

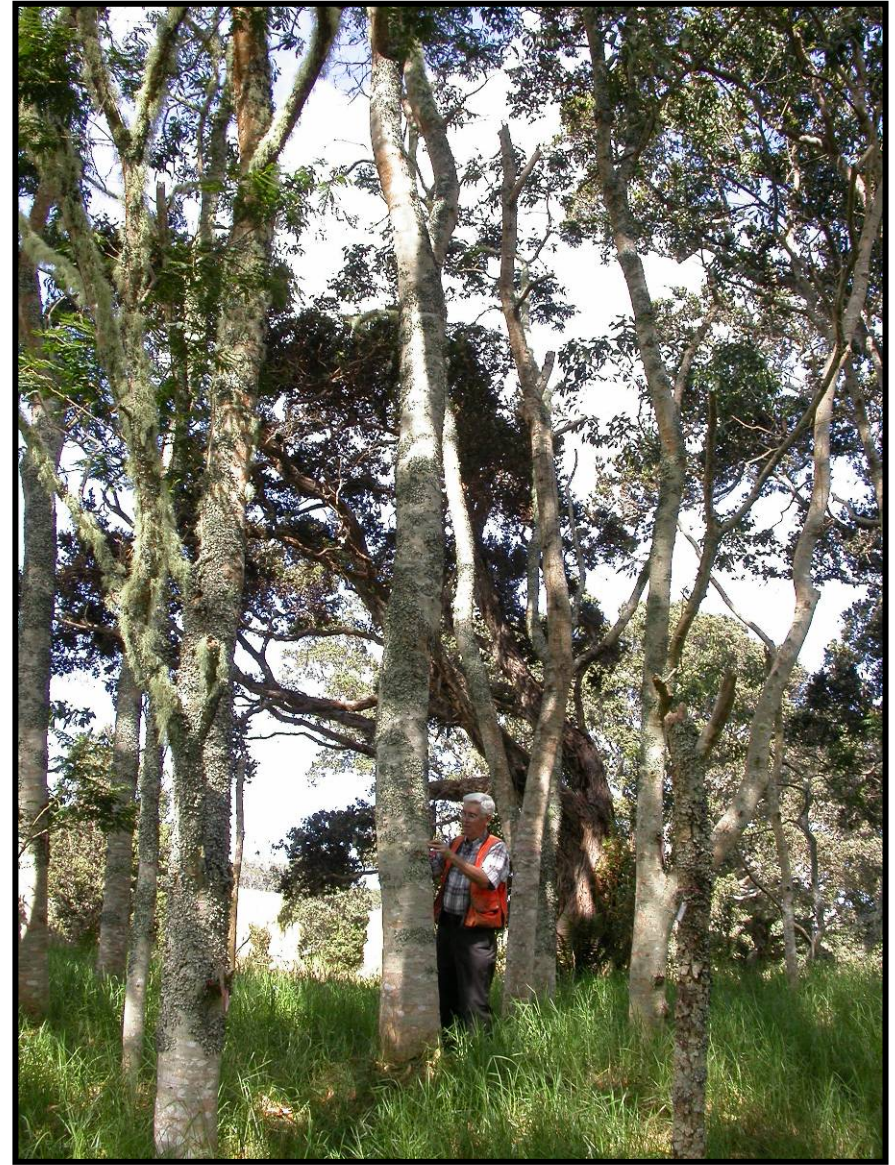
## Regenerating *Acacia koa* by soil scarification



Disk plow turning over sod in abandoned grassland at Hakalau Forest National Wildlife Refuge in 1987



Twenty-one year old *Acacia koa* tree naturally regenerated in grassland following scarification with a disk plow (1680-m elevation)

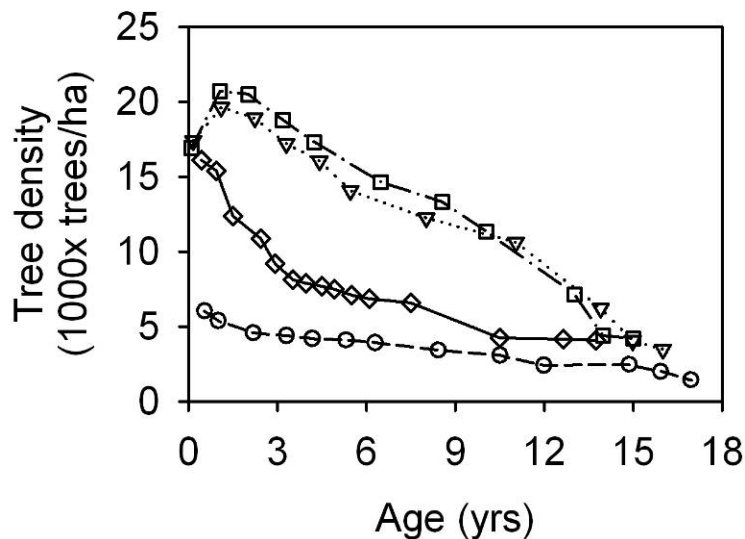


Twenty-one year old koa naturally regenerated by disk plowing under the canopies of old-growth koa parent trees

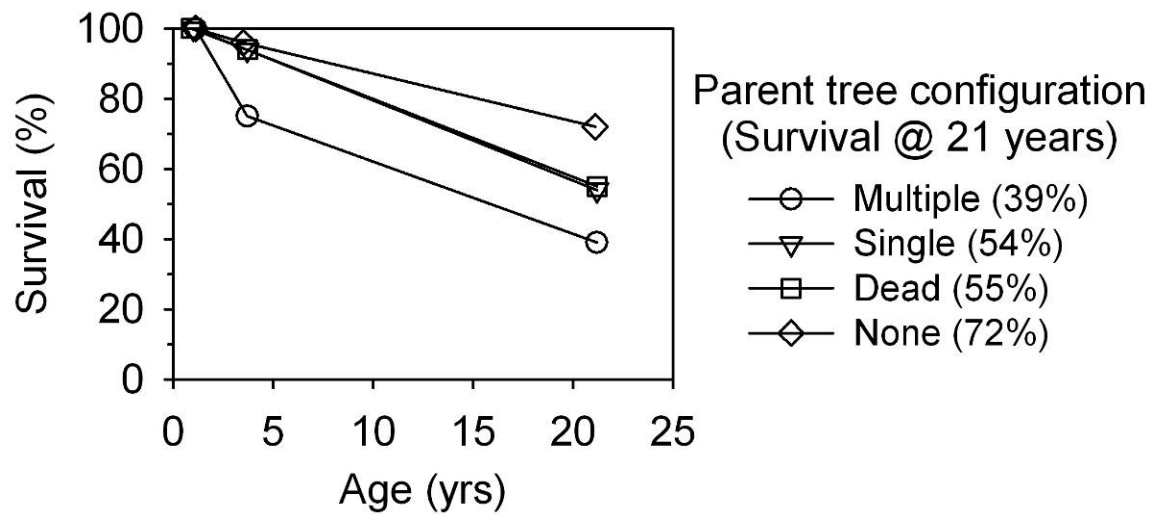




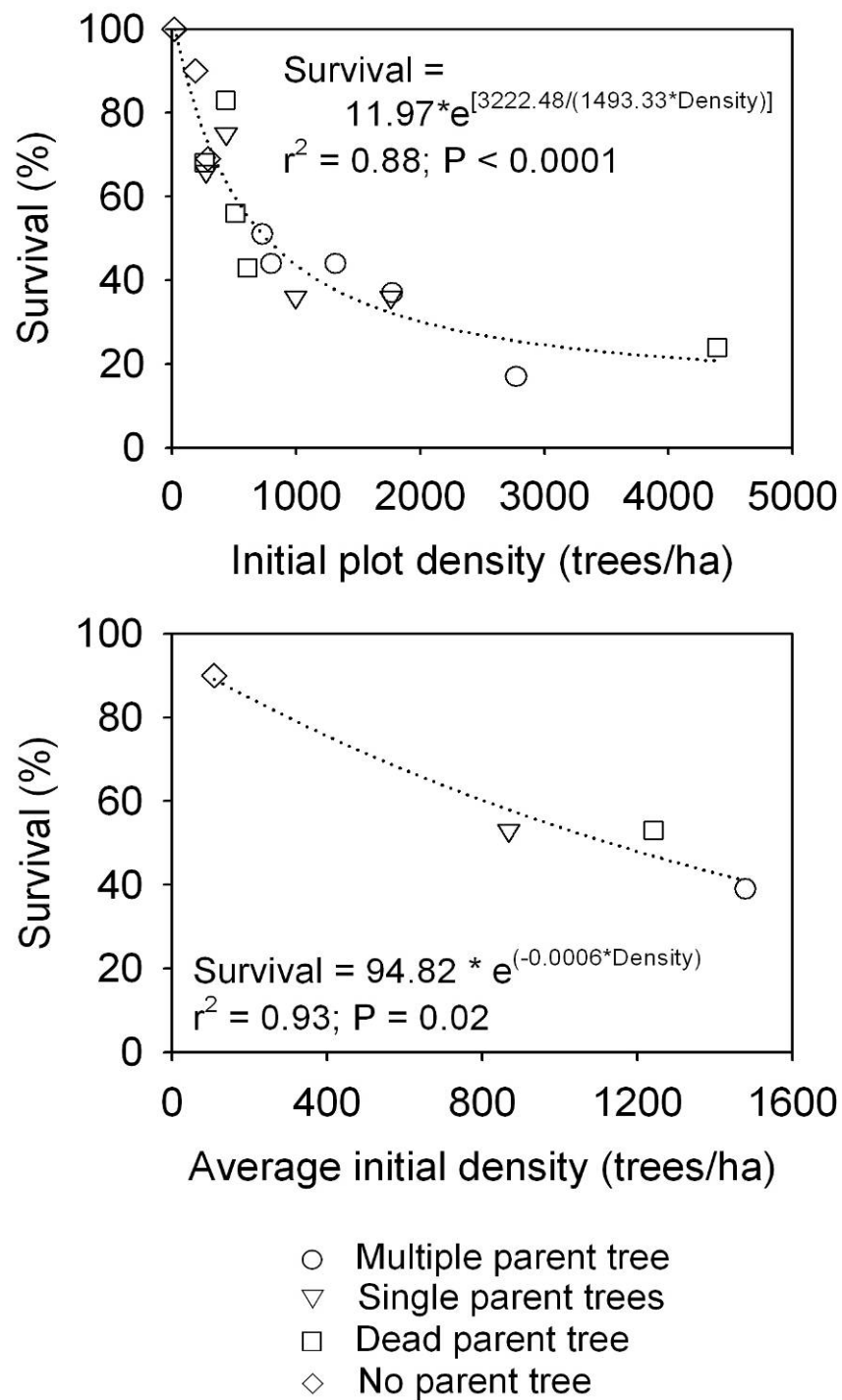
Average tree density of naturally regenerated *Acacia koa* in Hakalau Forest National Wildlife Refuge declined toward a common value during the first 21 years after soil scarification on sites that had one or another of the following parent tree configurations: (1) multiple live koa tree canopies overhead, (2) only a single live koa canopy overhead, (3) only a dead remnant of a former koa parent tree or (4) open grassland with no evidence that a koa tree ever stood there.



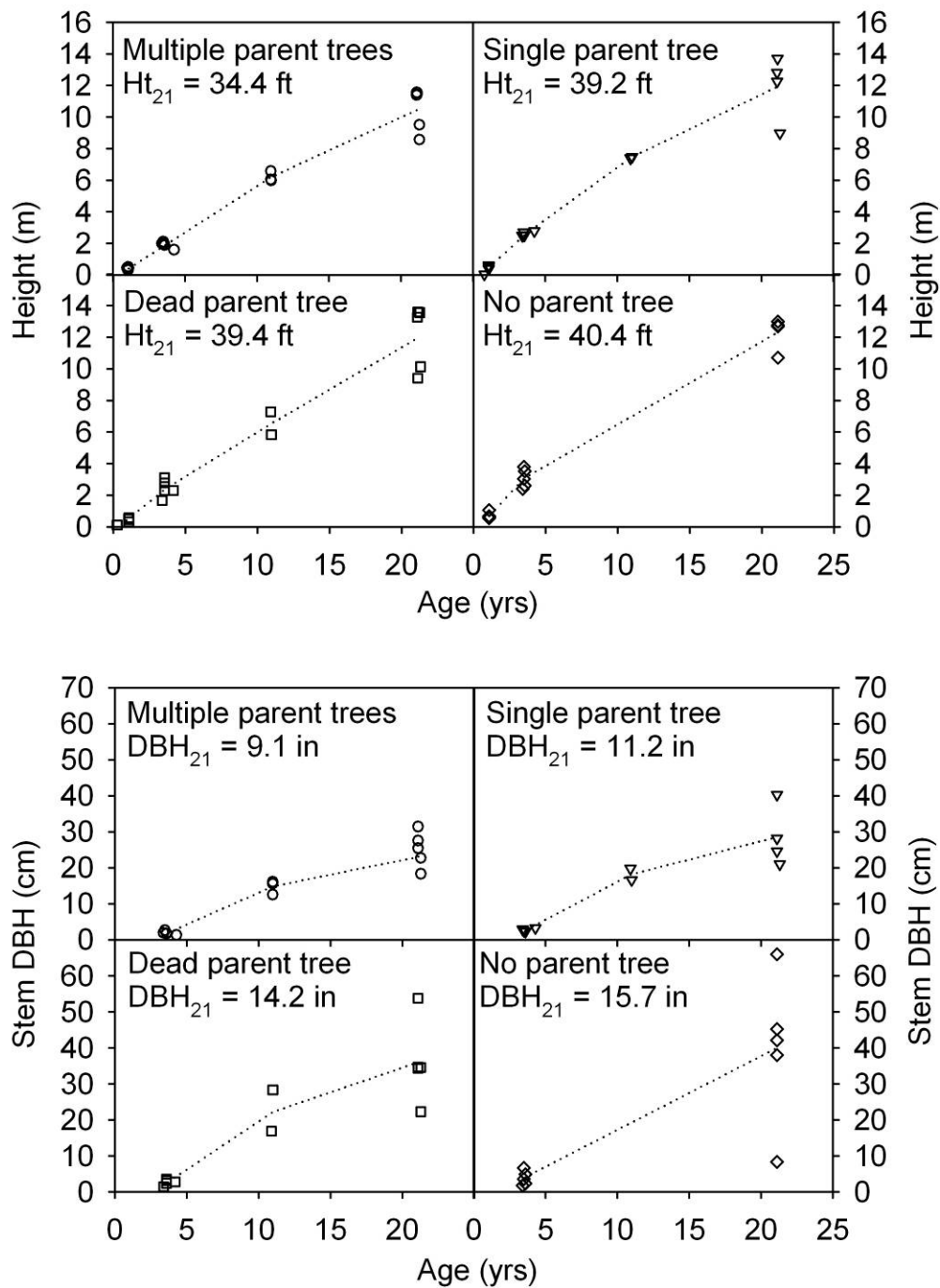
The convergence of stand densities with time also was observed for naturally regenerated *Acacia koa* stands located at 1260-m elevation in the leeward Honaunau Forest (◇) and at 1700-m elevation in the windward Keauhou Ranch reforestation area.



At 21 years of age survival of naturally regenerated *Acacia koa* in scarified sites of Hakalau Forest National Wildlife Refuge ranged from 39% on sites that had multiple koa the tree canopies overhead to 72% on open grassland sites that showed no evidence of ever having a koa tree present.



Initial density of naturally regenerated *Acacia koa* trees in Hakalau Forest Nation Wildlife Refuge was a determining factor in the percentage of individuals that were still alive 21 years after soil scarification. Non-linear curves fit to individual plot data (upper figure) and to plot averages (lower figure) show the strong influence of initial density on 21-year survival.



Parent tree configuration had little effect on height growth of naturally regenerated *Acacia koa* during the first 21 years of development in Hakalau Forest National Wildlife Refuge (upper figure). In contrast, DBH growth was greatest for the dead parent and no parent configurations, probably because the light levels available to the koa regeneration in those configurations were not reduced by overhead parent tree canopies.