# Burning to Control Rip Gut Brome Grass on Lagoon Island

In 2006, EEMB master's student, Alice Levine, began a project investigating the use of fire to control the exotic Rip gut brome grass (*Bromus diandrus*) that dominates much of the Lagoon Island mesa. The project investigated three objectives for controlling brome grass:

1) Do differences in fuel-load at the time of burning affect its seedbank and subsequent vegetative growth?
2) How do different frequencies of prescribed burning affect the *B. diandrus* seedbank and subsequent re-growth?
3) As an alternative management approach, how do the effects of tilling compare to those of prescribed burning?

It was hypothesized that supplemental fuel (dried coyote brush) burn would create higher fire intensity effects at and below the soil surface than an existing fuel-load burn, causing greater destruction of the *B. diandrus* seedbank and litter layer. It was further hypothesized that multiple burns would be more effective at destroying the seedbank than a single burn. Alice also investigated two different strategies for re-vegetating the burn sites with native coastal sage scrub species by spreading seeds and planting seedlings into different subsections of each plot.

Four 20m by 32m swaths were set up on the Lagoon Island mesa. Each swath contained 12, 4.5m by 6.5m burn plots in three columns of 4 plots each. Half of these plots were burned with supplemental fuel loads (cut and dried Coyote brush), while the rest were burned with only the existing dried grass as fuel. The two outside columns of each swath were burned only in 2006, while the center column was burned in 2006 and again in 2007. Unburned control plots surround the exterior of each swath. Four control plots for each swath were designated as tilled plots. Each plot was subdivided into six, 2m by 2m subplots, half of which were hand-weeded after burning or tilling had been concluded. In addition, native seeding and planting treatments were applied to one of each weeded and non-weeded subplot within each plot (See Figure 1).

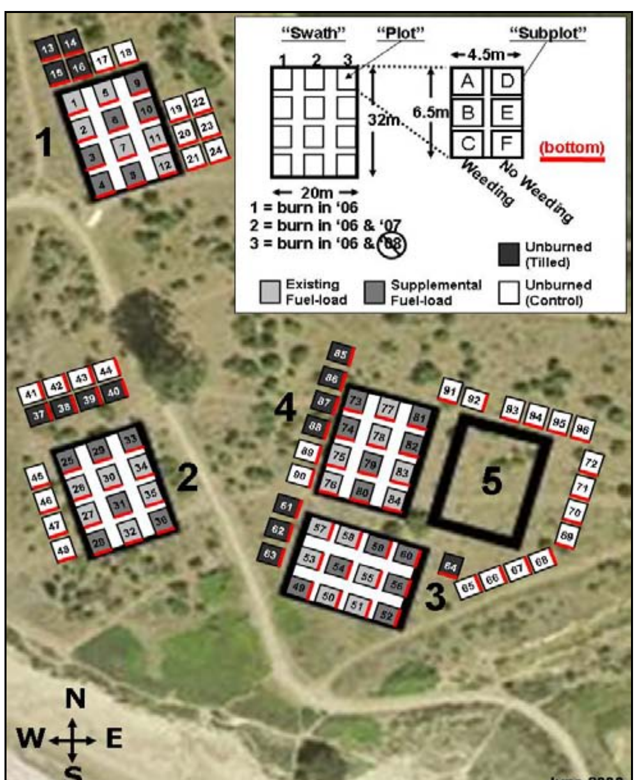



**Figure 1: Lagoon Island field site and experimental design.**

In the summer of 2009, after a year of no maintenance, CCBER monitored the vegetation cover, the percent cover and litter depth within each subplot to quantify the long term effects of burning.

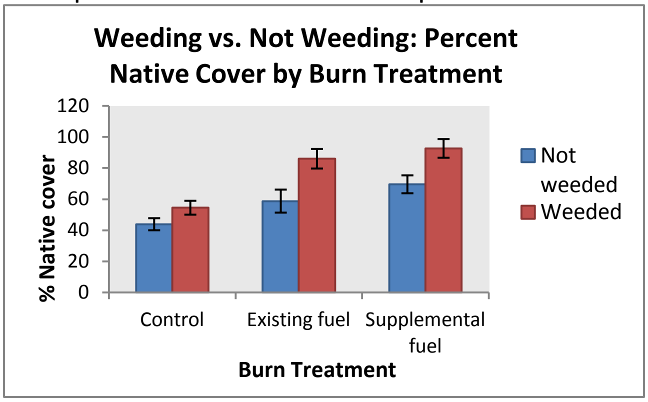



**Chart 1: Effect of weeding on native cover in different burn treatments.**

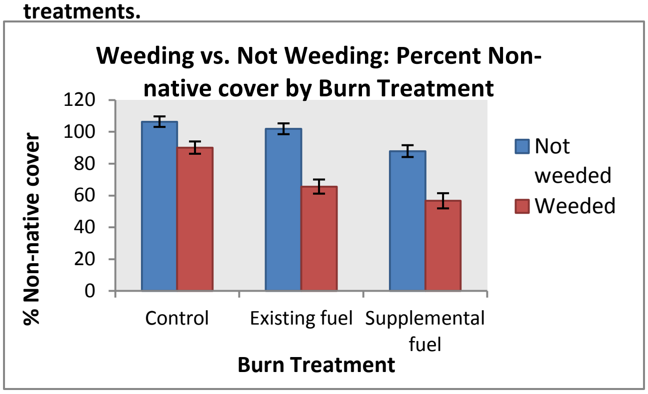



**Chart 2: Effect of weeding on non-native cover in different burn treatments.**

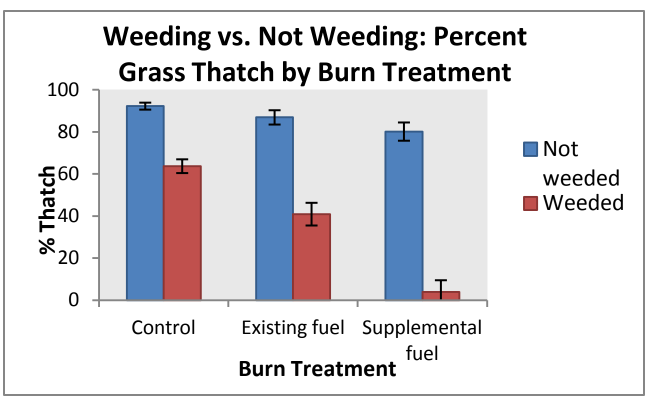



**Chart 3: Effect of weeding on grass thatch cover in different burn treatments.**

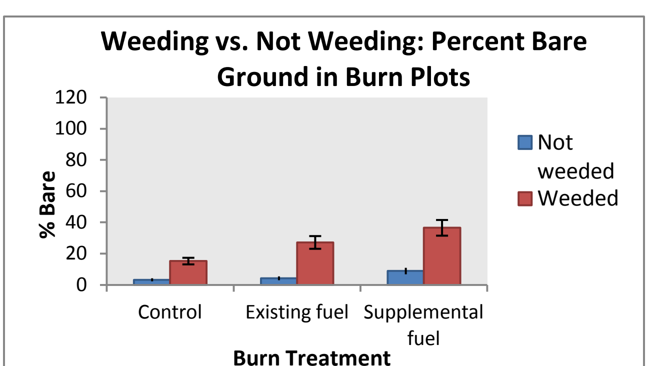



**Chart 4: Effect of weeding on bare ground cover in different burn treatments.**

Percent native cover was greatest in plots that were burned and subsequently weeded. Supplemental fuel plots had a slightly greater (but not significant) percent of natives than those that were burned with existing fuel. (Chart 1)

Supplemental fuel burns (with no weeding) significantly reduced the non-native cover, while non-native cover was only slightly reduced in existing fuel burns. However, weeding combined with burning greatly reduced non-native cover in both existing and supplemental fuel plots. As such , the best management strategy would involve a combination of burning and weeding. (Chart 2)

The percent grass thatch was highest in the not weeded treatments, but steadily decreased with added fuel load. However, weeding greatly reduced thatch cover in all treatments; thus, supplemental burns combined with weeding are most effective at reducing grass thatch. (Chart 3)

In all treatments, weeding greatly increased the percent bare ground. However, burn treatments further increased the effect of weeding and supplemental burns combined with weeding resulted in the greatest percent bare ground. (Chart 4)

It takes about 6 hours for a single person to weed a control plot, 3.5 hours to weed a plot burned with existing fuel, and only 1 hour to weed a plot burned with supplemental fuel. Meanwhile, native + bare cover increases with fuel intensity. Thus, the most efficient method for controlling non-natives would be to conduct supplemental burns followed by hand weeding. (Chart 5)

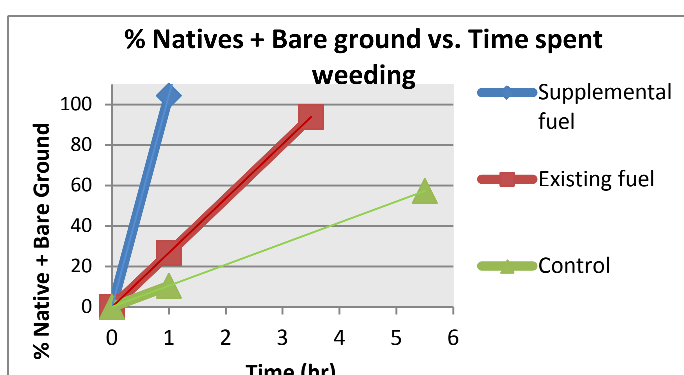



**Chart 5: Time spent weeding in each burn treatment and the resulting percent native and bare cover after one year of no maintenance.**

The frequency of the burn treatments had a significant effect on native cover. Areas that were burned twice had a greater percent native cover than in areas that were burned only once. Weeding combined with multiple burning was most effective with native cover reaching over 100% in both existing and supplemental fuel plots. (Chart 6)

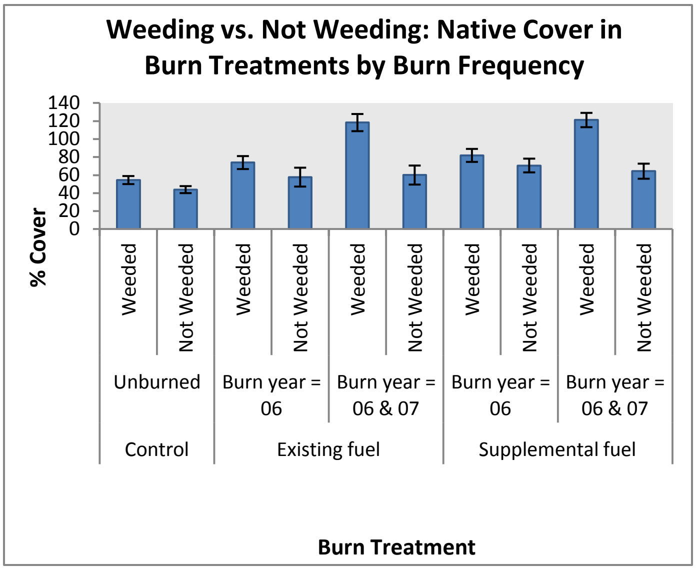



**Chart 6: Effects of fuel type, burn frequency, and weeding on native cover.**

Burn frequency alone had little effect on non-native cover. However, when combined with weeding, burning twice had the greatest effect and reduced non-native cover to approximately 40%. (Chart 7)

In the absence of weeding, multiple burns only affected bare ground cover where supplemental fuel was used . Weeding greatly enhanced the effects of multiple burns. Areas that were burned twice and weeded had the highest percent cover of bare ground both in existing fuel and supplemental fuel areas. (Chart 8)

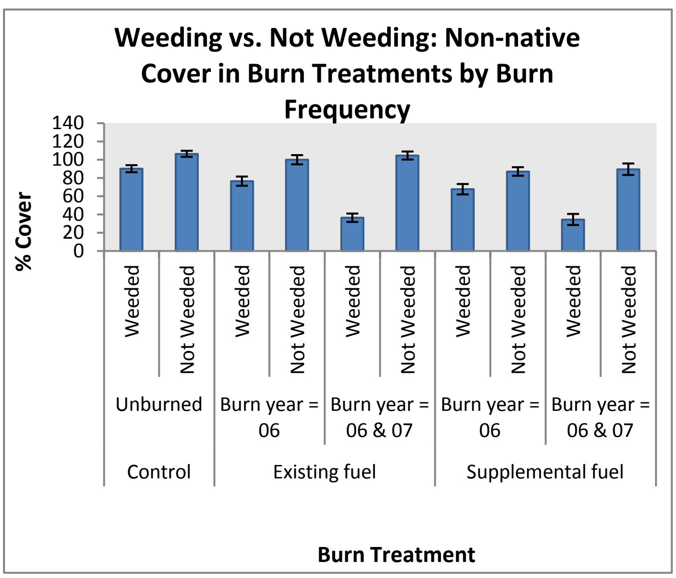



**Chart 7: Effects of fuel type, burn frequency, and weeding on non-native cover.**

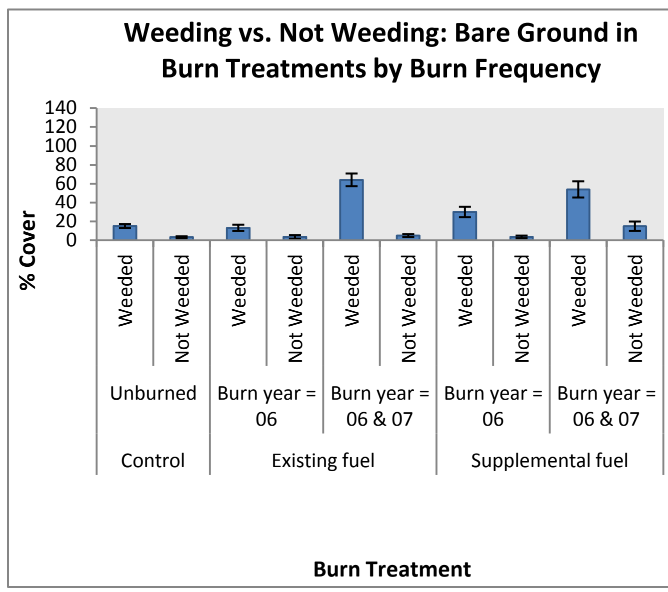



**Chart 8: Effects of fuel type, burn frequency, and weeding on bare ground cover.**

**Figure 2: A controlled burn with supplemental fuel added to increase the intensity of the burn.**

**Figure 3: Seacliff Buckwheat (*Eriogonum parvifolium*) a native plant species inhabiting Lagoon Island.**

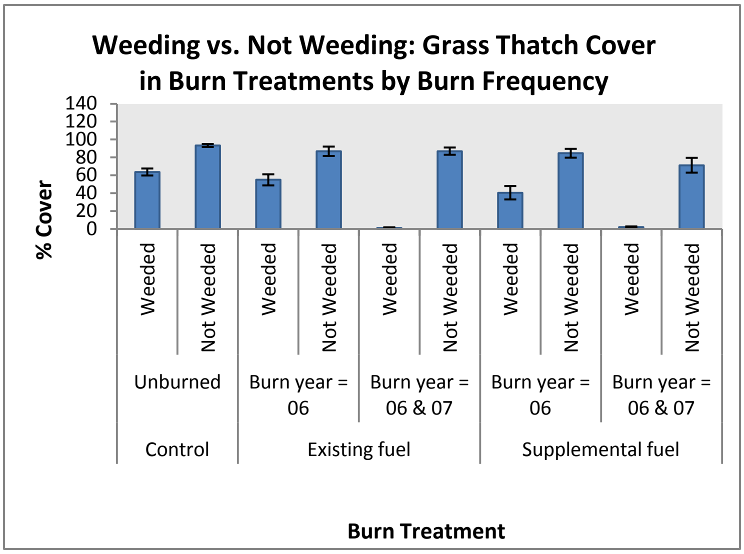
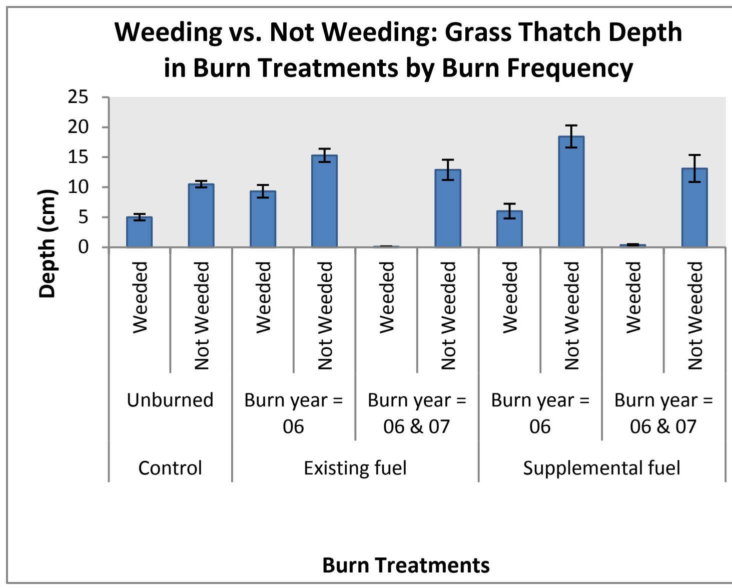



**Chart 9: Effects of fuel type, burn frequency, and weeding on grass thatch cover.**

Grass thatch cover is typically highest in not weeded treatments regardless of fuel load and burn frequency. Burning once with existing and supplemental fuel (and weeding) results in similar percent covers of grass thatch. Burning twice and hand-weeding had the most significant reduction in thatch cover for both existing and supplemental fuel loads (Chart 9).

**Chart 10: Effects of fuel type, burn frequency, and weeding on grass thatch depth.**

Grass thatch depth is highest when not weeded for all fuel loads and burn frequencies. However, the thatch depth is lower in the control most likely due to the lack of native plants and shrubs holding them upright when the depth was being measured. Burning twice and weeding has the most significant reduction in grass thatch depth than burning once and weeding (Chart 10).



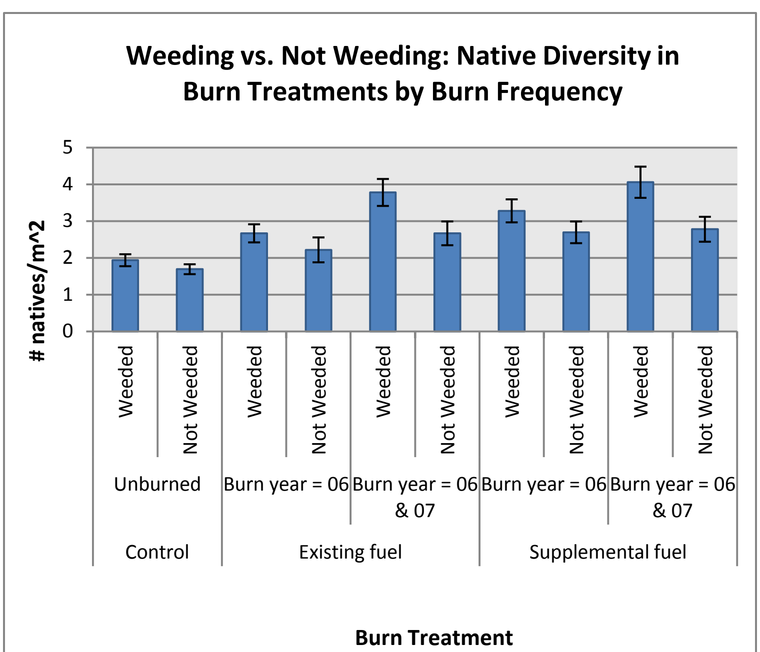




**Chart 11: Effects of fuel type, burn frequency, and weeding on native species diversity.**

Native diversity is lowest in the unburned control, where non-native grasses dominate. Burning once or twice (and not weeding) does not result in a significant difference between existing fuel and supplemental fuel loads. However, when burned twice and combined with weeding, the native diversity increases significantly, but the differences between existing and supplemental fuel is minor (Chart 11).

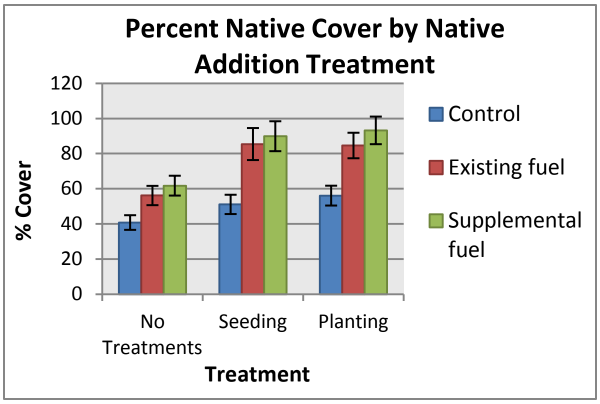



**Chart 12: Percent native cover in response to different native addition treatments and burning.**

Seeding and planting natives significantly increased native cover in all burn treatments and control plots. Native cover was greatest in burn treatments were natives were planted and seeded. Whether natives were added via seeding or planting did not result in a significant difference in native cover, nor did the intensity of the burn treatment. (Chart 12) The addition of natives did not seem to effect the percent non-native cover; however, burning did result in decreased non-native cover (Chart 13). Furthermore, The addition of natives greatly reduced the percent bare ground in burn plots (Chart 14).

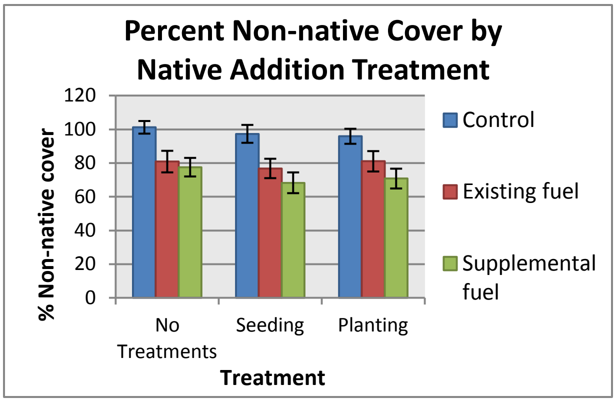



**Chart 13: Percent non-native cover in response to different native addition treatments and burning.**

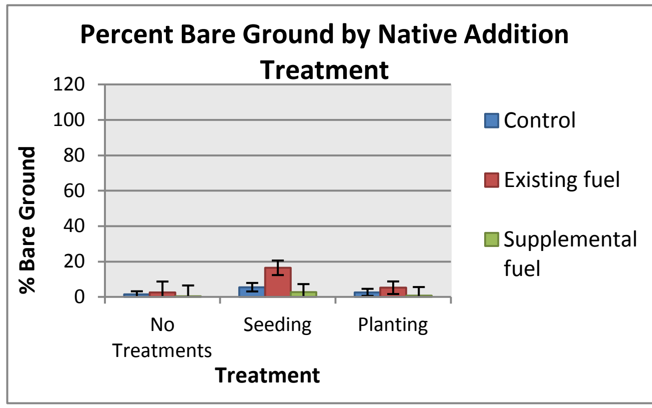



**Chart 14: Percent bare ground in response to different native addition treatments and burning.**

While native cover was not affected by whether natives were added via seeding or planting, native species diversity was greater where seedlings were transplanted than where seeds were scattered (Chart 12). This is because, of the species that were added, a few grow well from both scattered seeds or transplanted seedlings, such as *Artemisia californica*, *Eriogonum parvifolium*, and *Lotus scoparius.* In fact, *Artemisia* showed the best growth when seeded, but still established well when planted. Meanwhile many other species established better when grown in the greenhouse and transplanted as seedlings, such as *Encelia californica, Eriophyllum confertiflorum, Eschscholzia californica,* and *Scrophularia californica.* Therefore, more species were present in areas where natives were planted rather than seeded. Additionally, diversity increased with burn intensity and the cumulative effects of burning and weeding further increased diversity by eliminating non-native competition (Chart 16).

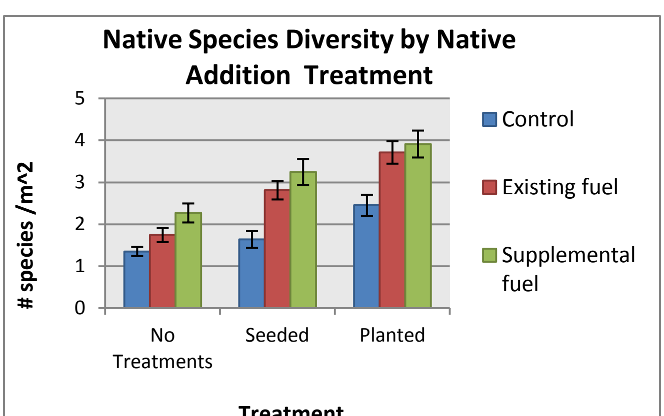



**Chart 15: Native species diversity in response to different native addition treatments and burning.**

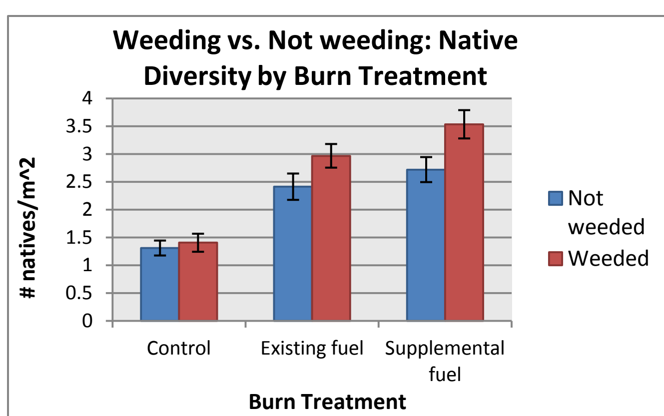



**Chart 16: Native diversity in response to different burn treatments and weeding.**

Tilling the soil can also reduce the non-native seedbank by burying many of the seeds deep into the soil where they cannot germinate.  Tilling did reduce non-natives, but not as much weeding. The combined effects of weeding and tilling greatly reduced non-native cover to 68% and increased native cover to 72% (Chart 17). However, even the combined effects of tilling and weeding were not as effective at reducing non-natives as those of combined supplemental burning and weeding, in which non-native cover was reduced to 59%, and native cover increased to 92% (Charts 1 and 2).

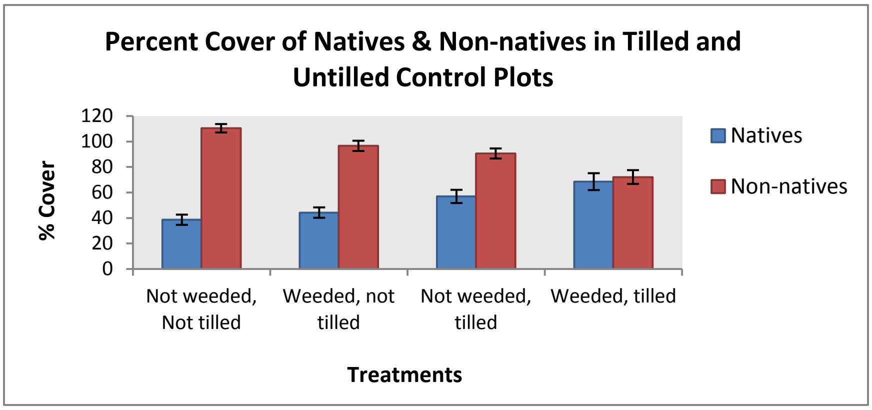



**Figure 17: The percent cover of natives and non-natives in response to tilling and weeding.**

In June 2009 and August 2011, CCBER conducted additional controlled burns on adjacent one half acre plots on the lagoon mesa top. Supplemental fuel was used to increase the intensity of the fire. Management and planting strategies for the newly burned areas are based on the data obtained from these experimental burns and include a mix of seeding and planting in the rainy season.

**Figure 4: A Santa Barbara County firefighter ignites a controlled burn with the use of a drip torch.**