Fusarium oxysporum isolate M12-4A controls *Striga hermonthica* in the field in west Africa

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Striga hermonthica (Del.) Benth is one of the most serious threats to cereal production in western Africa. This angiosperm parasite penetrates and fuses to the vascular system of the host roots, deriving water and nutrients for its growth and reproduction. An isolate of *Fusarium oxysporum* (M12-4A) is being evaluated as a tool to control striga infestations. Field trials in Mali tested soil-incorporation of straw pieces, ammonium nitrate and of the fungal isolate grown on straw pieces. Isolate M12-4A alone, and in combination with ammonium nitrate fertilizer, was found to be effective in controlling striga. In the latter case, the total number of striga parasitizing sorghum, and striga biomass were reduced by nine and 13 times respectively when compared to controls. Sorghum-yields increased by 100% in inoculated plots. Other important aspects of the biocontrol strategy such as shelf-life of the inoculum and low-cost technology for inoculum production (for subsistence farmers) were also examined. *Fusarium oxysporum* M12-4A grown on moist sorghum straw for seven days, dried and kept in the dark at 28°C can survive for at least 18 months. This dried material, referred to as 'inoculum starter', can be readily used to inoculate moist sorghum straw to produce fresh inoculum. Various amounts of inoculum starter (0.005, 0.01, 0.02, 0.03, 0.04, 0.05, 0.1 g) were incorporated to moist sorghum-straw in flasks to compare the rate of colonization of the straw. As little as 0.04 g of inoculum starter was sufficient to recolonize straw as effectively as a mycelial plug from a fresh culture. Moreover, these various inocula were simultaneously incorporated into pots infested with striga to determine the minimum dosage of inoculum starter needed to produce a striga-suppressive inoculum.

From the individual to the population in biological control of ragwort, *Senecio jacobaea*

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The ragwort flea beetle, *Longitarsus jacobaeae*, is able to regulate populations of its host, *Senecio jacobaea*, at very low average levels. We used a field experiment to test whether spatial heterogeneity and dispersal can explain the strong supression of plant populations and the persistence of plant-insect interactions. The treatments combined four levels of plant density (1, 4, 8, 16 rosettes per 0.25 m^2 patch) and two levels of insect density (patches with or without insect exclusion cages). Beetle-responses were measured as the number of colonizing beetles in one generation $N(t)$ (behavioural response), the numbers of emerging beetles in the subsequent generation $N(t+1)$ (numerical response), and the *per capita* rate of change of the beetle population ($N(t+1)/N(t)$). Beetle responses were measured and expressed as number of beetles per patch and re-expressed as beetles per host and per unit of host biomass to investigate ratio-dependence of beetle responses. We first assessed the magnitudes and causes of variation in the number of beetles per host. The number of beetles colonizing in the first generation increased with the number of hosts per patch at a decelerating rate, meaning that the number of beetles per host decreased with increasing numbers of hosts per patch. The number of beetles emerging in the second generation also increased with the number of hosts per patch. The spatial distribution of beetles set by colonization remained unchanged after reproduction, with log-log plots of the number of beetles per patch against numbers of host per patch yielding indistinguishable slopes for colonizing- and emerging-beetles. Thus, beetles respond to spatial variation in the

number of hosts per patch primarily by changes in movement rather than by changes in reproductive rate. Variation in the beetle:host ratio, among patches differing in the number of hosts, suggests that every host within the population may not have the same risk of attack. We next evaluated the consequences of variation in the number of beetles per host for rates-of-change in beetle- and host-populations. The *per capita* rate of change of the beetle population was slightly lower in 1-plant patches, but constant across other levels of host density in 4-, 8- and 16-plant patches. The lower growth-rate of beetle populations in single-plant patches was associated with a male bias (1.4:1) in sex ratio. The beetle population depressed plant-yield by a constant proportion across all levels of host-density indicating there was no density dependence in the size of the beetle effect. We draw the following conclusions about the pattern of beetle distribution, its causes, and its consequences for insect- and plant-population dynamics. Spatial heterogeneity and insect dispersal led to variation among patches in the number of beetles per host, but the magnitude of variation was not sufficent to significantly aggregate risk to hosts, either by imposing density dependence in positive effects of host-on-beetle populations, or by imposing density dependence in negative effects of beetle-on-host populations. Thus strong and stable supression of ragwort does not arise as a result of spatial heterogeneity and searching behaviour within fields, where plant-insect interactions spiral down to local extinction. An alternative possibility is that regulation occurs on more global scales through spatial heterogeneity and migratory movement between fields in a landscape. Density dependence does appear to be operating within the local host-population; in a patchy world, resources can often limit plant population growth, even at very low average densities characteristic of successful biological control.

Impact of a gall-forming rust fungus, *Uromycladium tepperianum*, on populations of an invasive tree, *Acacia saligna*, in South Africa

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A gall-forming rust fungus, *Uromycladium tepperianum*, first released in South Africa in 1987, has been artificially established on *Acacia saligna* trees at more than 150 localities in the Western and Eastern Cape Provinces of South Africa. Following further natural wind-dispersal of the fungus, it is now present throughout most of the range of the weed. Monitoring of weed populations at eight localities in the Western Cape Province showed that populations at all sites decreased in density by 80-94% six or seven years after the fungus was established, unless the area was burnt, which stimulated seed-germination and growth of seedlings. The number of seeds in the soil seed-bank has stabilized at most sites indicating a reduction in annual seed-production by the tree.

Measuring the intensity of herbivore pressure on goldenrods, *Solidago* species

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A new protocol for measuring herbivore pressure is illustrated by studies on goldenrods (*Solidago altissima*/*canadensis*) in New York where the plants are native and harbour a diverse fauna of at least 103 species of phytophagous insects. Pyrethroid insecticides were applied on a staggered-triennial schedule to produce plants that escaped herbivory in different years. By comparing plant performance in the controls with the various insecticide treatments, it was possible to measure the annual variation in both the contemporaneous and cumulative