Spatial Mapping to Estimate Pest Risk of Verde Plant Bug in Cotton Grown Along the Texas Gulf Coast

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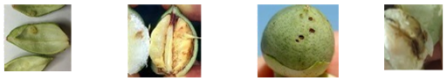
ABSTRACT

ArcGIS spatial mapping tools using crop data layers from USDA NASS were used to relate cropping system diversity (Shannon's Diversity Index [SDI]) to verde plant bug (Creontiades signatus) density observed in south Texas cotton from 2010-2012 (Obj. 1). In a validation exercise, the relationship was used to estimate "expected risk" from verde plant bugs in a new set of fields during a different year (2013) (Obj. 2). The "expected risk" matched 4 of 14 observations (28.6%), modestly over-estimated risk 4 of 14 observations (28.6%), and over-estimated risk 6 of 14 observations (42.9%). The "expected risk" never underestimated the field observations; an error to be avoided in field crop pest management. This provided initial evidence that using spatial GIS tools with landscaped analysis can assist field entomologists, crop consultants, and growers in predicting risk potential from verde plant bug in cotton fields along the Texas Gulf Coast.

INTRODUCTION

The verde plant bug is a relatively new insect pest of cotton grown along the Texas Gulf Coast (Armstrong, et al, 2012). Yield losses caused by this pest occur from the abortion of small fruit (squares & bolls) and damage to the bolls that remain on the crop. Where should pest managers look for this pest and focus their pest management resources in a large production area like south Texas, where 300,000 to 500,000 acres of cotton are grown annually? Mapping and landscape analysis tools are available that may be able to address this question. We previously found a positive linear relationship between increasing pest density of verde plant bug and increasing cropping system diversity for 16 cotton fields along the Texas Gulf Coast from 2010 to 2012. Here we confirmed this relationship and used it to estimate "expected risk" in new fields sampled in 2013 in a validation exercise. Our goal was to evaluate if this pest risk tool can help us to infer the intensities of the verde plant bug along the Texas Gulf Coast.

GREEN BOLLS DAMAGED BY VERDE PLANT BUG



EXPERIMENTAL APPOACH

OBJECTIVE 1: To confirm an initial study model regression of verde plant bug density against Shannon's Diversity Index (using a 1 sq.km. circular buffer).

OBJECTIVE 2: To validate the initial study model by applying "expected risk" results from the initial model to new fields sampled in 2013.

Confirmation of an Initial Study Model: A regression analysis was developed (Table 1) using verde plant bug densities of 16 cotton fields along the Texas Gulf Coast (Fig 1.) over a three-year period (2010-2012) along the y-axis. Shannon's Diversity Index (SDI) for a 1 sq.km. circular buffer cut from a USDA (Cropscape) crop data layer corresponding to the year and location the density data was taken used as the independent variable (x-axis). The verde plant bug density (insects per plant) was calculated from a field sampling during bloom of a minimum of 200 plants per location using a beat bucket sampling technique that is effective and efficient for this insect. The SDI was calculated using the FRAGSTAT function of ArcMap 10 centered upon the field location. The detailed methodology was presented last year (this poster can be found at http://ccag.tamu.edu/files/2013/01/Pruter-2013-Beltwide-Poster.pdf). The resulting regression was y(verde plant bug per plant) = 0.3129x (SDI) – 0.1534 (R^2 of 0.1212) (Table 1).

Validation of initial model: To validate the initial model, new field locations were selected by Texas A&M AgriLife Extension IPM Agents and crop consultants during the spring/summer of 2013. For the validation of the initial model in 2013 a total of 14 new fields were selected (Fig 2.) from 3 regions along the Texas Gulf Coast; Upper Gulf Coast (6), Coastal Bend (2), and Rio Grande Valley (6).

The FRAGSTAT function of ArcMap 10 was used to calculate the SDI for a 1 sq. km. circular buffer centered at the designated field site. The SDI for each new sampling site was substituted for "x" in the linear regression to calculate an expected verde risk for the site. The expected verde risk was then categorized as "low, moderate, or high" based upon previous established thresholds for the insect relating verde plant bug density to probably yield loss (Brewer et al. 2013). This formula designates a "LOW" risk as less than or equal to 0.11 verde per plant, a "MODERATE" risk as greater than 0.11 and less than 0.22 verde per plant, and "HIGH" risk as greater than or equal to 0.22 verde per plant (Table 2).

The new 2013 fields were sampled during mid-bloom for verde plant bugs (using a beat bucket technique per 200 plants) to generate an observed risk which was also categorized under the same criteria as the expected risk. A comparison was then made of the expected risk to the observed risk. Fields in which the two risks matched exactly were considered as "SPOT ON"; fields in which the expected risk was high and the observed risk was moderate were considered as "CLOSER"; and fields in which the two risks differed with one categorized as high and low risk were considered as "WAY OFF" (Table 2).

RESULTS

Fig. 1 Geographic locations of 16 fields sampled along the Texas gulf coast for the verde plant bug during 2010-12, resulting in data used for regression in table 1.

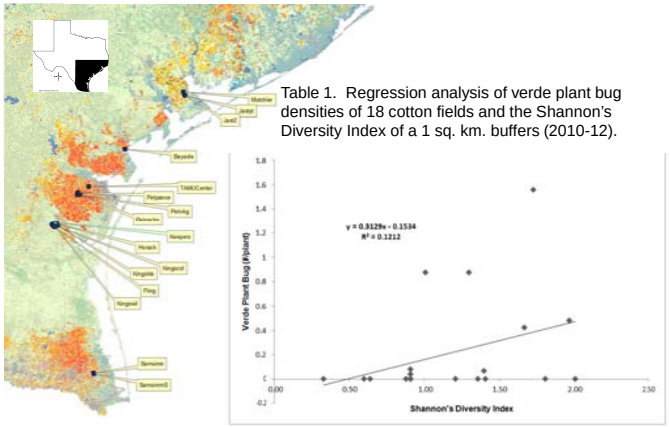


Table 1. Regression analysis of verde plant bug densities of 18 cotton fields and the Shannon's Diversity Index of a 1 sq. km. buffers (2010-12).

Fig. 2 Geographic locations of 14 cotton fields sampled along the Texas gulf coast for verde plant bug during bloom in 2013.

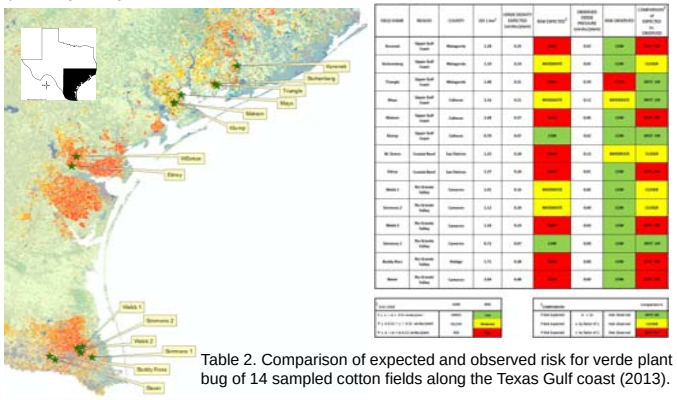
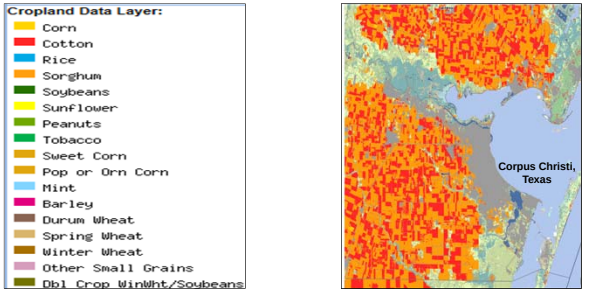


Table 2. Comparison of expected and observed risk for verde plant bug of 14 sampled cotton fields along the Texas Gulf coast (2013).

DISCUSSION

The drought in 2013 resulted in many crop failures and likely suppressed verde plant bug populations throughout south Texas. Even under severe environmental conditions (drought), a majority of the risk estimates (8 of 14) were "spot on" or "closer". Also, the approach did not underestimate the risk of any of the 14 locations. Of the estimates that were "way off", location (distance from coast, 3 fields) and lack of rainfall (3 fields) contributed heavily to the results of the experiment. The work we accomplished gives us a good foundation for building a tool that can be useful for consultants and growers in managing their cotton crop against the verde plant bug. Plans have been laid to improve this tool by the incorporation of additional field sample data, FRAGSTAT environmental indices, other geographic data, and weather.

Map Inspection
Texas Coastal Bend Crop Diversity using a Crop Data Layer



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