Factors Affecting Risk for the Whitefly-Transmitted Virus Complex in Fall-Grown Squash in Southern Georgia

Healthy plant

Crumpling of leaves on virus infected plant

Severe stunting of virus infected plant

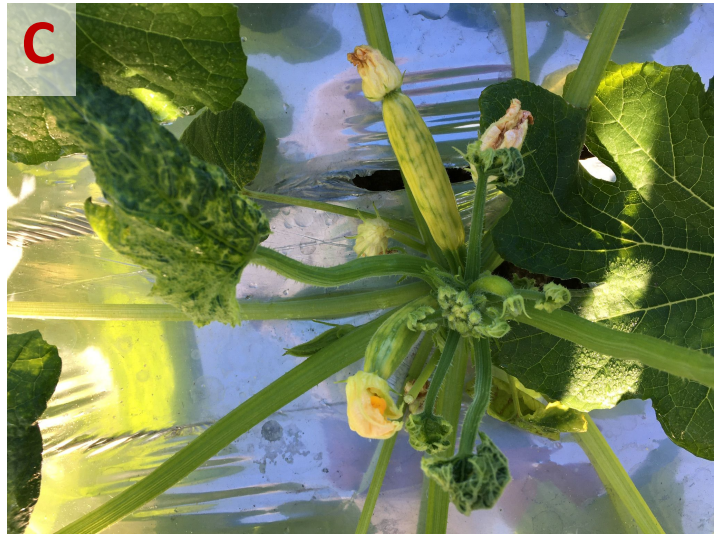
Non-marketable fruits on virus infected plant

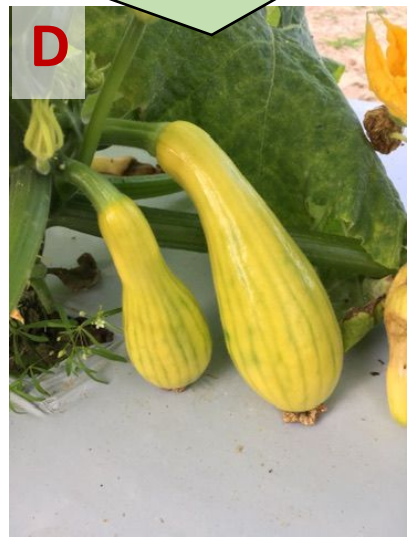
Whitefly-transmitted viruses have emerged as devastating problem in fall grown vegetables particularly squash in southern GA

- Whitefly-transmitted viruses including cucurbit leaf crumple virus (CuLCrV) and cucurbit yellow stunting disorder virus (CYSDV) cause cucurbit leaf crumple disease complex (CuLCrD).
- Other whitefly-transmitted viruses that occur in mixed infections include the squash vein yellowing virus (SqVYV) and cucurbit chlorotic yellows virus CCYV)

Increased tolerance in whiteflies to commonly used insecticides and high whitefly populations in fall renders management by insecticide application insufficient

Management of these viruses in fall is challenging as resistance to CuLCrV and CYSDV in commercial cultivars is not available





Yield losses worth millions of dollars are likely to occur with high whitefly populations and outbreaks of whitefly-transmitted viruses

Example: An estimated **35% reduction in squash crop** value was incurred due to severe occurrence of whitefly-transmitted viruses coupled with dry conditions in 2017 fall growing season.

Major Vegetable Crops	% Reduction in Crop Value	Damage ($ Millions)	Cost of Control ($ Millions)	Total ($ Millions)
Watermelon	10.0	14.2	6.0	20.2
Squash (Yellow and Zucchini)	35.0	18.0	20.0	38.0
Tomato	15.0	6.9	22.3	29.2

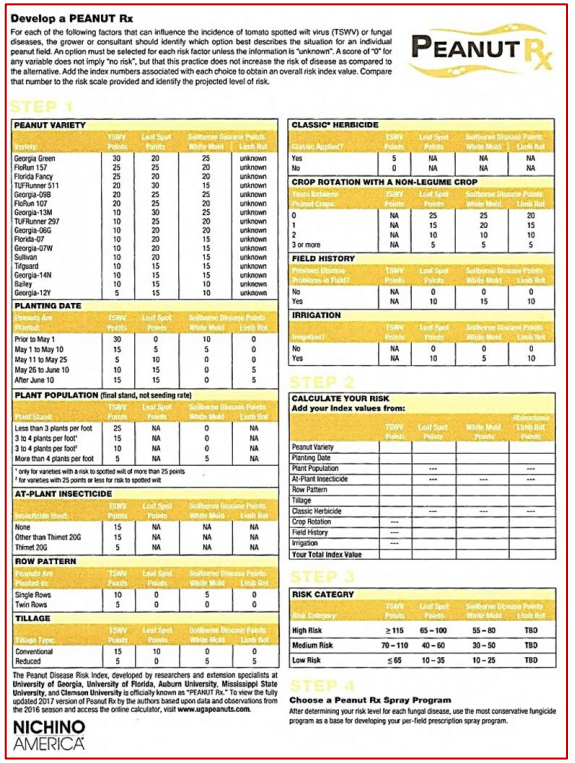
Source: Little, 2019. 2017 Georgia Plant Disease Loss Estimates.

UGA Cooperative Extension Annual Publication 102-10

Development of alternative management strategies are needed to reduce losses from CuLCrD in squash

Identification of factors that reduce the incidence of whitefly-transmitted virus complex in squash

Development of a risk assessment index similar to PEANUT Rx, which was instrumental in the area-wide management of tomato spotted wilt virus (TSWV) in peanuts.



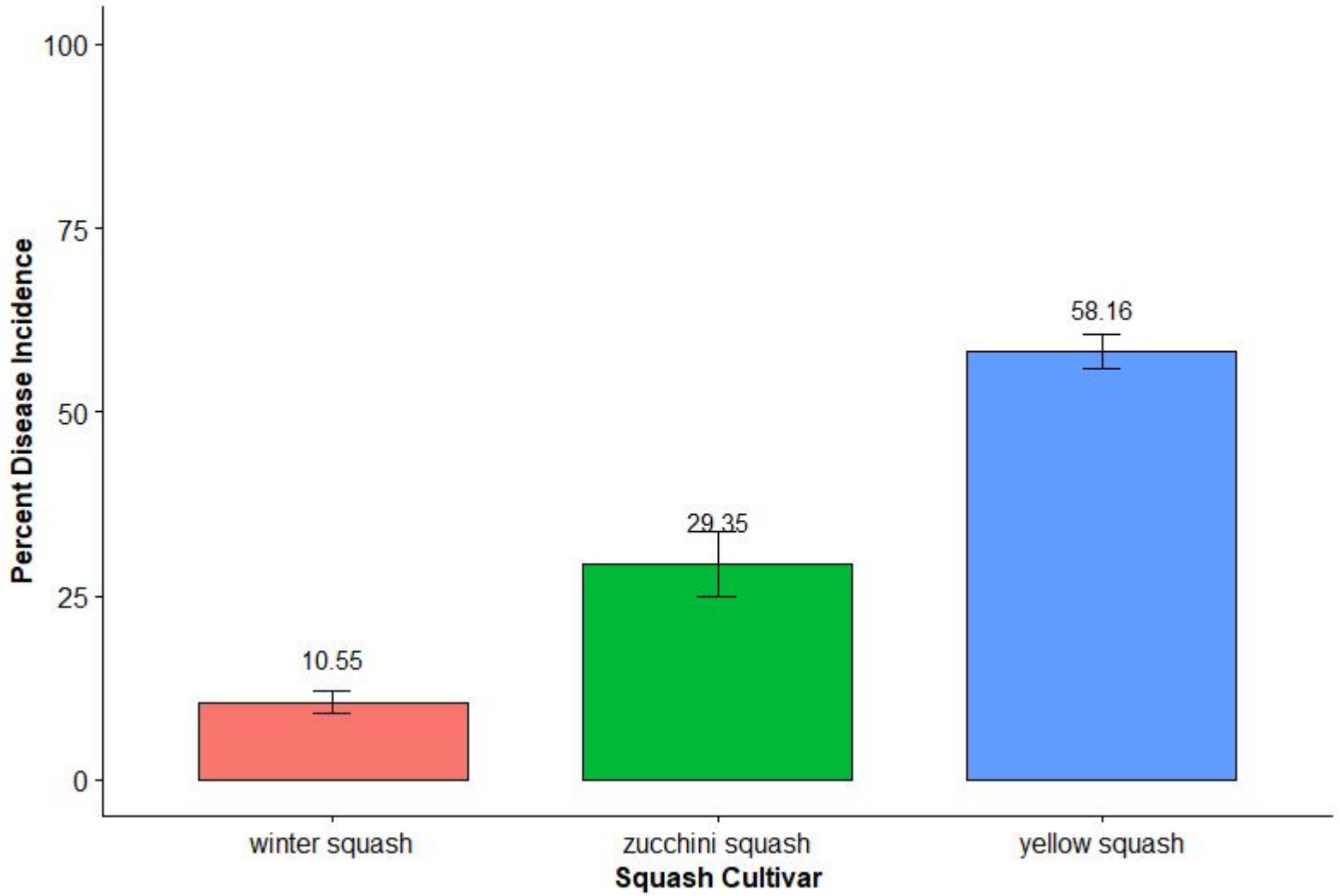
How different production practices and pest management tactics affect incidence of whitefly-transmitted virus complex?

- Type of squash
- Mulch type
- Distance to nearest cotton field
- Planting material
- Number of days from planting to whitefly peak
- Use of row cover
- Previous spring crop

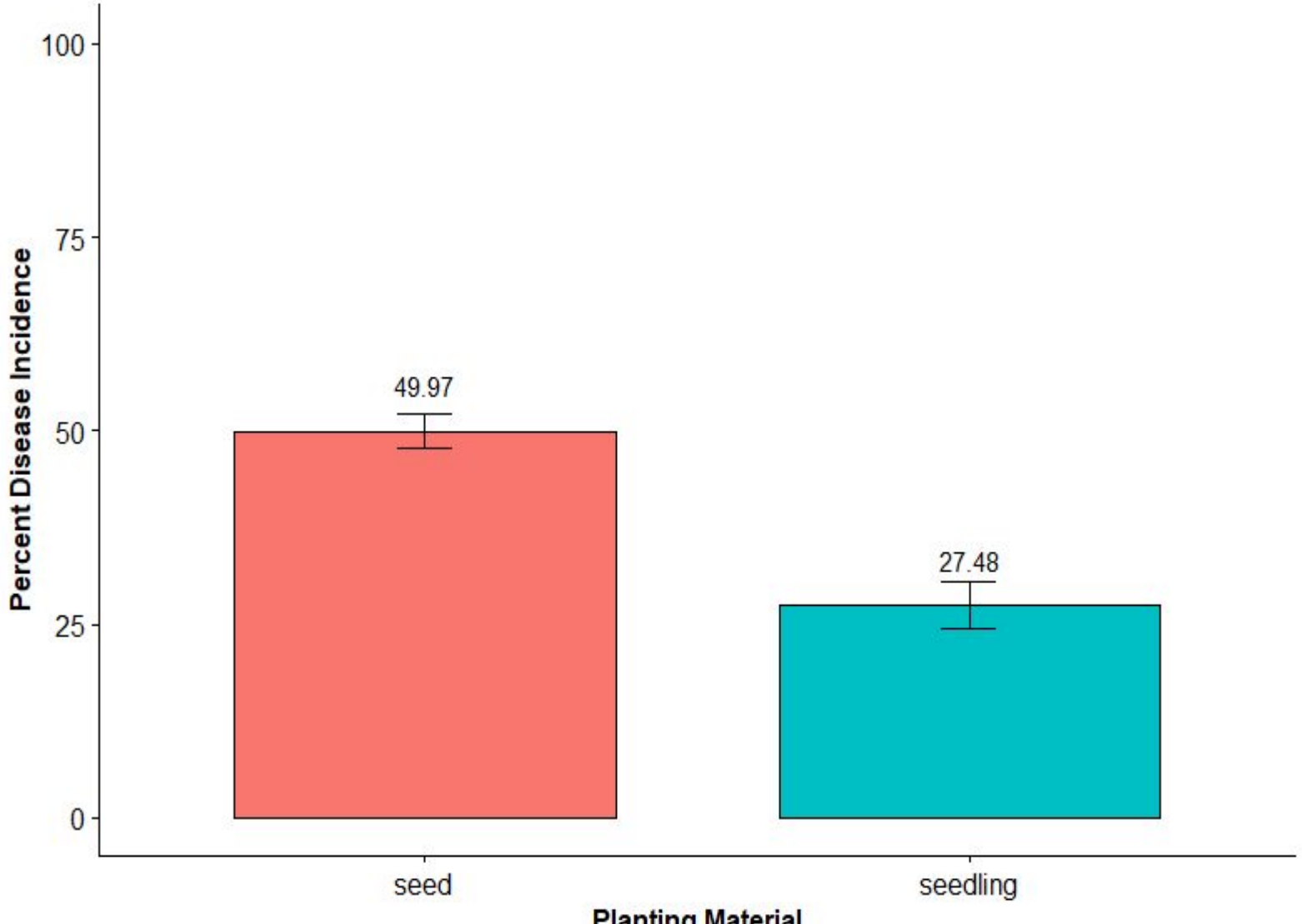
No to less severe symptoms

Severe viral disease symptoms

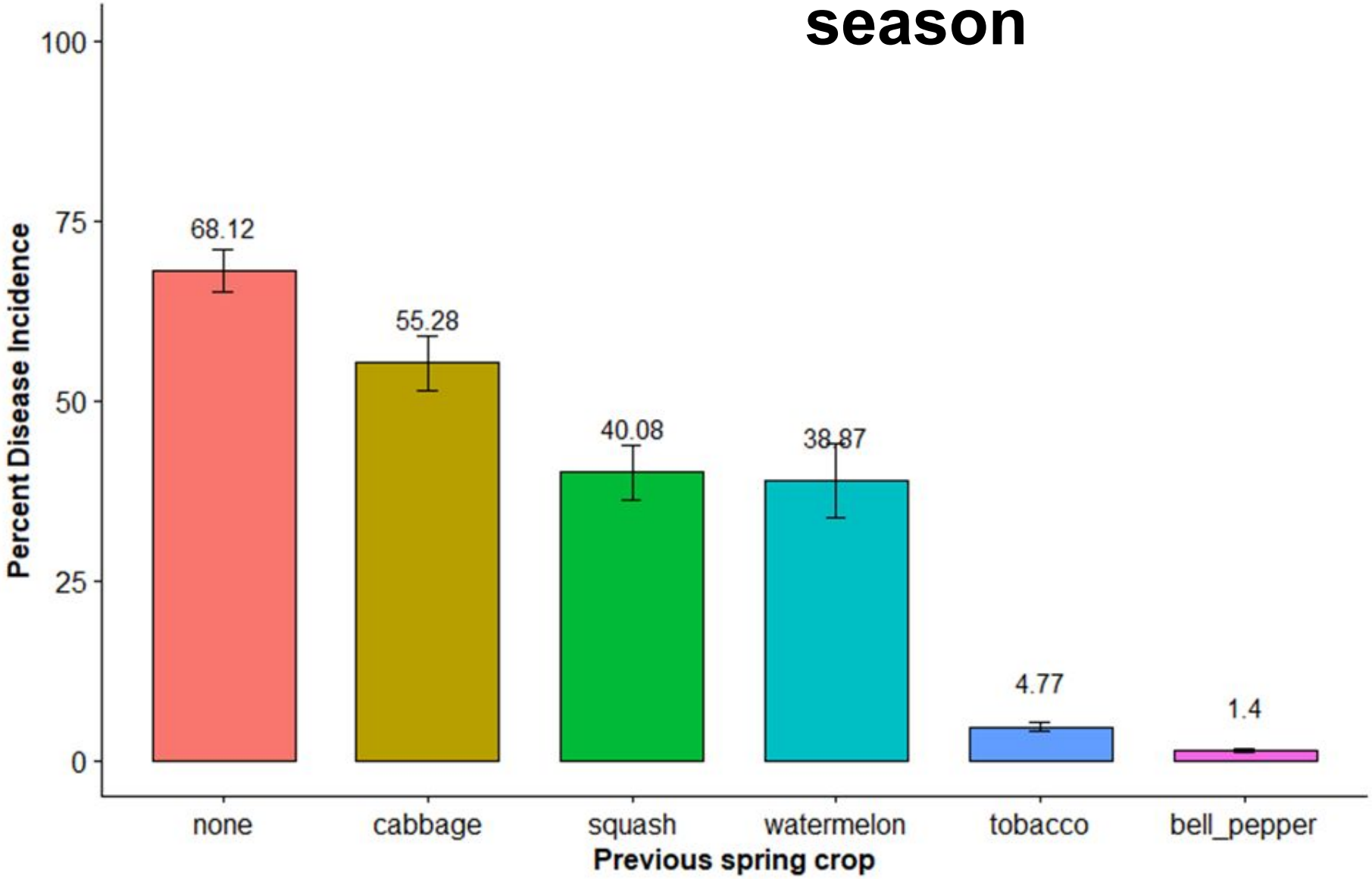
Lower incidence of CuLCrD observed in winter squash and zucchini squash compared to yellow squash



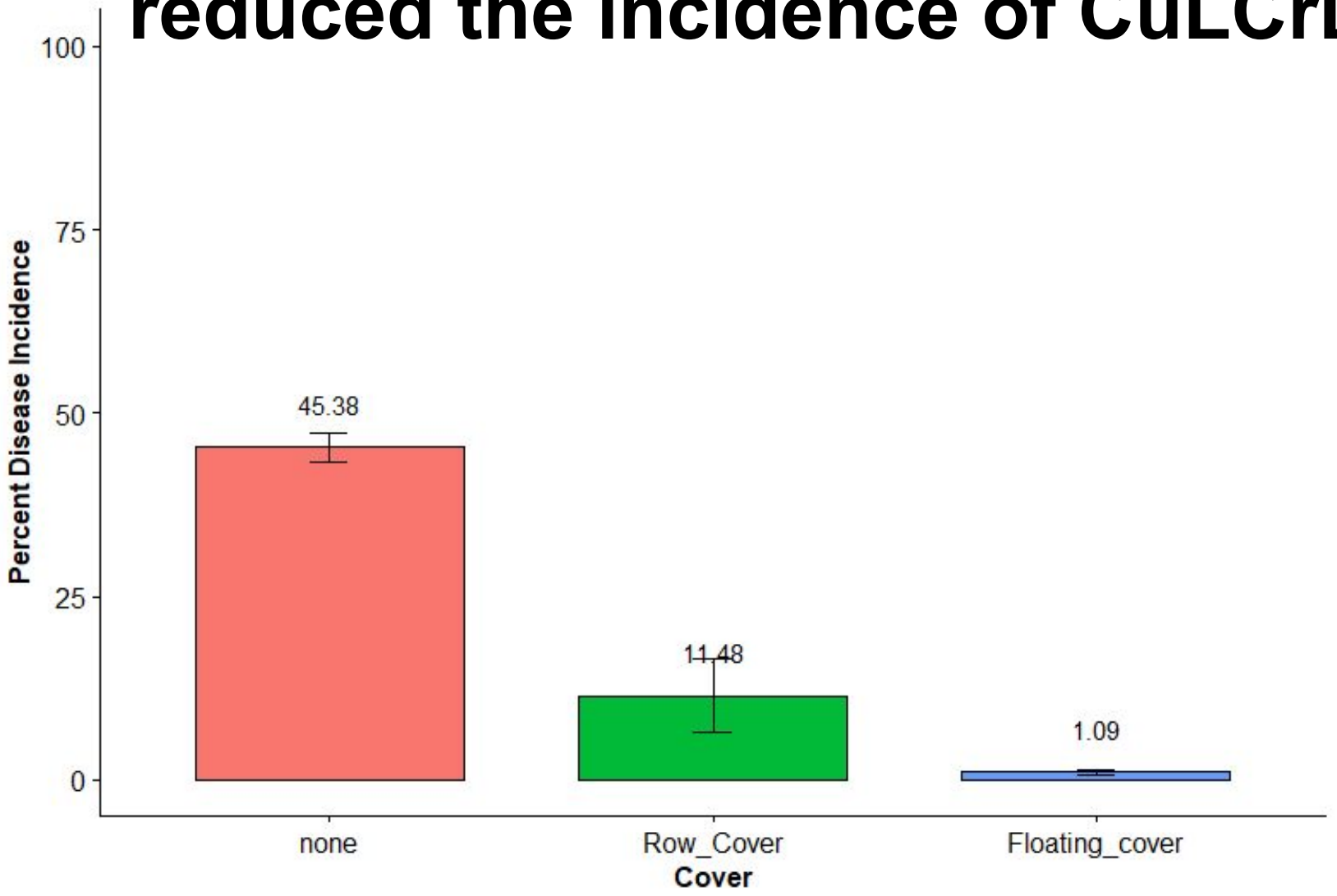
Seeds vs. Transplants on the incidence of CuLCrD



Previous spring crop affected CuLCrD incidence in squash grown during the fall cropping season



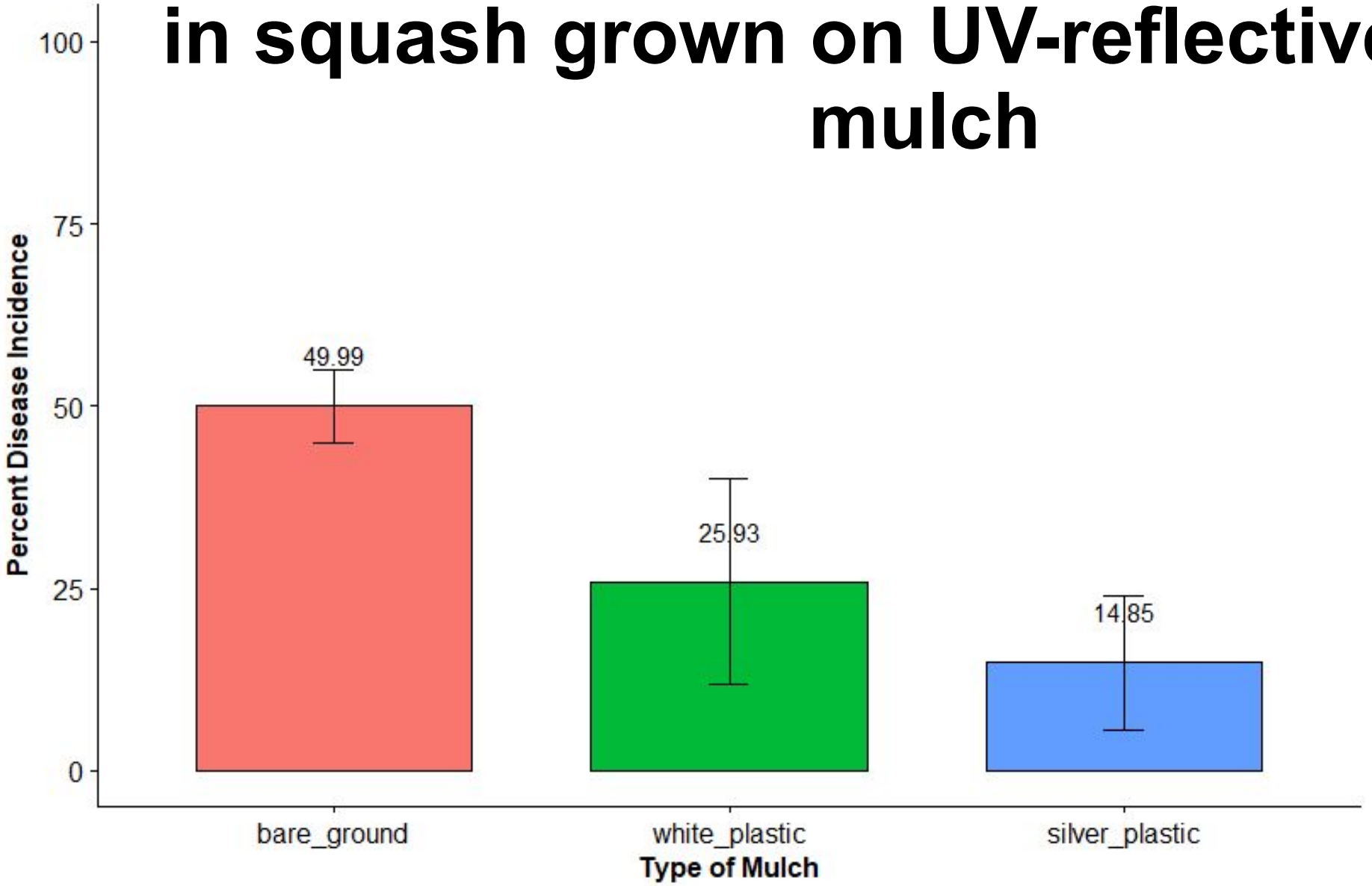
Use of row-covers effectively reduced the incidence of CuLCrD



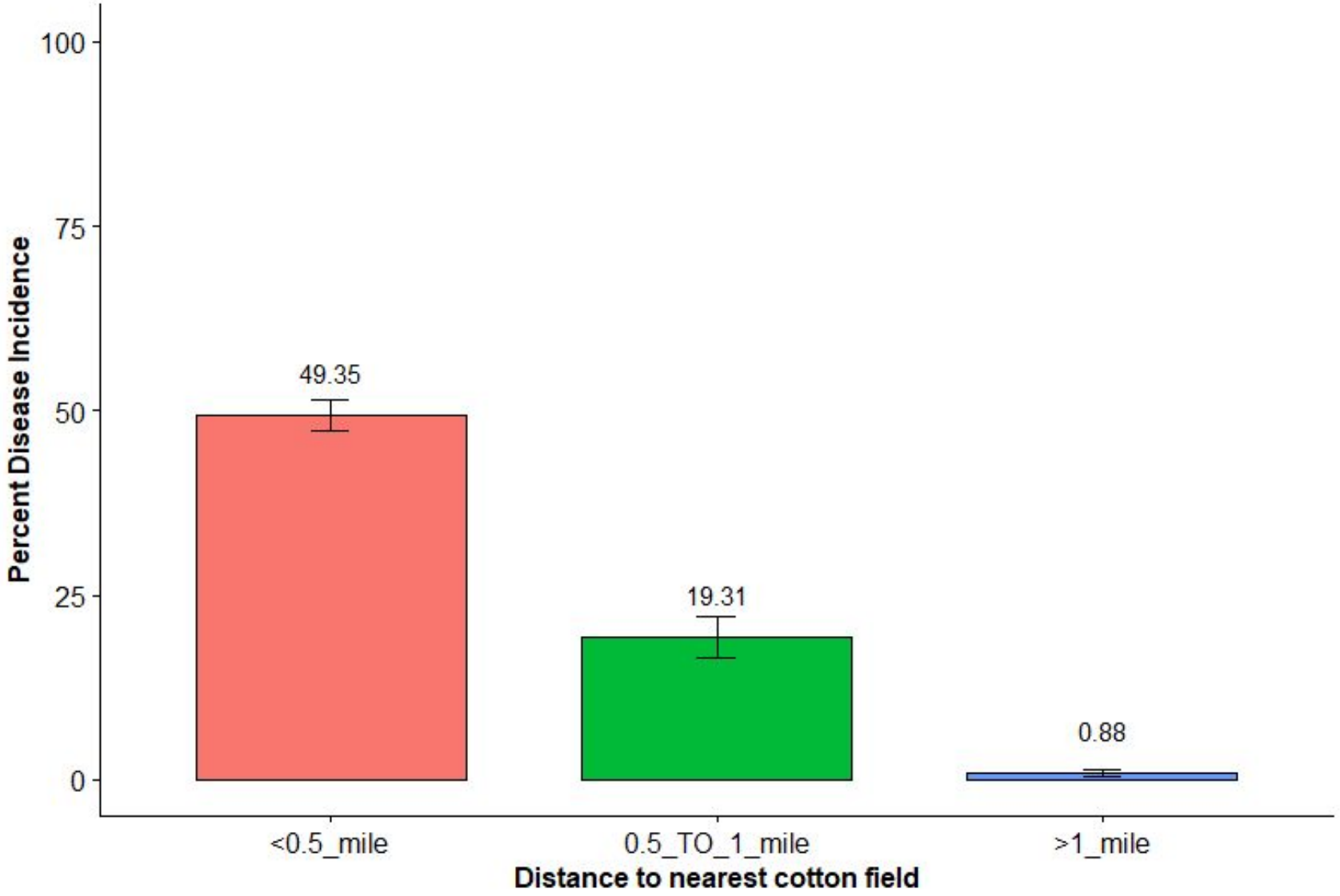
Row cover

Floating cover

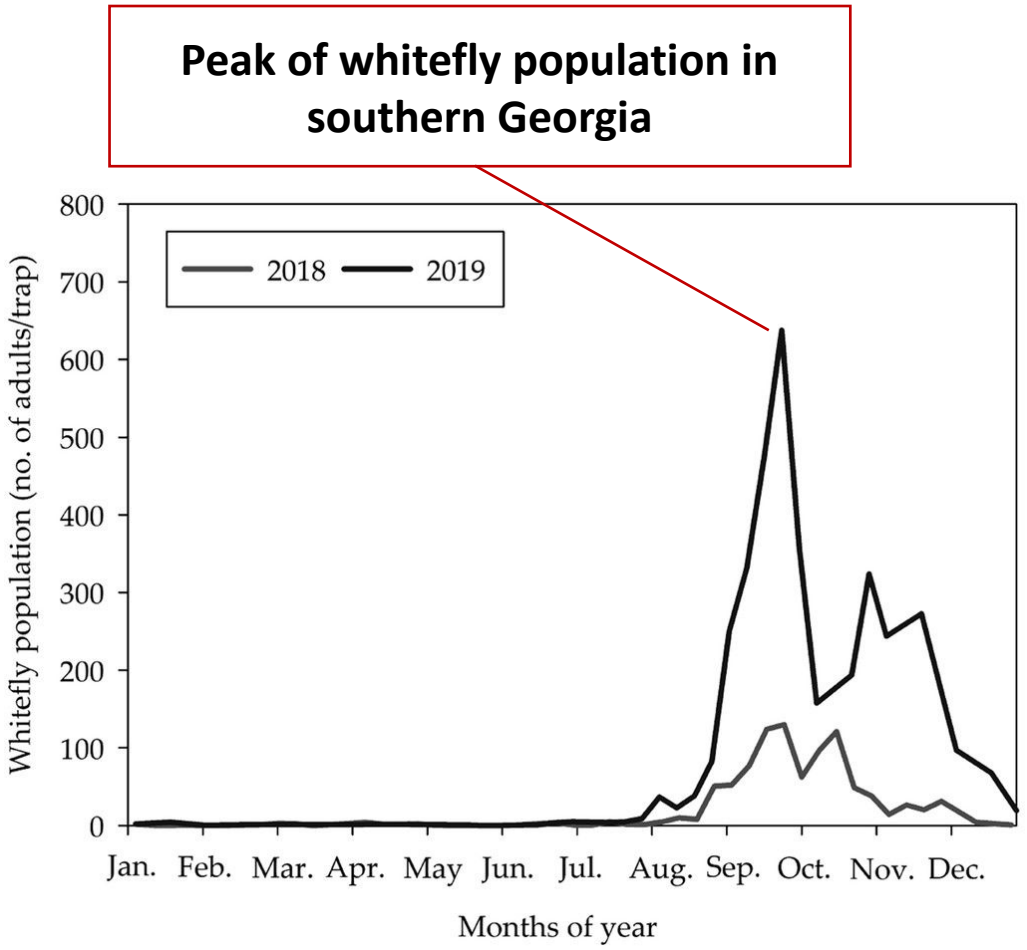
Lower levels of CuLCrD incidence observed in squash grown on UV-reflective (silver) mulch

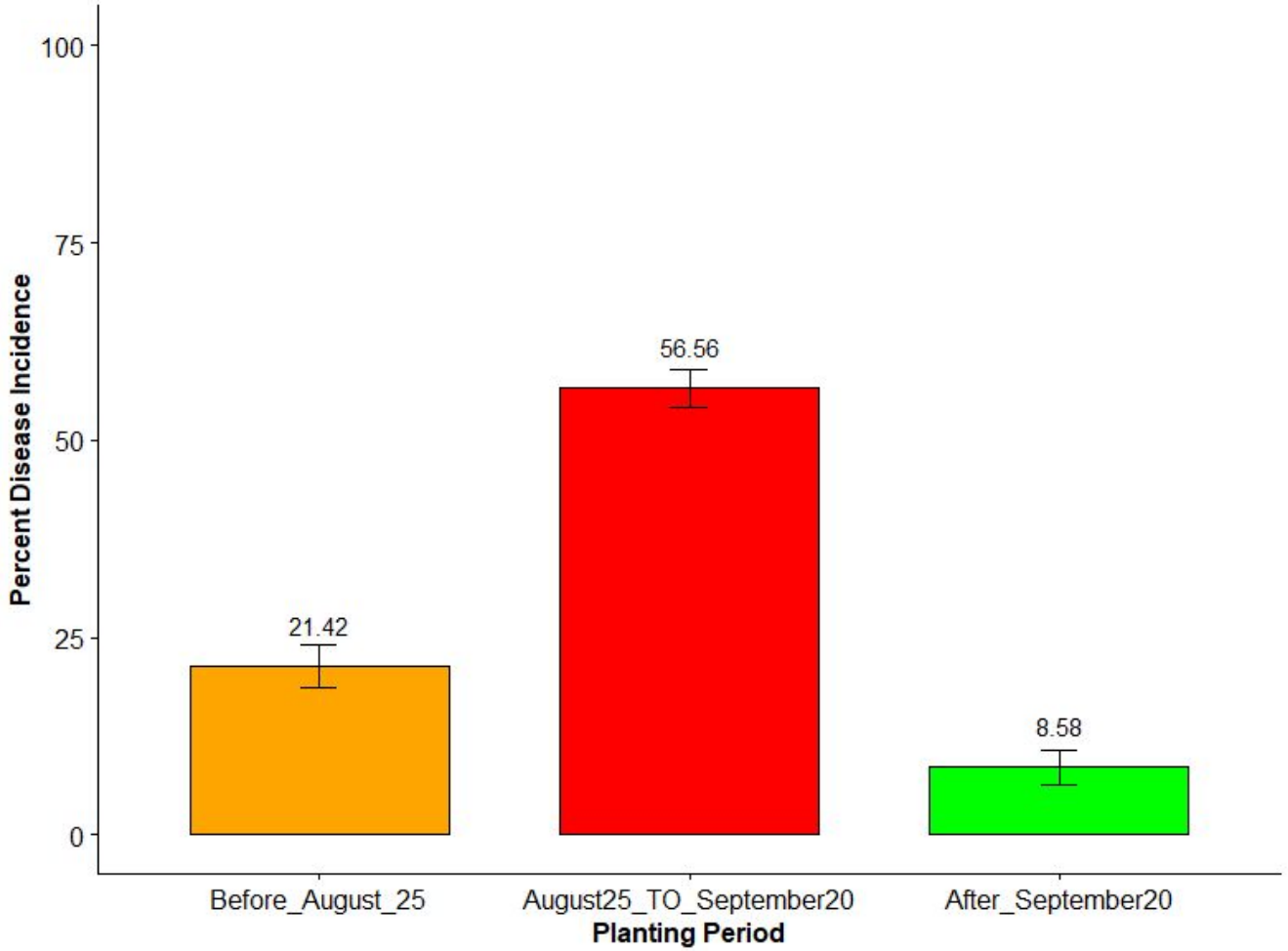


Distance to nearest cotton field impacts the incidence of CuLCrD in squash fields



CuLCrD incidence was lower among squash planted before August 25 or after September 20

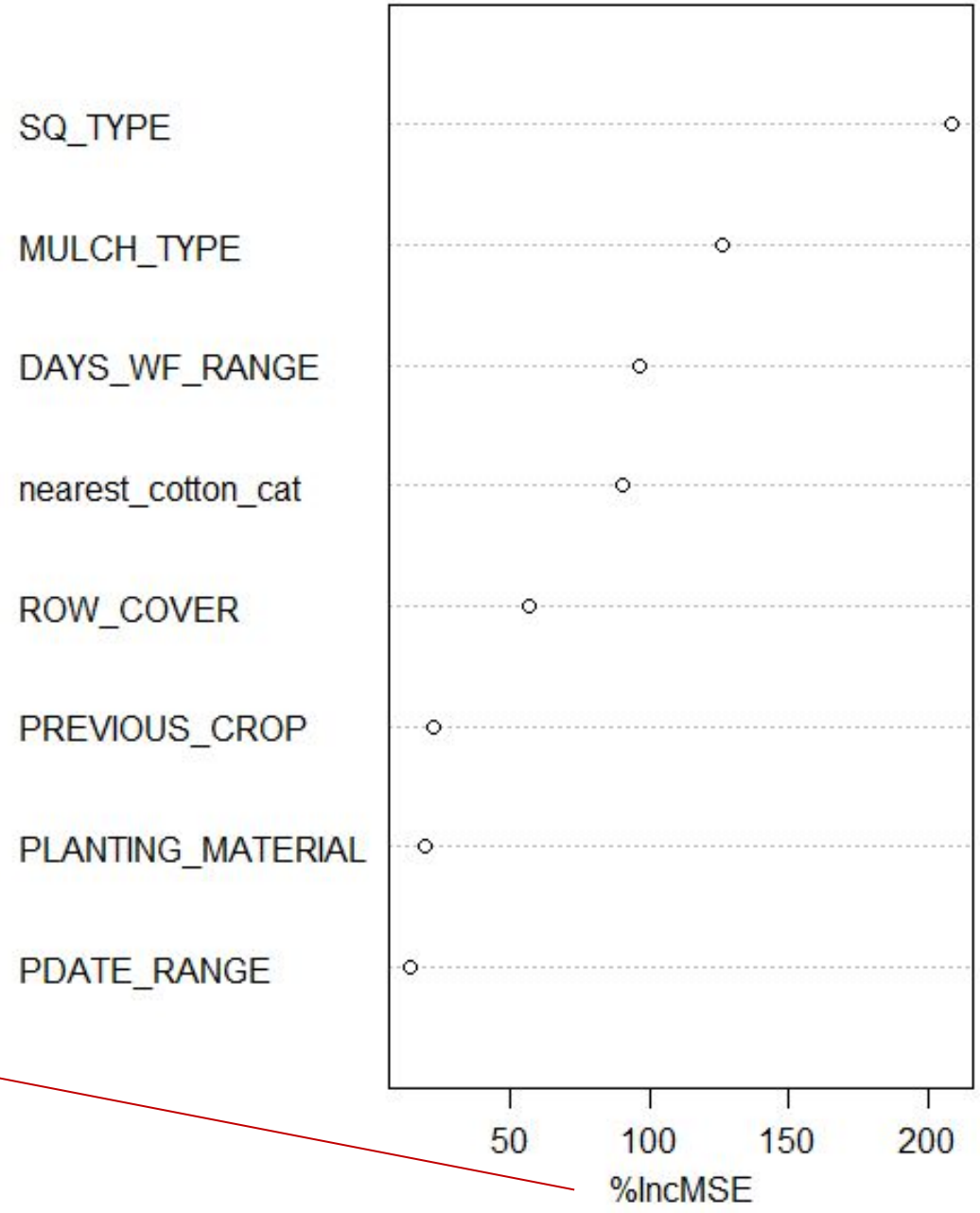




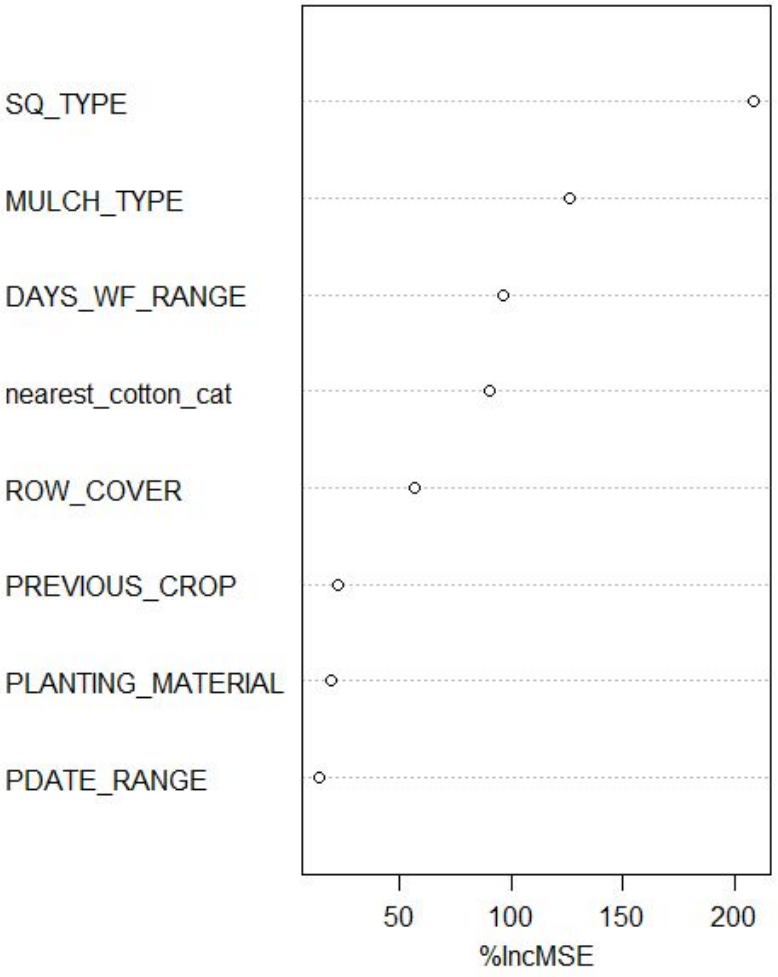
The predictor variables were ranked according to their importance as predictor of CuLCrD incidence based upon Random Forest analysis

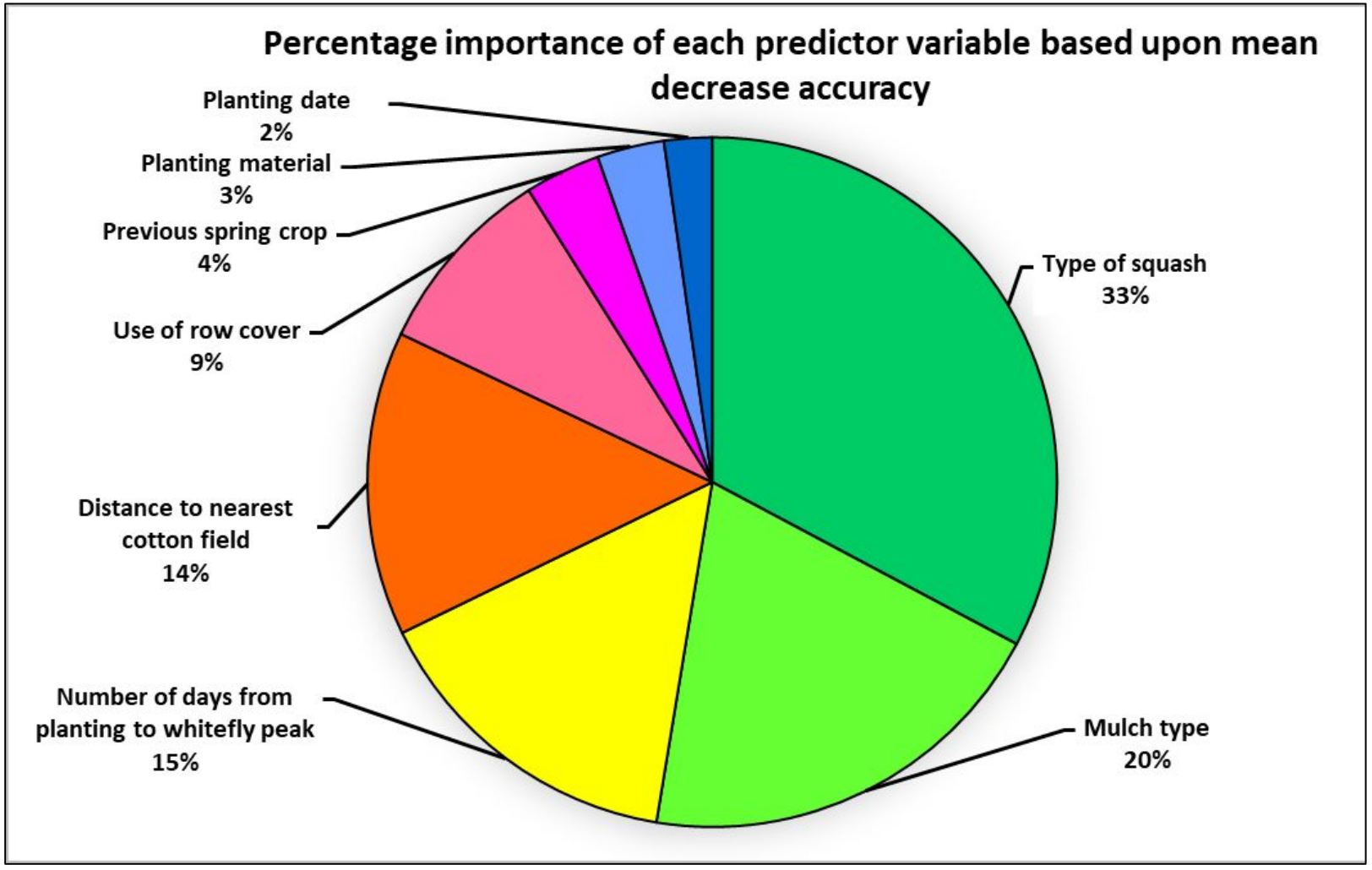
```
Call:
 randomForest(formula = incidence ~ ., data = TrainSet,
 ntree = 1500,      mtry = 6, importance = TRUE)
               Type of random forest: regression
                     Number of trees: 1500
No. of variables tried at each split: 6

          Mean of squared residuals: 218.9407
                    % Var explained: 85.22
```

Mean Decrease Accuracy (%IncMSE) - how much our model accuracy decreases if we leave out that variable.



Type of squash (winter, zucchini, or yellow squash) and type of mulch are the most important predictors of CuLCrD incidence





The maximum risk value possible for each predictor variable was assigned based upon their importance as predictors of CuLCrD incidence

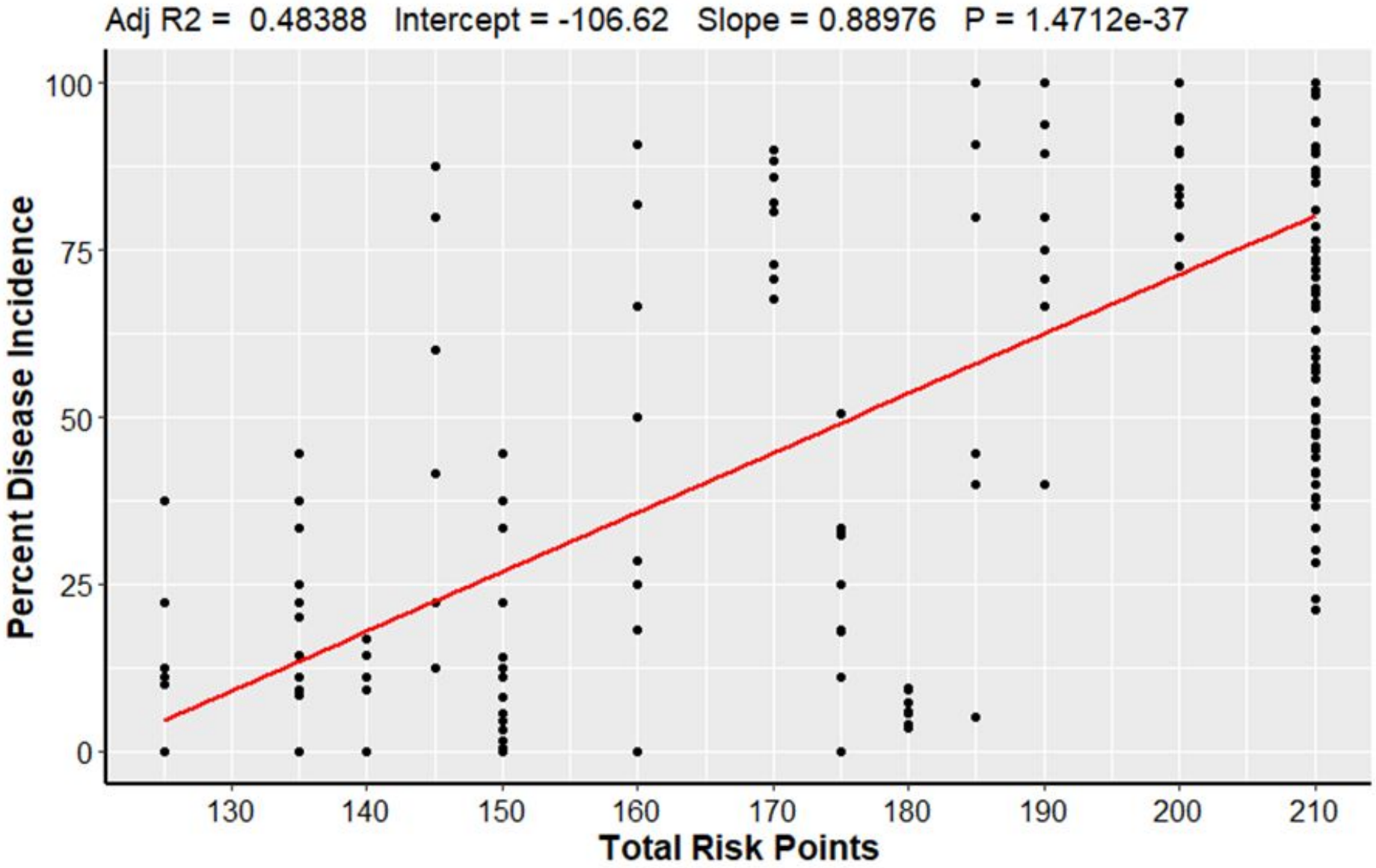
Predictor variable	Mean decrease accuracy	Percent importance	Base value	Maximum risk value assigned per variable
Type of squash	208.32	32.78	225	70
Mulch type	125.90	19.81	225	40
Number of days from planting to whitefly peak	96.61	15.20	225	30
Distance to nearest cotton field	90.70	14.27	225	30
Use of row cover	57.18	9.00	225	20
Previous spring crop	22.51	3.54	225	10
Planting material	20.01	3.15	225	10
Planting date	14.26	2.24	225	10

Squash Rx: a risk assessment index for CuLCrD in squash

Risk point values assigned to each categories under each predictor variable

Variables	Categories	Risk point value
Type of Squash		
	Winter squash	10
	Zucchini squash	30
	Yellow squash	70
Mulch Type		
	Silver plastic	20
	White plastic	30
	Bare ground	40
Distance to cotton field		
	>1 mile	10
	0.5 to 1 mile	20
	<0.5 mile	30
Days from planting to WF peak **NOTE: WF Peak = Sept 15*		
	>35 days before peak	10
	>5 days after peak	10
	21-35 days before peak	20
	20 days before to 5 days after peak	30
Insect Proof Cover		
	Floating cover	5
	Row cover	5
	No cover	20
Planting Date		
	After Sept 20	5
	Before Aug 25	5
	August 25 to Sept 20	10
Planting Material		
	Seedlings	5
	Seeds	10
Previous crop		
	Bell pepper	5
	Tobacco	5
	Watermelon	10
	Squash	10
	Cabbage	10
	None	10
Interpretation of summed risk values		
	Low Risk	**70 - 130**
	Moderate Risk	**135 - 175**
	High Risk	**180 - 220**

Evaluation of Squash Rx: A significant positive linear relationship was detected between total risk point values and the percent CuLCrD incidence



Conclusions:

- Production practices influence the incidence of CuLCrD in squash.
- Some production practices had greater impact on CuLCrD incidence than others

Variables	Categories	Risk based on combined data
Type of Squash		
	Winter squash	10
	Zuchini squash	30
	Yellow squash	70
Mulch Type		
	Silver plastic	20
	White plastic	30
	Bare ground	40
Distance to cotton field		
	>1 mile	10
	0.5 to 1 mile	20
	<0.5 mile	30
Days from planting to WF peak **NOTE: WF Peak = Sept 15*		
	>35 days before peak	10
	>5 days after peak	10
	21-35 days before peak	20
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Insect Proof Cover		
	Floating cover	5
	Row cover	5
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Planting Date		
	After Sept 20	5
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Planting Material		
	Seedlings	5
	Seeds	10
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	Squash	10
	Cabbage	10
	None	10
Interpretation of summed risk values		
	Low Risk	**70 - 130**
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The risk point values from Squash Rx are basis for assessing risk to CuLCrD in squash

The Squash Rx could potentially be a promising risk assessment tool that growers can use to achieve a minimal risk-level based on a set of production practices