Testing techniques for weed control at the Shipley Reserve (Western Riverside County Multispecies Reserve)

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Introduction

Invasions by exotic plant species have become a major problem for land managers of nature reserves in many areas, including the Shipley Reserve. Exotic plants may replace native species over large landscapes (Groves and Di Castri 1991, D'Antonio and Vitousek 1992, Pysek et al. 1995), where they reduce the available space for natives and may cause increased scarcity and endangered status of rare species (Pavlik et al. 1993, Pavlik 1994). One of the most invasible vegetation types in southern California is the coastal sage scrub (CSS), which is a dominant vegetation in the Shipley Reserve. CSS has been subject to fragmentation, heavy grazing, frequent fire, and air pollution, all of which promote weed invasion (Allen et al. 2000, Stylinski and Allen 1999, Westman 1981, Minnich and Dezzani 1998). The list of invading species is long, and is dominated by Mediterranean annual grasses. Some of these have been in California for two centuries or more (Frenkel 1970, Heady 1977, Maddox and Mayfield 1985, Rejmánek et al. 1991), including species in the genera *Avena, Hordeum, Bromus*, and *Schismus*. Exotic annual forbs also dominate some landscapes, especially those in the genera *Brassica* and *Erodium* at the Shipley Reserve.

In some vegetation types annual weeds decline after cessation of disturbance during the process of succession. However, long-term observations of many CSS sites show that, once established, the weeds persist and are not replaced by native species (Minnich and Dezzani 1998, Allen et al. 2000, Stylinski and Allen 1999, Zink et al. 1995). Experimental studies show them to be highly competitive with various native species, and weed control is necessary before natives will reestablish (Nelson and Allen 1993, Eliason and Allen 1997, Pavlik et al 1993, Gordon and Rice 1993, Cione et al. 2002). Weed control over large landscapes is costly, and weeds may reinvade. Cost effective methods of weed control need to be applied. These may be coupled with revegetation of native species, where the native vegetation has been largely replaced by exotics.

Several weed control methods were implemented at the Shipley Reserve, funded from 1999-2001 by the Western Riverside County Multispecies Reserve. During the 2001-2002 growing season funding was obtained from the CNAS Shipley Skinner fund, as the WRCMR Management Committee was not able to continue funding the project.

This report will emphasize the year funded by CNAS, but, to set the context, the data from all years of the project will be shown.

The objectives were to test several weed control techniques that are especially suited for the Shipley Reserve, including areas of CSS and annual forb lands. These were timed grazing, grass-specific herbicide, and dethatching. Fire was not used because the Reserve Management Committee does not feel that fire should be used as a tool at this time since much of the vegetation recently burned in the wildfire of 1993. The vegetation response was followed after weed control to determine how often treatments must be reapplied, and to determine whether the desired native species reestablish or must be reseeded because the seedbank has been depleted.

Methods

A research plan for weed control was designed by the Scientific Advisory Committee of the WRCMR (including UCR researchers, Reserve managers, and others) in 1998. Two sites were chosen for treatment, exotic annual grassland in Crown Valley and weedy coastal sage scrub in Lopez Canyon, both sites in the Shipley Reserve. The treatments agreed upon were timed grazing by sheep, application of the grass-specific herbicide Fusilade, and dethatching plus Fusilade. However, grazing was not done at Crown Valley, because the objective of vegetation management was to establish a native forbland at this site, and sheep consume both forbs and grasses. Sheep grazing was used at Lopez Canyon, where there is an overstory of CSS shrubs with an understory of exotic grasses and forbs.

The experimental design was a randomized block design with three replicates of 1-ha plots of each of the following treatments: 1) Untreated controls, 2) grass-specific herbicide, 3) grass-specific herbicide plus dethatching, applied at both Crown Valley and Lopez Canyon, and 4) sheep grazing, applied at Lopez Canyon only. The dethatching treatment was applied to remove a build-up of thatch that might have reduced the effectivity of herbicide, e.g., to improve the contact of the herbicide with living vegetation.

The treatments were applied as follows:
Herbicide—February/March in 1999 and 2000, using hand-held applicators at the lowest level of the manufacturer's recommended dose.
Dethatching—November 1999 using hand-held weed trimmers.
Grazing—March/April in 1999, 2000, and 2001, using 200 sheep per hectare plot for 48 hours.

Percent cover data were collected in permanent 0.5 X 1.0 m quadrats, 20 per 1-ha plot, in February/March and again in late April/early May of each year. Only the April/May data will be shown in this brief report. No additional treatments were applied in 2002, but percent cover data were collected to determine the longterm response to treatments, and whether the native plants had recovered from sheep grazing.

Results

Lopez Canyon

The exotic grass cover (mainly *Bromus madritensis* ssp. *rubens* and *B. diandrus,* with some *Avena fatua, Vulpia* spp., and *Schismus* spp.) decreased with the herbicide treatment in 1999 compared to control plots, and decreased even more in 2000, the second and final year of herbicide application (Fig. 1A). The dethatching plus herbicide treatment was not significantly different from herbicide alone, indicating that the herbicide did have good contact with the grasses in spite of the dense thatch. No additional herbicide was applied in 2001, but exotic grass cover was still significantly lower than in control plots. By 2002 there were no significant differences among the treatments, but this was the driest year on record in this region since record-keeping began in the state, only about 10 cm in an area that averages 28 cm.

The grazing treatment was not effective in controlling grasses until the third season, 2001 (Fig. 1A). The grazing was done in March/April, before the percent cover data were collected in April/May, and showed that the sheep did not consume grasses until 2001. This was the only year that the grasses had not produced seed by the time the sheep were placed in the plots, and sheep will not graze the seeds because of sharp awns.

The exotic forbs consisted mainly of *Erodium cicutarium* and *E. brachythecum* with less than 2% wild mustard (*Brassica geniculata*), but there were no significant differences among the treatments in any year except the very dry spring of 2002 when the grazed plots had slightly higher cover of exotic forbs than control plots (Fig. 1A).

The native forbs consisted of some 20-30 annual and perennial species each year, none of which was very abundant individually. Their combined cover increased significantly in the 2000 and 2001 growing seasons in response to the herbicide treatment, but decreased with grazing (Fig. 1B). In 2002 there was virtually no forb growth at all due to the drought.

The native shrubs did not respond in cover to any of the treatments (Fig. 1B). We examined the sample quadrats for germinating shrub seedlings, but did not observe a higher density of seedlings in response to any of the treatments.

Crown Valley

The responses of exotic annual grasses to herbicide and dethatching plus herbicide were similar in Crown Valley (Fig. 2) as for Lopez Canyon, with a greater effect of herbicide in 2000 than 1999, and a continual significant effect into 2002. Although vegetation at Crown Valley also suffered from the drought of 2002, it had a higher cover of vegetation than the slopes of Lopez Canyon, probably due to moisture in the valley bottom.

The exotic forbs actually had increased cover following grass control with herbicide, possibly because the reduction in grass cover opened areas for germination of annual forbs (Fig. 2). Again, most of the exotic cover was *Erodium cicutarium* and *E. brachythecum* with a very small amount of Brassica geniculata. The response of the exotic annuals to grass removal persisted into the 2002 drought year, although eoxitc cover was very low.

Native forbs showed an increase in cover following exotic grass control by 2001, but the native cover was virtually 0% in the 2002 drought year (Fig. 2).

Discussion

Grass-specific herbicide gives a more rapid and reliable response both in terms of reduced grass cover, as grazing did not cause a reduction in grasses until the third growing season of application. By contrast, the herbicide reduction in grasses was immediate, and greater in the second than the first year of application. However, there are tradoffs of using herbicides and grazing as will be discussed below, and this experiment will not be complete until the native forb response to grazing has been observed. This will require an additional spring growing season with normal rather than drought conditions.

The reduction of grass cover by the herbicide promoted an increase in both native and exotic forbs, but the exotic forb cover overall was higher than native forbs at both Crown Valley and Lopez Canyon. This was especially true in the 2002 drought year, when native forbs did not grow at all. The conservative response of native forbs to drought has also been observed in the Mojave desert, where at least some exotic annuals germinated even in the driest years, but native plants emerged primarily during wetter years (Brooks 1999, 2000).

The lack of response of exotic grasses to grazing during the first two years was not due to poor management of the sheep herd, but rather to timing of rains. The rains came late in 1999 and 2000, and by the time grasses had produced sufficient forage for sheep to graze (at least 5 cm of vegetation growth), they had also produced seeds. Timing of precipitation was more conducive to annual grass grazing in 2002, as rains came earlier, were more abundant, and grasses had sufficient forage for grazing prior to seed production. Grazing was used successfully to control exotic grasses in northern California (Weiss 1999), where the levels of precipitation are greater and the rainfall season is longer. Native forbs, including *Plantago erecta* that is the host plant for the endangered Bay checkerspot butterfly, were more abundant in areas that had cattle grazing, while dense grass cover in ungrazed areas was probably responsible for sparse forb cover and an absence of butterflies. An analogy exists in the adjacent Lake Skinner Reserve which has the endangered Quino checkerspot butterfly and its host plant *Plantago erecta*, that must also compete with exotic grasses.

In our study sheep consumed the native forbs preferentially in all three years, but to determine whether the sheep had positive or negative long-term effects on the native forbs, the plots will need to be observed during a year of normal precipitation. Whether the native forbs can recover from sheep grazing will depend on the longevity and density of their seedbanks. This is likely quite long, as many of the annuals are largely fire-following species that remain in the soil between the 25-30 year fire-intervals in CSS (Keeley and Keeley 1984, Keeley 1991).

The shrub cover at Lopez Canyon has also not icnreased in response to reduction of extoic grasses, but this may be expected if exotic forbs are increasing. The relative competitive ability of exotic grasses and forbs may be different, and is the subject of other studies at the Shipley Reserve (Gillespie and Allen 2003, Cox and Allen unpubl.).

At this point it is reasonable to recommend the use of grass-specific herbicide to control exotic annual grasses and increase the cover of native forbs. The impacts of sheep grazing need to awati the rsults of the sprng 2003 growing season, which has been a wetter season. Depending upon the ability of the native forbs to recover from sheep

grazing, a recommendation to use grazing may be made in years of sufficient forage, and where grazing does not impact other resources.

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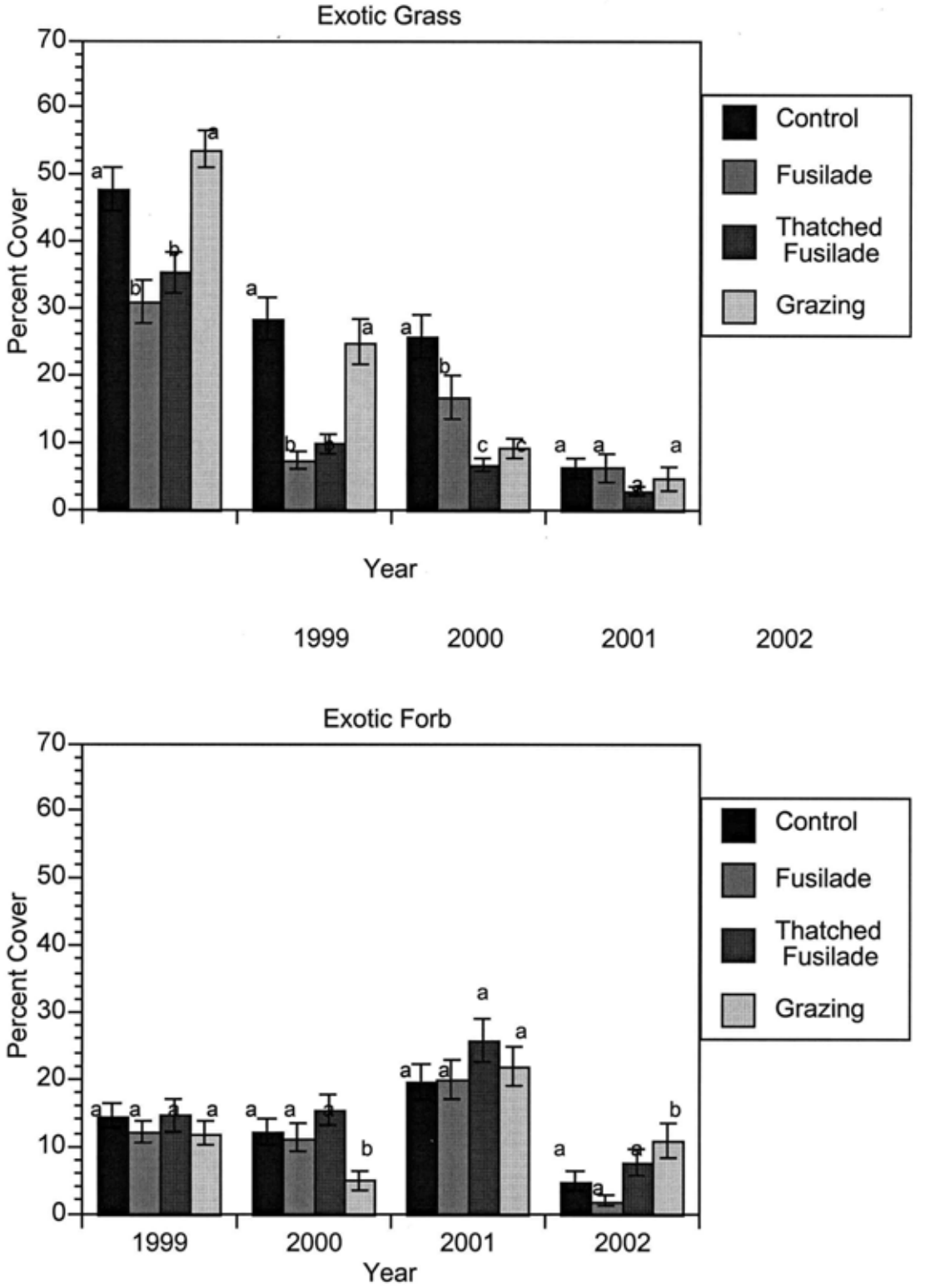
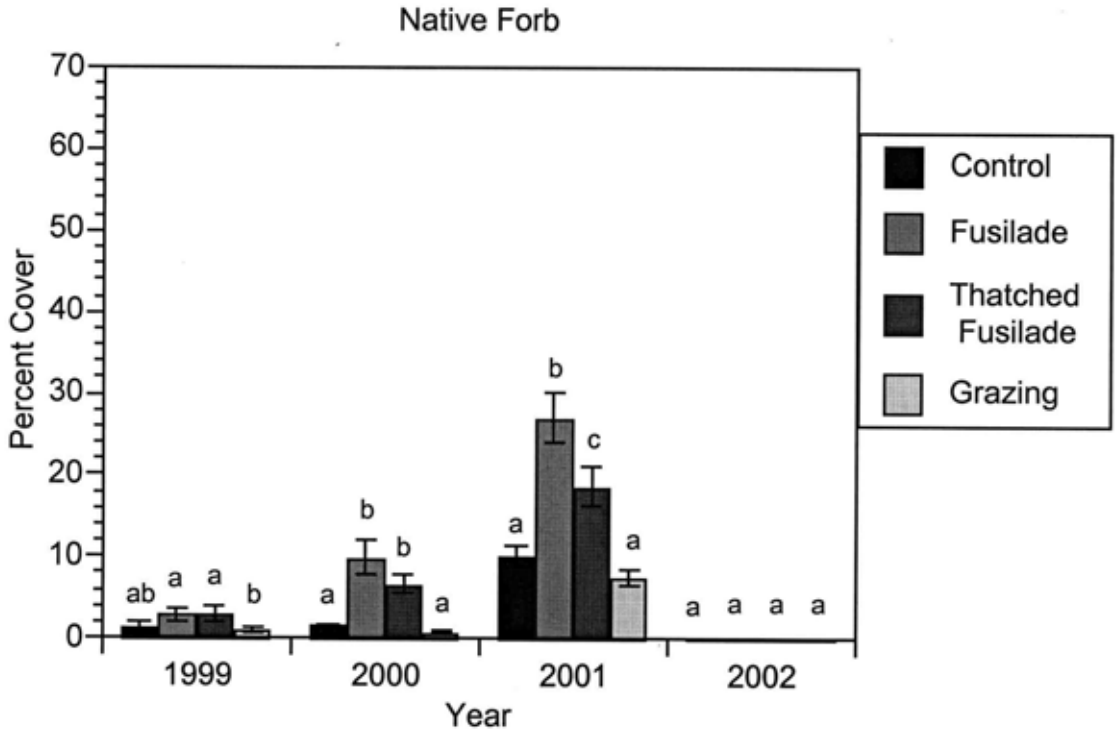


Fig. 1A. Responses of vegetation (exotic annual grasses and exotic annual forbs) to grass-specific herbicide (Fusilade), herbicide plus dethatching, and sheep grazing over four growing seasons at Lopez Canyon, Shipley Reserve.



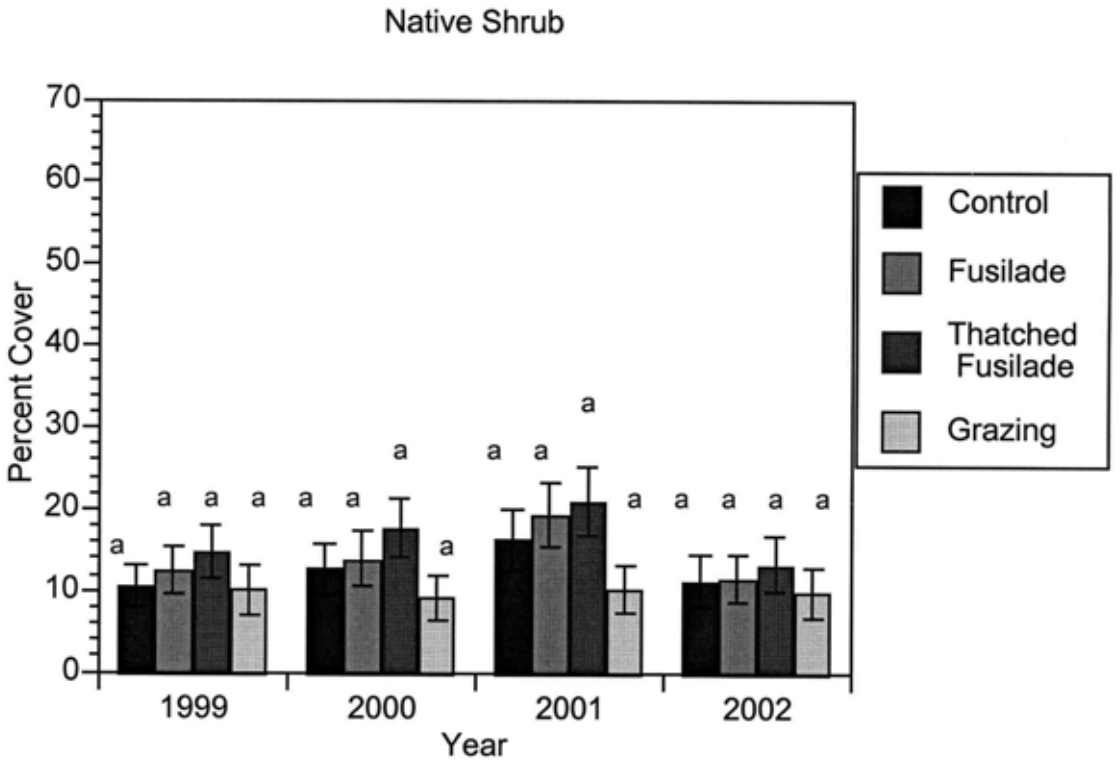


Fig. 1B. Responses of vegetation (native forbs and shrubs) to grass-specific herbicide (Fusilade), herbicide plus dethatching, and sheep grazing over four growing seasons at Lopez Canyon, Shipley Reserve.

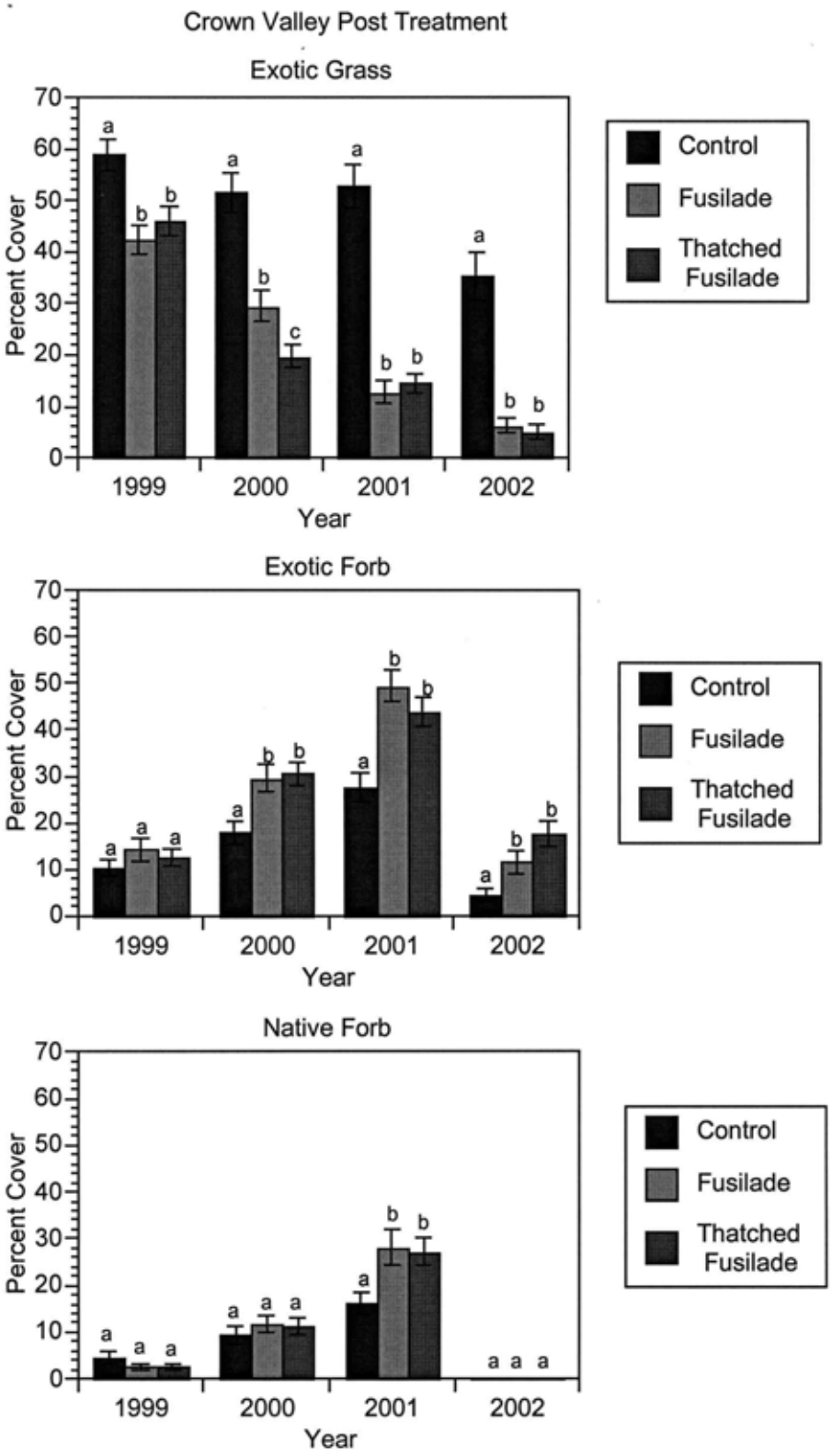


Fig. 2. Responses of vegetation to grass-specific herbicide (Fusilade) and herbicide plus dethatching over four growing seasons at Crown Valley, Shipley Reserve.