United States Department of Agriculture
Midwest Climate Hub

Potential Geographical Range & Abundance of the Invasive Brown Marmorated Stink Bug under Climate Change Scenarios

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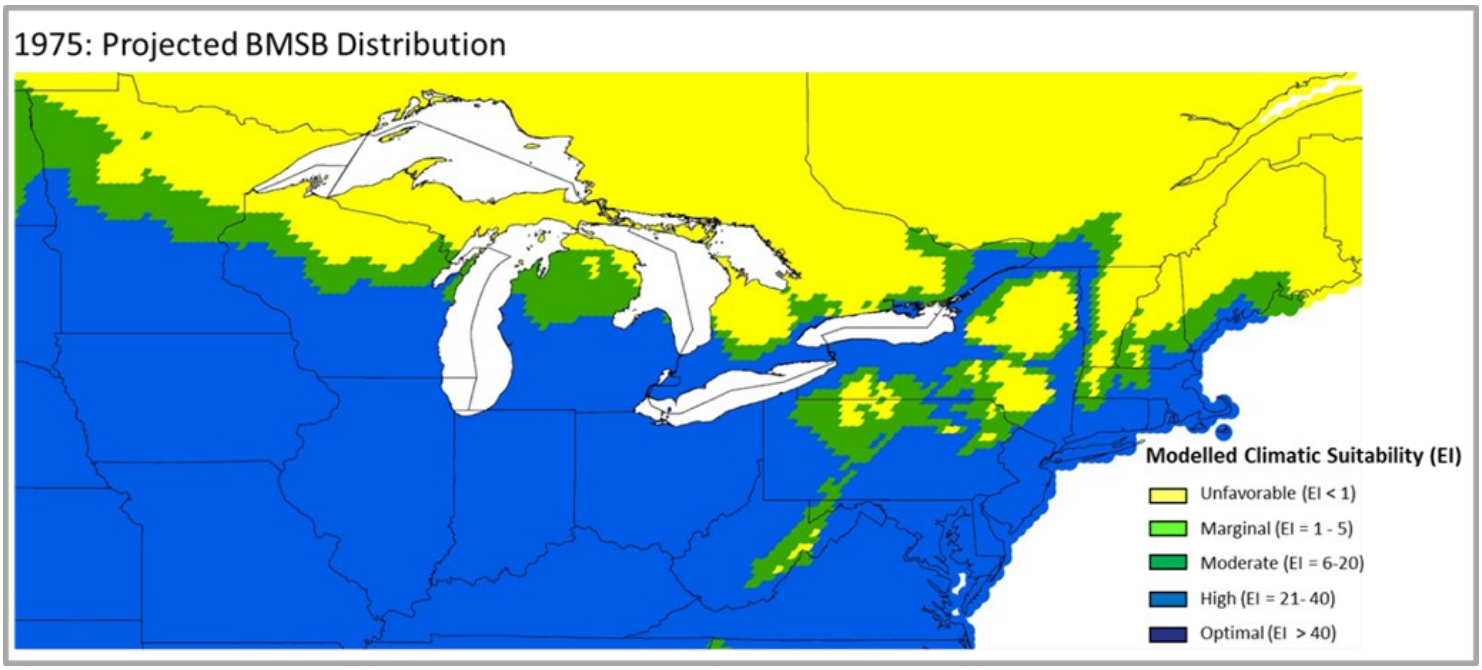
Climate change is predicted to exacerbate agricultural losses from crop pests and pathogens by 1) expanding their geographic ranges, 2) reducing winter die-offs, and 3) increasing the number of generations produced per year. For example, numerous crop pests and pathogens have expanded their range northward since the 1960s due, in part, to warming annual temperatures.

A Case Study with a Recent Invader

The brown marmorated stink bug, Halyomorpha halys (BMSB) is native to East Asia where it is a minor pest of fruit trees with occasional outbreaks. In less than twenty years, BMSB has become a major specialty crop pest in the U.S. due to a lack of natural enemies and an abundance of food. Since its initial discovery in Pennsylvania in 1996, BMSB has been detected in 43 U.S. states; 9 of which currently report severe agricultural losses from this invasive pest. Alarmingly, BMSB populations in many U.S. states are continuing to grow and spread.

BMSB is not a picky eater with > 300 known host plants including economically important crops like applies, sweet corn, tomatoes and soybean. BMSB is also a nuisance pest as it will overwinter in human-made structures. This highly adaptable pest poses a serious threat to the United States specialty crop industry. Specialty crop losses from BMSB are expected to increase under ongoing climate change as rising temperatures, especially in the winter, will likely enable BMSB to further expand its range northward as well as enhance BMSB survival and reproduction.

Figure 1. BMSB eating an apple. In 2010, the mid-Atlantic apple industry suffered ~ US$37 million in losses from BMSB feeding damage. Photo by Tracy Leskey, USDA -ARS Appalachian Fruit Research Station.



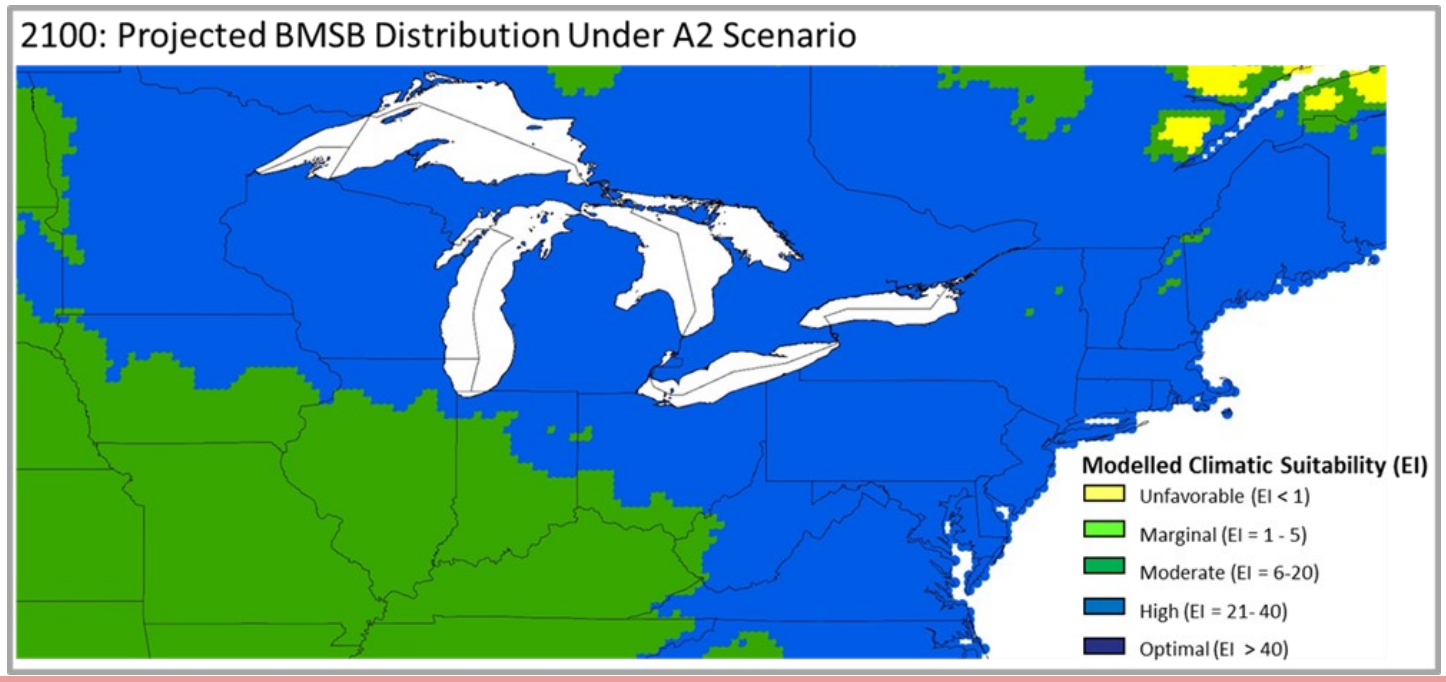
Methods

We employed bioclimatic simulations in the program CLIMEX to determine the potential geographic distribution and abundance of the invasive BMSB in the U.S. Midwest and Northeast regions under different climate scenarios. We used CLiMond 10' resolution (~344 km2) gridded climate data to map potential distribution of BMSB under the following three scenarios: (1) historical climate data from 1951-2000 (centered on 1975) and projected SRES A2 greenhouse gas emissions climate change scenarios for the years 2) 2050, and 3) 2100. The SRES A2 represents the "worst case" scenario (i.e. no reductions in greenhouse gas emissions), which highlight the invasion potential of BMSB. Parameters describing BMSB responses to abiotic conditions were inferred from its known geographic distribution as well as published experimental data.

Results

Projected rising winter minimum temperatures would enable BMSB to expand its range northward throughout much of the Midwest and Northeast regions. In addition, rising annual temperatures are expected to increase the number of BMSB generations per year. Currently, BMSB is reported to have a single generation per year in both the Midwest and Northeast regions. By 2100, BMSB is predicted to exhibit 2 generations per year in the major apple growing regions of New York, Pennsylvania, and Michigan.

However, there is some good news; by 2100, climatic conditions in the southern Midwest will become less favorable for BMSB, which originates from a temperate climate. The A2 scenario's projected daily mean and maximum temperatures in July-August of 2100 will be well above BMSB's optimal temperature limit of 77°F, which in turn should reduce BMSB growth and reproduction. Unfortunately, our neighbors to the north, particularly Ontario and Québec, may experience increased BMSB outbreaks as warming winter temperatures enable BMSB to expand its range in Canada.



The Take Away

Overall, CLIMEX simulations indicate that BMSB will benefit from ongoing rising temperatures by expanding its range northward and increasing the number of generations produced per year. Therefore, specialty crop growers should be especially wary of this pest given that effective biological and chemical control of BMSB is still being investigated.

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