Genetic Characteristics of Local Lygus lineolaris Populations

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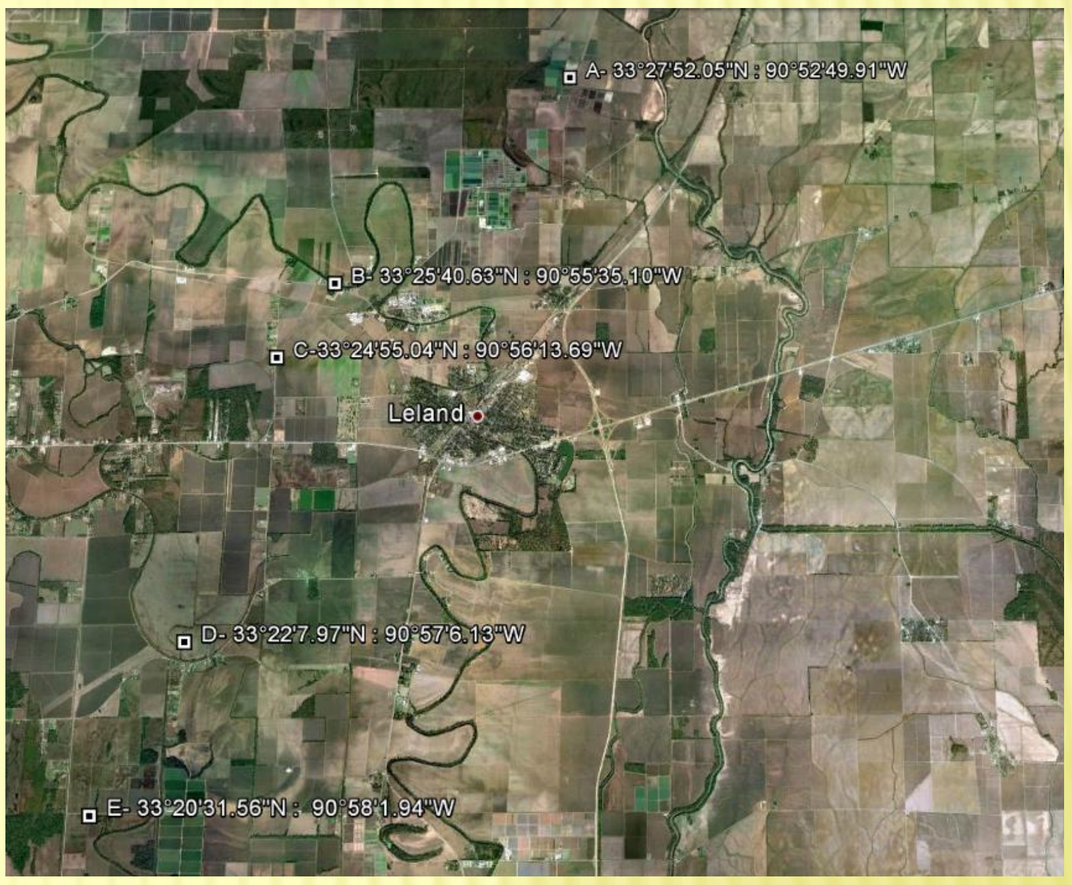
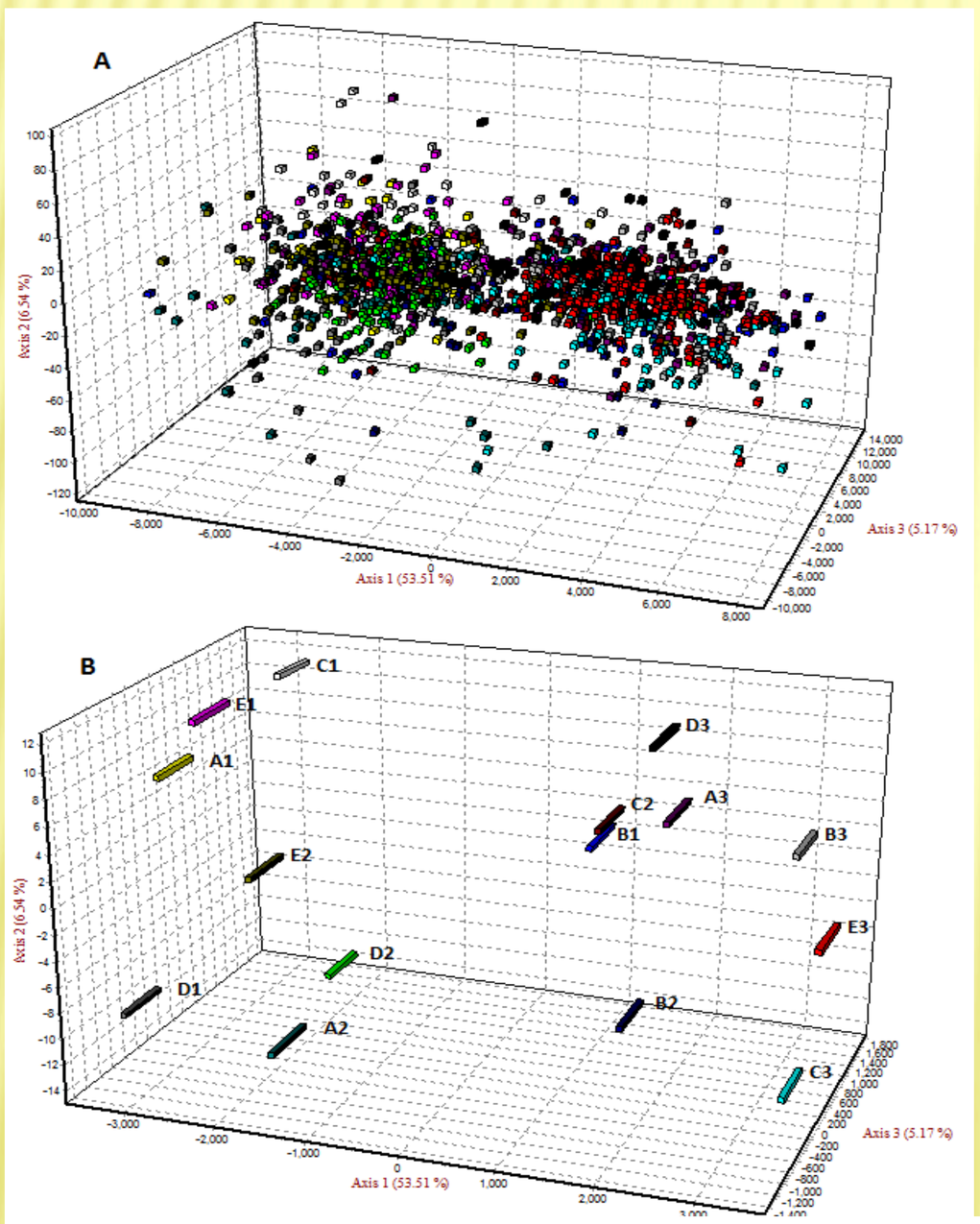
Lygus lineolaris, also known as the tarnished plant bug (TPB), is an agricultural pest affecting the growth of various crops in many parts of North America, including the southern United States. As of now, synthetic insecticides specifically tailored to control TPB populations are administered to crops multiple times throughout each growing season. However, continual insecticide usage has prompted genetic selection within *TPB* populations, resulting in widespread insecticide resistance in *L. lineolaris*. In other words, insecticides eliminated most of the insects, excluding those that have genes that make them resistant to the insecticide (the use of insecticides has "selected" those genes). The insecticide-resistant bugs reproduce, resulting in a higher percentage of resistant bugs than before. Therefore, the development of more synthetic insecticides would only have temporary effectiveness since the targeted pests would eventually develop a new resistance to them. Also, more synthetic insecticides would only enlarge the environmental footprint left behind by agricultural chemicals. In order to design better ways to manage insecticide-resistant bugs, more information concerning the genetic variation and distribution of *TPB* populations is required.



Five collection sites; bugs were collected from each site three times over a four-month period

One particular study (Perera et al., draft) conducted by USDA-ARS researchers compares the genetic characteristics of different L. lineolaris populations near Stoneville, MS and tracks their genetic variability at multiple times throughout the growing season. First, L. lineolaris adults were collected from five locations in a small geographic area surrounding Stoneville, MS in May, July, and September 2006. The insects were then preserved at -80^{o}C until they were used for DNA extraction. Genomic DNA (gDNA) was extracted from ninety-six TPB specimens from each population. Then, the gDNA was genotyped using fourteen pre-designed microsatellite markers along with genotyping software. Software-performed statistical analysis was used to calculate informative genetic parameters from the resulting genotypes, such as allelic diversity, Garza-Williamson indices (M values), and linkage disequilibrium. Allelic diversity is a measure of genetic variation, M values serve as an indicator of population bottlenecks, and linkage disequilibrium may indicate that certain loci have been selected by outside factors (Perera et al., draft). Also, a descriptive technique called factorial correspondence analysis (FCA) was used to identify relations between different populations. These genetic parameters, among others, were calculated and interpreted in order to evaluate the genetic state of these local populations.



FCA results showing centroid values for (a) individuals and (b) populations

The resulting genetic parameters showed that there was considerable genetic differentiation between the *L. lineolaris populations*. Also, FCA calculations indicated that two "genetic clusters" existed among the fifteen groups. Almost all of the populations (four out of five) appeared in the first genetic cluster in early season (in May) and transferred to the other cluster in late season (in September). Furthermore, low M values and a decreasing allelic diversity throughout the season suggest that the populations experienced a "population bottleneck," meaning that a significant decrease in population size caused the genetic variation of the population to decrease. The significant linkage disequilibrium values support this finding, as they are an indication that several of the genetic loci have been subject to selection by some external factor. Given the indigenous environment of these populations, it is mostly likely that the selection exerted on these populations was caused by insecticide usage (Perera et al, draft). More studies will be required in order to pinpoint the genetic loci represented by the microsatellite markers used.

References:

Perera, O. P., J. Gore, G. L. Snodgrass, R. E. Jackson, K. C. Allen, C. A. Abel, and R. G. Luttrell. "Temporal and Spatial Genetic Variability of the Tarnished Plant Bug, *Lygus lineolaris* (Palisot de Beauvois), Populations in a Small Geographic Area." (Draft)

Perera, O. P., G. L. Snodgrass, B. E. Scheffler, J. Gore, and C. A. Abel. 2007. Characterization of eight polymorphic microsatellite markers in the tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois). Molecular Ecology Notes 7: 987-989.

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