Regional Cropping and Landscape Analysis Applied to Cotton Pest Management: Risk Assessment of a Sucking Bug

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INTRODUCTION

For the last two decades cotton fields have suffered losses from boll-feeding sucking bugs in the southern U.S. Relationships between pest density, boll damage, and yield decline have been found for several species, including the verde plant bug, *Creontiades signatus* (Hemiptera: Miridae), in South Texas. Verde plant bug pest potential has been verified in cage studies, including its ability to introduce bacteria causing cotton boll rot (see table). Results from a two year insect survey along the Texas Coastal Bend to the Rio Grande Valley found 99% of the boll-feeding sucking bugs to be this species. It was highly variable in abundance across 15 cotton fields, as was the damage to cotton. Which begs the questions, "Where do pest managers look for this pest in this large cotton-growing region? "

Verification of pest potential of Verde plant bug on cotton


Counting Verde Bugs


Punctured Boll and Damage


Verde Plant Bug Field Cage Study


Diseased Boll (Boll Rot)

	Infest.[z]	Boll count[x]	Locule count[x]	% punctured bolls	% punctured locules	Puncture per boll	% diseased bolls	% diseased locules	Amount disease per boll
2010[y]	0	84	341	11.90	2.93	0.12	0.00	0.00	0.00
	0.25	96	387	35.42	17.05	2.69	17.71	9.82	1.28
	2	67	271	43.28	21.96	4.49	16.42	9.23	0.85
χ^2				14.2 **	46.4 ***	319 ***	14.8 **	32.7 ***	41.3 ***
2011[y]	0	81	324	2.47	0.93	0.037	2.47	0.62	0.25
	2	49	166	35.00	15.06	1.30	27.50	9.64	0.60
	4	49	160	35.00	18.12	1.08	17.50	5.00	0.42
χ^2				22.9 ***	46.2 ***	89.7 ***	14.6 **	22.9 ***	9.1 *

Comparison of insect-punctured bolls and diseased bolls and locules from verde plant bug-infested and uninfested plants (plant infestation varied from 0.25 to 4 verde plant bug per plant, including a 0 non-infested control), Corpus Christi, Texas, 2010 and 2011.

Where do pest managers look for this pest?

When a pest appears geospatially variable across the landscape, pest risk assessment mapping using a geographic information system (GIS) can help address the 'Where to look' question'. The USDA NASS has been building digital cropping maps called crop data layers for the continental US, which are available online at www.nass.usda.gov/research/Cropland/SARSla.htm. These maps show crops being grown annually with very high accuracy especially for field crops like cotton (>95%). By comparing our observed insect abundance data from field scouting with the already created USDA crop data layer, we can be more efficient in identifying pest risk areas and help steer the allocation of our management resources, like pest monitoring.

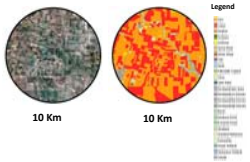
Verde Plant Bug Nymph

Verde Plant Bug Adult

APPLYING NEW MAPPING TECHNOLOGIES

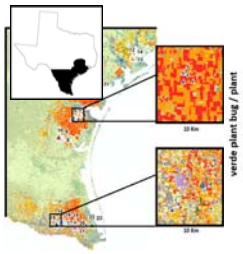
For our South Texas cotton pest, we used ArcMap 10, a GIS program, to cut segments of the crop data layer (downloadable from USDA NASS) to create comprehensive raster-based maps of 6 areas of interest (AOI), each containing 2 to 3 of our 15 cotton fields where we scouted for verde plant bug during mid-bloom. We were working with a wide range of insect densities, including damaging ones at > 0.5 verde plant bug per plant. We used spatial analysis tools to generate many landscape statistics of 1 sq. km sections around our 15 cotton fields (local perspective) and 10 sq. km sections around our 6 areas of interest (regional perspective).

USDA NASS uses multiple Satellite Images (left) to create yearly crop data layers (right)

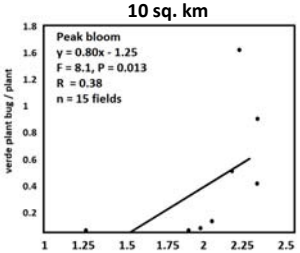


Shannon's Diversity Index (the higher the number the greater the mix in crops) is one of the landscape statistics generated that is used in landscape analysis studies.

Texas Coastal Bend

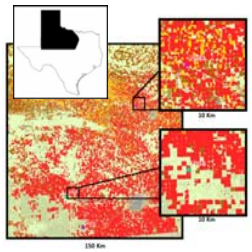


Shannon's Diversity Index 10 sq. km



Using Shannon's Diversity Index, we looked at the relationship between crop diversity in 10 sq km sections surrounding our cotton fields to verde plant bug density per plant. A positive linear relationship was detected, revealing that cotton in the more diverse cropping areas had higher populations of verde plant bug. These areas were concentrated near the coast and major water bodies like the Rio Grande River by inspection of the map. The same result was found using 1 km sections around cotton fields.

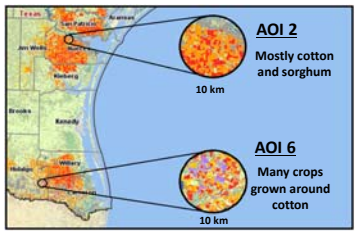
Texas High Plains



The same approach has been used elsewhere. Colleagues in the Texas High Plains (Parajulee et al.) found that Lygus tends to be more abundant in cotton fields located in more crop diverse areas where corn and alfalfa also occur.

MAP INSPECTION

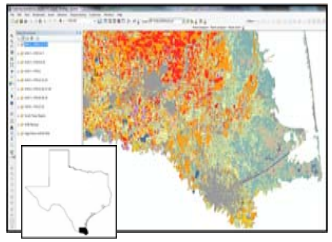
Texas Coastal Bend Crop Diversity using a Crop Data Layer (CDL)



Legend

Notice that area of interest (AOI) 2 has low cropping diversity, and these fields have relatively low verde plant bug densities (a low risk region). This is the case for all the cotton fields inspected for verde plant bug in this area. In contrast, cotton fields in AOI 6 had a higher crop mix and usually more verde plant bug. A second year of insect survey in 2011 and the corresponding 2011 Crop Data Layer was consistent with this pattern.

ArcMap 10 (CDL) view of the Diverse Rio Grande Valley Region



ArcMap 10 has allowed us to manipulate the crop data layer from USDA NASS and focus on specific cropping areas. For South Texas, analysis revealed that diverse cropping areas are more prone to verde plant bug. By inspecting the map, these high pest risk areas occur more toward the coastline and major water bodies like the Rio Grande River.

CONCLUSIONS

1. *New mapping tools are available for agricultural and regional pest management application: Cropping system regional maps and insect monitoring data can be merged to help address the question 'Where should pest managers look for this pest?*

2. *Pest management monitoring for verde plant bug on cotton in South Texas should focus on high risk fields: cotton fields located where many crops are grown near the coast and major rivers.*

ACKNOWLEDGEMENTS

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