or flooding. Importantly, this value is not an estimate of the value of damaged/destroyed buildings, machinery, and equipment nor is it an estimate of the repair/replacement costs for damaged/destroyed buildings.

In the areas of Florida impacted by Hurricane Idalia, the estimated value of the buildings that were present in 2022 on the agricultural lands impacted by high-intensity weather conditions (HCII level 10-12) was $81.8 million (2022$), which would be valued at $84.8 million (2023$) after adjusting for inflation using the GDP implicit price deflator, published by the St. Louis Federal Reserve Bank (Figure 9). The estimated value of the machinery and equipment present in 2022 on the agricultural lands impacted by high-intensity weather conditions (HCII level 10-12) was $7.6 million (2022$), which would be $7.9 million (2023$) after adjusting for inflation (Figure 10). Similarly, the estimated value of the buildings that were present in 2022 on the agricultural lands impacted by medium-intensity weather conditions (HCII level 4-9) was nearly $7.3 billion (expressed in 2022$), which would be valued at over $7.6 billion (2023$) after adjusting for

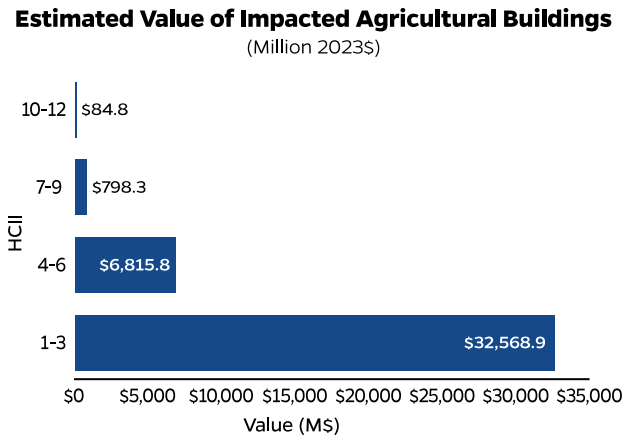


Figure 9. *Estimated value of impacted agricultural buildings by HCII level.*

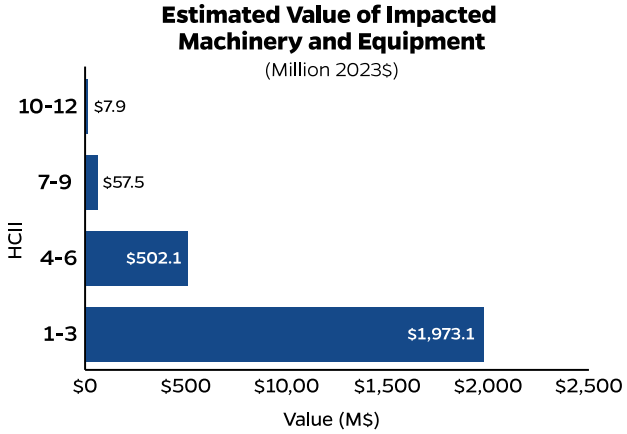


Figure 10. *Estimated value of impacted agricultural machinery and equipment by HCII level.*

inflation. The estimated value of machinery and equipment present in 2022 on the lands impacted by medium-intensity weather conditions (HCII level 4-9) was $540.0 million, which would be $559.7 million (2023$) after adjusting for inflation.

Note that these estimates do not capture the value of buildings, machinery, or equipment built or acquired after the 2022 Census of Agriculture was completed. These values are also not adjusted for buildings, machinery, or equipment that were demolished or are no longer present/used and they are not adjusted for depreciation over the period 2022-23. It is also important to note that the accuracy of these values for 2022 might be influenced by the response rate on the 2022 Census of Agriculture.

Irrigation Equipment

The Irrigated Lands Geodatabase (ILG) that is published within the FDACS FSAID Geodatabase provides information on irrigated agricultural lands in Florida as of 2021, including information on the type of irrigation system used. Over the agricultural land impacted by Hurricane Idalia (~ 3.5 million acres), there were over 627,000 acres of irrigated

agricultural lands, shown in Table 6. The irrigation systems adopted in the impacted region have diverse vulnerabilities to strong wind, heavy rainfall, and flooding. For example, center pivot/lateral move and traveling guns are highly vulnerable to strong wind. On the other hand, micro spray, gravity systems, and drip are more resistant to wind but face a higher risk of damage from flooding.

This database suggests that there are over 112,400 acres of irrigated agricultural lands impacted by Category 1 or 2 hurricane conditions, over 90% of which employ gravity systems, which are relatively resistant to wind damage. About 6,300 acres of agricultural lands with center pivot/lateral move irrigation systems experienced Category 1 or 2 hurricane conditions. Survey respondents reported that center pivot systems sustained heavy damage from Hurricane Idalia, especially from the counties that experienced Category 1 or 2 hurricane conditions. As irrigation systems come in different sizes and are used to irrigate a wide range of farm/field sizes, there is not a good method of converting from acreage irrigated by center pivot/lateral move systems to number of center pivots or lateral move systems or to further convert from number of systems impacted to the current value of those systems or an estimated value of damage to them (or repair/replacement costs associated with damage/destruction).

Table 6. *Estimated impacted irrigated acreage by irrigation system by HCII level.*

Irrigation System	Hurricane Composite Intensity Index (HCII)				Total
	1-3	4-6	7-9	10-12	
Center Pivot/ Lateral Move	70,201	95,946	5,507	764	**172,417**
Container Nursery	10,065	1,788	-	-	**11,852**
Drip	62,703	11,577	236	27	**74,543**
Gravity Systems	82,480	3,449	277	-	**86,206**
Impact Sprinkler	14,433	942	74	-	**15,449**
Micro Spray	188,876	59,435	2,354	-	**250,666**
Traveling Gun	11,046	3,506	98	-	**14,651**
Total	**439,804**	**176,643**	**8,546**	**791**	**625,784**

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APPENDIX

Table A-1. *Estimated county-level agricultural acreage affected by Hurricane Idalia by commodity group.*

County	Citrus	Field and Row Crops	Fruit and Tree Nuts	Vegetables, Melons, and Potatoes	Animals and Animal Products	Greenhouse/ Nursery	Total
Alachua	<100	33,942	1,656	468	88,241	1,019	**125,327**
Baker	-	1,119	<100	<100	11,438	149	**12,767**
Bradford	-	6,260	<100	244	20,144	<100	**26,798**
Brevard	241	3,519	-	-	47,180	<100	**51,019**
Charlotte	3,538	2,637	-	5,634	66,832	<100	**78,679**
Citrus	<100	3,094	-	134	26,325	176	**29,732**
Clay	-	596	-	-	15,091	331	**16,018**
Columbia	-	21,051	380	<100	41,477	275	**63,252**
DeSoto	59,576	3,550	<100	3,767	164,502	463	**231,875**
Dixie	-	9,001	-	<100	19,866	<100	**28,960**
Duval	-	875	129	-	12,915	294	**14,212**
Flagler	-	2,322	-	1,349	23,977	499	**28,147**
Franklin	-	<100	-	-	<100	-	**<100**
Gadsden	-	<100	<100	-	109	-	**188**
Gilchrist	-	33,906	<100	815	31,289	234	**66,321**
Hamilton	<100	19,688	-	2,697	22,872	250	**45,511**
Hardee	38,923	5,438	-	1,811	187,193	1,446	**234,813**
Hernando	<100	2,645	<100	-	31,212	663	**34,539**
Highlands	23,794	8,339	<100	301	107,487	1,107	**141,029**
Hillsborough	772	4,157	825	5,336	76,932	1,544	**89,567**
Jefferson	<100	15,858	2,551	<100	25,647	1,021	**45,090**
Lafayette	-	21,382	<100	179	19,964	358	**41,966**
Lake	4,062	4,298	245	272	99,745	3,653	**112,275**
Lee	-	<100	106	303	8,868	1,405	**10,762**
Leon	-	2,769	<100	<100	10,721	<100	**13,634**
Levy	-	44,192	<100	2,485	96,905	1,823	**145,457**
Madison	<100	44,581	202	1,702	50,361	355	**97,205**
Manatee	8,239	4,425	409	25,034	83,361	1,639	**123,107**
Marion	286	18,841	<100	427	203,643	1,512	**224,775**
Nassau	-	2,665	-	<100	15,393	105	**18,177**
Okeechobee	-	-	-	-	2,438	-	**2,438**
Orange	357	558	-	130	73,969	1,311	**76,326**
Osceola	4,883	10,568	-	2,478	391,044	1,489	**410,461**
Pasco	567	6,471	<100	<100	81,563	560	**89,179**
Pinellas	-	<100	-	-	491	-	**512**
Polk	60,131	5,645	126	742	220,239	1,279	**288,162**
Putnam	<100	9,373	<100	1,032	39,600	2,447	**52,480**
Sarasota	756	1,818	-	1,134	49,637	368	**53,713**
Seminole	119	294	-	<100	18,701	663	**19,797**
St. Johns	<100	8,205	-	2,987	8,031	211	**19,450**
Sumter	<100	6,863	-	643	89,857	764	**98,127**
Suwannee	-	59,897	928	2,422	61,779	1,577	**126,603**
Taylor	<100	1,706	-	-	17,527	215	**19,457**
Union	-	5,803	<100	304	17,653	<100	**23,795**
Volusia	304	2,813	<100	<100	48,767	6,759	**58,697**
Wakulla	-	1,321	<100	<100	4,165	<100	**5,556**
Total	**206,617**	**442,659**	**8,159**	**65,099**	**2,735,224**	**38,269**	**3,496,028**

Note: All values less than 100 are displayed as '<100' for consistency.

Table A-2. *Estimated county-level value of annual production on agricultural lands affected by Hurricane Idalia by commodity group (2023$, Thousands).*

County	Citrus	Field and Row Crops	Fruit and Tree Nuts	Vegetables, Melons, and Potatoes	Animals and Animal Products	Greenhouse/ Nursery	Total
Alachua	<$100	$21,353	$2,228	$4,377	$25,613	$32,223	**$85,797**
Baker	$$-	$879	<$100	$286	$14,592	$1,701	**$17,531**
Bradford	$-	$3,465	$106	$2,345	$19,070	$566	**$25,553**
Brevard	$566	$1,832	$-	$-	$7,065	$6,096	**$15,559**
Charlotte	$8,288	$2,410	$-	$58,283	$7,048	$6,381	**$82,409**
Citrus	<$100	$2,294	$-	$1,289	$6,118	$3,491	**$13,197**
Clay	$-	$395	$-	$-	$4,747	$3,159	**$8,302**
Columbia	$-	$13,602	$511	$666	$32,245	$7,603	**$54,627**
DeSoto	$139,567	$2,312	$149	$46,496	$48,227	$18,225	**$254,977**
Dixie	$-	$7,536	$-	$249	$6,951	<$100	**$14,771**
Duval	$-	$606	$176	$-	$6,069	$6,896	**$13,746**
Flagler	$-	$1,711	$-	$9,539	$2,479	$3,004	**$16,732**
Franklin	$-	<$100	$-	$-	$440	$-	**$442**
Gadsden	$-	<$100	<$100	$-	$606	$-	**$682**
Gilchrist	$-	$25,189	$102	$7,176	$67,946	$3,702	**$104,116**
Hamilton	<$100	$14,864	$-	$27,405	$13,287	$1,747	**$57,315**
Hardee	$91,184	$3,490	$-	$21,154	$89,874	$35,948	**$241,656**
Hernando	<$100	$1,861	<$100	$-	$14,080	$11,898	**$27,881**
Highlands	$55,741	$4,499	<$100	$2,897	$42,779	$19,801	**$125,736**
Hillsborough	$1,809	$3,570	$7,935	$73,061	$56,969	$124,935	**$268,279**
Jefferson	<$100	$9,823	$3,432	<$100	$13,748	$6,201	**$33,291**
Lafayette	$-	$15,377	$602	$1,720	$70,564	$2,333	**$90,595**
Lake	$9,516	$2,686	$1,374	$2,582	$34,496	$161,832	**$212,487**
Lee	$-	<$100	$1,214	$2,960	$3,498	$38,921	**$46,655**
Leon	$-	$1,676	$302	$115	$2,187	$1,600	**$5,879**
Levy	$-	$34,069	<$100	$23,612	$54,604	$19,978	**$132,334**
Madison	<$100	$32,702	$272	$21,570	$55,637	$9,653	**$119,842**
Manatee	$19,301	$3,572	$3,938	$436,808	$45,294	$45,067	**$553,981**
Marion	$670	$13,728	<$100	$4,106	$108,446	$22,448	**$149,496**
Nassau	$-	$1,974	$-	$136	$12,345	$121	**$14,575**
Okeechobee	$-	$-	$-	$-	$7,031	$-	**$7,031**
Orange	$836	$429	$-	$1,253	$7,364	$252,801	**$262,684**
Osceola	$11,439	$7,216	$-	$23,839	$34,513	$22,634	**$99,641**
Pasco	$1,328	$4,662	<$100	<$100	$41,895	$6,293	**$54,250**
Pinellas	$-	<$100	$-	$-	$928	$-	**$945**
Polk	$140,868	$4,093	$661	$2,512	$56,045	$54,165	**$258,343**
Putnam	<$100	$7,612	$123	$6,184	$20,064	$16,814	**$50,821**
Sarasota	$1,771	$1,381	$-	$16,004	$7,624	$15,548	**$42,328**
Seminole	$279	$233	$-	$190	$2,044	$20,991	**$23,736**
St. Johns	<$100	$6,375	$-	$20,077	$2,665	$14,919	**$44,074**
Sumter	<$100	$4,778	$-	$7,672	$30,788	$19,157	**$62,397**
Suwannee	$-	$42,616	$1,249	$23,299	$185,599	$7,823	**$260,586**
Taylor	<$100	$981	$-	$-	$2,822	$1,336	**$5,161**
Union	$-	$3,400	<$100	$2,928	$6,200	$2,083	**$14,619**
Volusia	$712	$2,037	<$100	$126	$15,246	$177,536	**$195,721**
Wakulla	$-	$766	<$100	$116	$1,977	$1,189	**$4,066**
Total	**$484,038**	**$314,200**	**$24,763**	**$853,155**	**$1,289,827**	**$1,208,855**	**$4,174,839**

Note: All values less than $100,000 are displayed as '<$100' for consistency.

Table A-3. *The area-weighted intensity of wind, precipitation, and flood, HCII, and percentage of affected agricultural land in by county.*

County	Area-Weighted Wind Speed Index	Area-Weighted Precipitation Index	Area-Weighted Flood Index	Area-Weighted HCII	% Affected Agricultural Land
Alachua	1.81	0.38	0.09	2.32	100%
Baker	1.99	0.22	0.11	2.33	100%
Bradford	1.65	0.48	0.14	2.29	100%
Brevard	1	0.01	0	1.01	51%
Charlotte	0.4	1.12	0.25	1.77	60%
Citrus	1.12	0.97	0.17	2.26	100%
Clay	1	0.27	0	1.27	100%
Columbia	2.48	0.18	0.19	2.87	100%
DeSoto	0.98	1.55	0.47	3.01	100%
Dixie	3.01	0.83	0.27	4.11	100%
Duval	0.99	0	0.02	1.02	100%
Flagler	1	0	0	1	100%
Franklin	1	1.7	0.39	3.09	55%
Gadsden	0.99	0.31	0.21	1.54	1%
Gilchrist	2.58	0.58	0.2	3.36	100%
Hamilton	2.98	0.94	0.5	4.42	100%
Hardee	1	2.58	0.62	4.2	100%
Hernando	1	0.8	0.19	1.99	100%
Highlands	0.96	1.05	0.27	2.28	40%
Hillsborough	1	1.24	0.38	2.62	100%
Jefferson	1.17	1.69	0.31	3.43	100%
Lafayette	3.33	0.95	0.36	4.83	100%
Lake	1	0.65	0.04	1.7	100%
Lee	0.07	1.21	0.35	1.63	21%
Leon	0.99	1.21	0.28	2.51	100%
Levy	2.08	0.88	0.09	3.05	100%
Madison	2.41	2.04	0.58	5.04	100%
Manatee	1	1.65	0.27	2.92	100%
Marion	1.1	0.79	0.04	1.94	100%
Nassau	1.49	0	0.07	1.57	100%
Okeechobee	1	0	0.1	1.1	1%
Orange	1	0.83	0.02	1.84	100%
Osceola	1	0.38	0.09	1.47	87%
Pasco	1	1.05	0.25	2.3	100%
Pinellas	1	0.95	0.39	2.34	100%
Polk	1	1.44	0.36	2.8	100%
Putnam	1	0.28	0	1.28	100%
Sarasota	1	1.28	0.33	2.6	100%
Seminole	1	0.83	0	1.83	100%
St. Johns	1	0	0	1	100%
Sumter	1	1.33	0.15	2.48	100%
Suwannee	3.18	0.81	0.24	4.23	100%
Taylor	3.26	1.04	0.36	4.66	100%
Union	1.99	0.03	0.12	2.15	100%
Volusia	1	0.11	0	1.11	100%
Wakulla	1	1	0.25	2.25	100%

Note: All values less than $100,000 are displayed as '<$100' for consistency.

Table A-4. *Estimated county-level agricultural losses due to Hurricane Idalia by commodity group (2023$, Thousands).*

County	Citrus	Field and Row Crops	Fruit and Tree Nuts	Vegetables, Melons, and Potatoes	Animals and Animal Products	Greenhouse/ Nursery	Total
Alachua	$-	$165	<$100	$657	$1,323	$-	**$2,159**
Baker	$-	<$100	$-	<$100	$756	$-	**$804**
Bradford	$-	<$100	<$100	$352	$1,003	<$100	**$1,381**
Brevard	$-	$-	$-	$-	$353	$-	**$353**
Charlotte	$-	<$100	$-	$8,742	$361	$-	**$9,140**
Citrus	$-	<$100	$-	$201	$327	$-	**$585**
Clay	$-	$-	$-	$-	$237	$-	**$237**
Columbia	$-	$582	<$100	$100	$2,043	<$100	**$2,834**
DeSoto	$5,771	<$100	$-	$7,127	$2,852	$452	**$16,261**
Dixie	$-	$1,307	$-	<$100	$652	$-	**$2,008**
Duval	$-	$-	<$100	$-	$303	<$100	**$306**
Flagler	$-	$-	$-	$1,431	$124	$-	**$1,555**
Franklin	$-	$-	$-	$-	<$100	$-	**<$100**
Gadsden	$-	$-	<$100	$-	<$100	$-	**<$100**
Gilchrist	$-	$2,568	<$100	$1,318	$4,705	$251	**$8,851**
Hamilton	<$100	$3,038	$-	$5,578	$1,281	$174	**$10,071**
Hardee	$4,633	$476	$-	$3,631	$7,238	$2,296	**$18,275**
Hernando	$-	<$100	$-	$-	$742	$134	**$905**
Highlands	$508	$103	$-	$512	$2,291	$713	**$4,127**
Hillsborough	<$100	<$100	<$100	$11,012	$3,272	$968	**$15,403**
Jefferson	$-	$713	$314	<$100	$941	$292	**$2,271**
Lafayette	$-	$3,162	$125	$368	$7,066	$271	**$10,993**
Lake	$-	<$100	$-	$387	$1,734	$259	**$2,384**
Lee	$-	$-	$-	$450	$180	$109	**$740**
Leon	$-	<$100	<$100	<$100	$121	$-	**$165**
Levy	$-	$1,764	<$100	$3,863	$3,199	<$100	**$8,889**
Madison	<$100	$6,874	<$100	$4,867	$5,563	$984	**$18,356**
Manatee	<$100	<$100	<$100	$66,702	$2,581	$789	**$70,216**
Marion	$-	<$100	$-	$616	$5,532	$111	**$6,298**
Nassau	$-	<$100	$-	<$100	$624	$-	**$652**
Okeechobee	$-	$-	$-	$-	$352	$-	**$352**
Orange	$-	$-	$-	$188	$369	$-	**$557**
Osceola	<$100	<$100	$-	$3,576	$1,767	$-	**$5,349**
Pasco	$-	<$100	$-	<$100	$2,273	<$100	**$2,361**
Pinellas	$-	$-	$-	$-	<$100	$-	**<$100**
Polk	$2,183	$166	<$100	$410	$3,333	$1,296	**$7,412**
Putnam	$-	$-	$-	$928	$1,003	$-	**$1,931**
Sarasota	$-	<$100	$-	$2,424	$434	$615	**$3,498**
Seminole	$-	$-	$-	<$100	$102	$-	**$131**
St. Johns	$-	$-	$-	$3,011	$133	$-	**$3,145**
Sumter	$-	<$100	$-	$1,159	$1,646	<$100	**$2,850**
Suwannee	$-	$7,107	$245	$4,585	$17,097	$752	**$29,786**
Taylor	<$100	$200	$-	$-	$278	$149	**$630**
Union	$-	<$100	$-	$439	$320	$170	**$949**
Volusia	$-	$-	$-	<$100	$762	$-	**$781**
Wakulla	$-	<$100	<$100	<$100	$108	$-	**$143**
Total	**$13,169**	**$28,849**	**$904**	**$134,848**	**$87,493**	**$10,938**	**$276,201**

Note: All values less than $100,000 are displayed as '<$100' for consistency.

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All photos courtesy of survey respondents.