Zorro fescue used in revegetation of acid mine spoils near Ione, California.

Zorro annual fescue for emergency revegetation

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Landscape and revegetation specialists in southern California have long sought a ground cover that could grow quickly and persist on steep, shallow, infertile soils and barren disturbed slopes as well as adapt to the low and highly variable winter rainfall pattern characteristic of much of southern California.

This plant may now have been found. It is 'Zorro' annual fescue, *Festuca megalura* Nutt., a self-reseeding grass that occurs naturally on many California wildlands. Zorro is a selection from a wild grass population made by the USDA Soil Conservation Service (SCS) Plant Materials Center at Lockeford, California. Variety selection and tests on Zorro began in 1970. It was released to commercial nurseries and seed producers in early 1977.

The origin of this plant is in dispute; some plant materials specialists believe it was brought into California by the settlers who also introduced sheep and cattle. It may be the same as *Vulpia myuros* var. *hirsuta,* found in Europe, North and South America, Hawaii, Japan, and Australia. In Munz's *A Flora of Southern California, F. megalura* is considered a native grass "common on dry slopes, below 2100 m, in many plant communities; cismontane southern California to Baja California, mountains, lower California, to South America and on our southern California islands."

Early tests in central and northern California along newly constructed highways showed Zorro to be superior to the conventional barley *(Hordeum vulgare)* or ryegrass *(Lolium multiflorum)* mixtures on many low-fertility, shallow, low pH soils. In many cases Zorro grew and persisted where barley or ryegrass failed to establish. Zorro also shows promise for minespoil revegetation and cover-crop use.

Tests of Zorro's adaptation in San Diego County began in the fall of 1977. Our trials consisted of evaluating Zorro for roadside revegetation and seeding in chaparral on both manually cleared and wildfire sites. The results are compared with a controlled study at Davis.

Roadside revegetation

Construction of Interstate Highway I-15 provided test sites for evaluating plant materials. In the fall, plots of 27 square meters were laid out on a fill made of disturbed B and C horizons of soil of the Cieneba rocky coarse sandy loam series (typic xerorthents). Slope varied from 15 to 20 percent and elevation was 240 meters. Chosen for comparison was Blando brome *(Bromus mollis),* a grass species commonly used to protect disturbed areas where ryegrass will not persist.

Plots of fertilized and unfertilized Zorro fescue and Blando brome were broadcast-seeded at 2,200 pure live seeds (PLS) per square meter. All seedings were mulched with barley straw at 2,200 kilograms per hectare (kg/ha), and the straw anchored with wood fiber at 880 kg/ha. The fertilized plots were hand-broadcast at time of seeding with a 14-14-7 commercial fertilizer at 300 kg/ha. In the spring of 1978, nearing the end of the rainy season, ammonium sulfate (21-0-0) at 1,120 kg/ha was broadcast by airplane on the fertilized plots. Rainfall in 1977-78 and 1978-79 (July 1 to June 30) was abnormally high (respectively, 625 mm and 500 mm), exceeding the 350-mm average. For production estimates, plots were sampled by four 30- by 30-cm samples in June 1978 and by a 1-meter-diameter circle in June 1979.

Zorro provided adequate cover and surpassed Blando brome in yield on the unfertilized plots (table 1). Blando brome would probably not have survived on this low-fertility site had it not been for the two years of high rainfall. Blando brome responded much more to fertilizer than did Zorro,

TABLE 1. Slope Cover Protection (Dry Matter Yield) for Zorro Annual Fescue and Blando Brome, Fertilized and Unfertilized Plots*

Grass cover	Dry matter yield			
	Fertilized		Unfertilized	
	1978	1979	1978	1979
	kg/ha	*kg/ha*	*kg/ha*	*kg/ha*
Zorro	2,210	4,910	1,480	2,920
Blando brome	4,710	5,511	1,240	2,488

*On Highway I-15 fill slope during 1977-78 and 1978-79 seasons.

TABLE 2. Total Weight of Plant Cover by Species from Zorro Annual Fescue, Blando Brome, and Natural Grasses*

Treatment	Zorro	Blando brome	Naturalized grasses	Total grasses
	kg/ha	*kg/ha*	*kg/ha*	*kg/ha*
Zorro	1,048	—	276	1,324
Blando brome	—	36	415	451
Naturalized grasses	—	—	371	371
LSD 0.05				460

*On disturbed chaparral site, 1978-79 season.

TABLE 3. Plant Density, Frequency, Cover, and Yield of Four Grasses*

Treatment	Plant cover March 21, 1979	No. of plants/ sq. m May 23, 1979	Samples with seeded species present May 1979	Dry-matter yield May 23, 1979
	%		%	*kg/ha*
Zorro fescue	15	117	100	444
Blando brome	4	15	67	132
Annual ryegrass	2	10	50	32
Naturalized grasses	14	58	100	242
LSD 0.05 (seeded species only)	3	57	31	128

*On a wildfire site.

TABLE 4. Comparison of Plant Numbers, Height and Top Weight (Oven Dry) of Zorro Annual Fescue, Blando Brome, and Annual Ryegrass at Three Dates*

Treatment	Number/cylinder			Mean height			Top weight/cylinder		
	A	B	C	A	B	C	A	B	C
				cm	*cm*	*cm*	*g*	*g*	*g*
Zorro fescue	40	35	23	2.6	14	26	0.4	6	17
Blando brome	29	28	12	1.8	6	23	0.1	2	6
Annual ryegrass	20	21	12	3.6	14	26	0.2	7	16
LSD 0.05	5	10	6	0.4	2	NS	0.2	2	6

*Dates A through C are 50, 98, and 127 days, respectively, after planting on January 8, 1980.

TABLE 5. Comparison of Maximum Root Length and Total Root Weight of Zorro Annual Fescue, Blando Brome and Annual Ryegrass at Three Dates*

Treatment	Root length			Root weight/ cylinder		
	A	B	C	A	B	C
	cm	*cm*	*cm*	*g*	*g*	*g*
Zorro fescue	26	68	77	0.56	2.3	4.2
Blando brome	35	77	84	0.17	1.3	1.6
Annual ryegrass	35	82	87	0.31	3.7	6.3
LSD 0.05	5	8	7	0.21	1.0	1.1

*Dates A through C are 50, 98, and 127 days, respectively, after planting on January 8, 1980.

which could be an undesirable trait, since excessive growth provides a highly flammable fuel for spreading a potential wildfire from the highway slope to adjoining brush fields. In contrast, Zorro provided adequate cover for erosion control without excessive fuel production, even without fertilization.

Manually cleared chaparral revegetation

Zorro was evaluated at the mid-elevation (860-meter) site of chamise chaparral. The soil series was Fallbrook sandy loam (typic haploxeralfs), and the slope varied from 15 to 20 percent. Chaparral brush had been cleared from the site by hand, and some manual disturbance had occurred. The amount of soil disturbance was less than would be caused by mechanical clearing but greater than results from fire. Plots of 3 by 6 meters were broadcast-seeded to Zorro and Blando brome at 440 PLS per square meter on January 4, 1978, and the soil was lightly raked to cover the seed. The seeding was replicated four times in a randomized block. In this zone averaging 500 mm, rainfall was about 750 mm in 1977-78 and 625 mm in 1978-79. Samples were harvested on June 6, 1979, by clipping plant production from 1- by 1-meter quadrants on each plot.

Zorro provided significantly more site protection than did Blando brome, as indicated by the greater total grass weight (table 2). In the control plots, naturalized grasses (consisting of red brome—*Bromus rubens*—and annual fescues) moved into the plots in the 1978-79 season, providing some

Zorro seed increase field at USDA Plant Materials Center, Lockeford. Ca.

cover. Without fertilization, Blando brome yield was insignificant on this poor chaparral soil site.

Wildfire revegetation

The third in the series of trials on Zorro evaluation consisted of reseeding a wildfire burn that had occurred in October 1978. This trial was designed to compare Zorro with the commonly used grasses, common annual ryegrass and Blando brome, for revegetation of soils where there had been a chaparral wildfire. The soils were eroded Cieneba rocky sandy loam (typic xerorthents) with slopes from 10 to 30 percent and south, southeastern, and northern aspects at 540 meters elevation. The vegetation was chamise dominant chaparral. On December 20, 1978, the seeds were broadcast on the soil surface following a wildfire. Seed rates used were 8 kg/ha (400 seeds per square meter PLS) common annual ryegrass and Blando brome and 3.3 kg/ha (723 seeds per square meter) of Zorro fescue. A design of 6- by 30-meter plots (ryegrass and Blando brome) and 3- by 12-meter plots (Zorro) was replicated on three different slopes in a randomized block. Rainfall for this site averaging 375 mm was 550 mm for the 1978-79 season. The plots were evaluated on May 23, 1979, for dry-matter yield, density, frequency, and cover from 10 square frames (30 by 30 cm).

Early-cover estimates in March did not show seeding of any species to be beneficial for improving early ground cover over the naturalized grasses (table 3). The natural grasses were red brome, nitgrass *(Gastridium ventricosum), Festuca octoflora,* and other annual fescues. At the end of the season, however, Zorro yielded more dry matter than did naturalized grasses or other seeded species. Blando brome or annual ryegrass each provided less dry matter than did the naturalized grasses, although Blando brome was considerably better than annual ryegrass. Zorro had higher frequency and plant density than Blando brome or annual ryegrass. Observations indicate that Zorro initiates germination rapidly after rains and is vigorous in winter growth when compared with Blando brome or ryegrass.

Controlled experiment

The Davis experiment compared Zorro fescue, Blando brome, and annual ryegrass. The grasses were grown outside in the winter and spring in aluminum pipes 25 cm in diameter by 76 cm deep, filled with decomposed granite. All were seeded at 11 kg/ha. Actual numbers of live seeds per cylinder were different because of variations in the number of seeds per kilogram, purity, and germination. The approximate number of live seeds planted was Zorro fescue 54, Blando brome 31, and ryegrass 28. Measurements of plant numbers, shoot length, shoot weight, maximum root length, and root weight were made of four replications at each of three dates. Results appear in tables 4 and 5.

Plant numbers of Zorro were greater than the other species at all dates because of a greater number of seeds per kilogram (2,192,000 compared with 556,000 and 501,000 for Blando and rye). This in spite of a lower germination test of 44 percent compared with 97 percent and 100 percent. Thus, the large number of seeds of Zorro can be expected to more than make up for the typically low germination.

Top height of Zorro was shorter than ryegrass on the first date but similar at the second two dates. Top weight of Zorro was actually greater than rye at the early date, indicating an increased amount but shorter stature. Weight was similar at the latter two dates. Blando brome was generally shorter and less productive than either.

Maximum root length of Zorro was always less than ryegrass, but total root weight at the early date was greater, indicating an abundance of roots but nearer the surface. Total root production of Zorro at the latter dates was less than rye. Blando brome produced a lower root weight than did either Zorro or rye.

Summary

These trials provide encouragement that Zorro has a place in southern California and other locations for revegetation of critically disturbed and denuded areas. It has proved to be a plant material much superior to Blando brome or annual ryegrass for persistence on steep slopes and poor soil sites. Growth characteristics are comparable to ryegrass and superior to Blando brome. Trials are needed to evaluate Zorro in drier-than-average rainfall years.

Foundation seed is maintained at the SCS Lockeford Plant Material Center and made available to certified seed producers through the California Crop Improvement Association. Seed growers in resource conservation districts can also obtain seed through the district's seed-increase program. Seed is now commercially available.

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