Escape from disease: its role in broomsedge invasiveness and weediness Janet A. Morrison, Department of Biology, The College of New Jersey, Ewing NJ, 08628

Project Summary

This project begins to investigate whether escape from a parasitic smut fungus (*Sporisorium ellisii*) is a factor in why the eastern native grass broomsedge (*Andropogon virginicus* L.) is a weed in pastures, a serious invasive in Hawaii where it is introduced, and not invasive in California, where it is also introduced. The enemy release hypothesis has gained wide acceptance for non-native invasions, but there are inadequate direct tests of the hypothesis, and most studies address insect herbivores rather than pathogens, even though disease can have strong negative effects in natural plant populations. We are surveying a number of broomsedge populations from each range for disease frequency and plant characteristics related to weediness, developing protocols necessary to produce smut fungus inoculum, and conducting a pilot common-environment study in the greenhouse to compare growth, physiology, and disease resistance of plants from all the ranges, under inoculated and non-inoculated conditions. Also, we are comparing the changes over two years in an infected and uninfected population of plants in the native range, to indicate the potential for host population regulation by the pathogen. This program of basic research relates to the USDA CSREES NRI goal of understanding ecological processes that contribute to plant invasiveness. It may eventually aid in developing an environmentally sound biocontrol agent for broomsedge, which supports the Natural Resource and Environmental Quality agricultural issue.



Above: Broomsedge infructescence: left, healthy; right, smutted

Below: Broomsedge invasion in Hawaii



How does the disease affect individual plants and their populations in the native range?





DISEASE SEVERITY AND FITNESS

Individual plants within a population may be uninfected and produce seeds normally, may have partial infection with only some sterile spikelets, or have all spikelets infected and so be completely sterile.

INFECTION FREQUENCY

Four populations surveyed in detail showed overall infection rates ranging from 15% to 31%.





MORPHOLOGY Plants with different infection status show variation in plant morphology. The more severely diseased tend to be somewhat shorter (left; Spearman rank correlation r = -0.19, P = 0.04, n

= 177). Tiller numbers are very similar for uninfected and systemically infected plants but significantly larger for partially infected plants (right; uninfected mean = 4.17, se = 0.59; systemic infected mean = 4.8, se = 0.46; partially infected mean = 8.65, se = 0.91, ANOVA F = 10.91, P<0.001, df = 2, 171).



PHOTOSYNTHESIS Plants infected with smut fungus have lower photosynthesis rates than uninfected plants (one-tailed t-test, t =1.82 , P =0.04, df = 50).

NEXT STEPS : Longitudinal study of large samples of infected and uninfected individuals

Comparison of population dynamics of infected and uninfected populations

Main Questions and Preliminary Results

What factors influence host plant susceptibility and disease transmission, and how does the pathogen infect host plants?



PLANT DENSITY AND DISEASE Plant density (top) and infection rate (bottom) show similar spatial pattern across the Mercer1 site, and are positively correlated (Spearman's rank r = 0.26, P<0.001, n = 174 plots).





BEETLE Infected plants in the Mercer2 population were examined for the presence of a mycophagous beetle larva (Family Ciidae), which may be a possible vector for the disease.



SMUT FUNGUS CULTURE

We have succeeded in growing the smut fungus in culture and are experimenting with the best inoculation method for experimental work.

mycelial culture on ag

NEXT STEPS : Expanded longitudinal study of plantpathogen density dependence (with spatial analysis)

Infection trials: pathogen races vs. host genotypes X environmental conditions

Beetle exclusion experiment

Develop DNA markers for presence of smut in plant tissue



Do broomsedge populations in the native range (old-fields and pastures) the naturalized range (California) and the invasive range (Hawaii) differ genetically in weedy characteristics, disease resistance/tolerance, and disease frequency?



POPULATION

SURVEYS Multiple broomsedge populations have been located and mapped with a GPS in the eastern states (NJ through NC), in California (central valley), and in Hawaii (especially in Volcano National Park).





NEXT STEPS :

Assess populations for disease presence and plant density

Collect seeds for an experiment at The College of New Jersey to compare growth, physiology, and disease resistance of plant genotypes from all the ranges, under inoculated and noninoculated conditions

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