Does Disturbance Similarly Facilitate Weed Invasion within Grass, Forb, and Shrub Plots?

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Introduction Big sagebrush communities (*Artemisia tridentata* Nutt .) in the Great Basin have been degraded by the synergistic consequences of chronic disturbance and annual weed invasion (Young and Evans 1978) . Repairing ecosystem function is an overarching goal of restoration efforts , but it remains unclear which species most effectively resist weed invasion and how disturbance mediates weed invasion . We evaluated whether disturbance similarly facilitates invasion in single-species grass , forb , and shrub plots .

Materials and methods Experiments were conducted at Millville , UT (41°39 .44′N , 111°48 .88′W , 1402 m) . The soil is a gravelly loam series . Plots (1 .5 m×1 .5 m , 1 m aisles) were established in May 2003 from transplants reared in a greenhouse , and consisted of 24 plants in a 5×5 square arrangement equally spaced (30 cm apart) , with the center plant absent . Three plot-types were randomly located with 30 replicates : grass (*Agropyron cristatum* [L .]) , forb (*Achillea lanulosa* [Nutt .] Piper) , and shrub (*Artemisia tridentata* var .*wyomingensis* [Beetle & A . Young] Welsh) . A disturbance treatment was applied in mid November 2004 to 15 replications by removing four plants from the 1 m^2 center of plots with a shovel to potentially increase above and below-ground resources and create safe seed sites for the two invasive species . Plots were seeded an invasive annual grass (*Bromus tectorum* L .) and an invasive forb (*Isatis tinctoria* L .) autumn 2004 and 2005 (400 seeds per species) . Total weed seedling density was determined in summer 2005 and 2006 . Total (non-weed) shoot dry mass , soil nitrate and solar radiation (400-700 nm) at the soil surface was determined for plots in summer 2006 .

Results Disturbance significantly increased weed density for all three growth forms except for *Agropyron* in 2006 (Figure 1) . Within a treatment , weed density was less variable in 2005 than 2006 . Weed density also sharply increased between 2005 and 2006 in all plots except *Agropyron* . In fact , weed density declined within disturbed *Agropyron* plots during the study . In contrast , *Achillea* and *Artemisia* plots had 2-3 fold greater weed density than *Agropyron* . Total plot non-weed shoot dry mass (g) of *Achillea* (1957 ±542) was lower (P <0 .01) than *Agropyron* (4608±542) , which was lower (P <0. 01) than *Artemisia* (14 ,594 ± 542) . The disturbance treatment did not consistently increase soil nitrate (mg kg^{-1} soil) or solar radiation at the soil surface (mol m^{-2} s^{-1}) . However , *Achillea* plots had significantly greater (P<0. 01) mean soil nitrate and solar radiation (5 .2±0 .05 and 382± 50) than *Agropyron* (1 .3 ± 0 .05 and 355 ± 50) and *Artemisia* (0 .9±0 .05 and 155±50) plots , respectively .

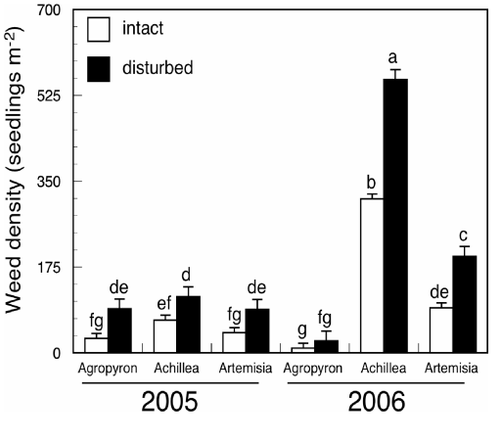

Figure 1 *Mean (+1 SE) weed density in autumn . (Lowercase letters indicate differences (P<0. 01) .*

Conclusions The importance of disturbance to mediate weed invasion is clearly corroborated by our results . The capability of the long-lived perennial grass (*Agropyron*) to resist invasion appears to be associated with greater biomass productivity . In contrast , high susceptibility to weed invasion of *Achillea* plots was due to significantly greater amounts of underutilized above and belowground resources (Davis et al . , 2000) . Our results agree with the general contention that disturbance events increase available resources or safe sites for weed invasion . Perennial grasses appear to be a necessary component of minimizing underutilized resources . Our results also emphasize that managerial efforts to reduce the recurrence of disturbance events should be a primary goal to reduce the impacts and prevent continual dominance of invasive annual species in the sagebrush-steppe ecosystems of the Great Basin .

References

Young , J .A . , Evans , R .A . , 1978 . Population dynamics after wildfires in sagebrush grasslands . *Journal of Range Management* 31 :283-289 .

Davis , M .A . , Grime , J .P . , Thompson , K . , 2000 . Fluctuating resources in plant communities : a general theory of invisibility . *Journal of Ecology* 88 :528-534 .