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STUDIES ON THE INITIAL EFFECT AND RESIDUAL CHARACTERISTICS OF SEVERAL SELECTIVE PREEMERGENT HERBICIDES IN RELATION TO OVERSEEDING AND POA ANNUA CONTROL

By CARL DOWNING, H. HAMILTON WILLIAMS, VICTOR A. GIBEAULT, JOHN VAN DAM and A. H. LANGE*

Annual bluegrass *(Poa annua L.)* is generally considered a weed when growing in a turfed area because of many undesirable characteristics. First, due to its light green color and variable growth habit, *Poa annua* does not blend well with more desirable grasses such as Kentucky bluegrass, and common or improved bermudagrass. Second, the continuing seedhead production, irrespective of cutting height, results in an aesthetically objectionable appearance and, more importantly perhaps, constitutes a potential for re-infestation. Third, the species is susceptible to numerous diseases. Fourth, the shallow root system under turf conditions, especially where the soil is compacted, leaves it sensitive to drought and nutrient deficiencies. Fifth, its propensity for dying out during periods of environmental stress, such as occurs during the warm, dry summer months in Southern California, can leave the turf badly scarred, often at times of peak usage.

Efforts to develop an effective control for *Poa annua* have been numerous. The most recent, and potentially the most successful, method involves the use of preemergent herbicides. With this program, the herbicide is applied to the turf prior to the main period of annual bluegrass seed germination. As local climatic conditions become more favorable, a certain fraction of the seed germinates and is subject to being killed by the herbicide according to its effectiveness. Successive fractions of seed present in the soil may continue to germinate over a period of many months, as long as environmental conditions are favorable. The date of application of these preemergent herbicides, their herbicidal characteristics and consequent degredation rate under local management systems and soil types would largely determine their level of effectiveness at any given time during the extended priod of *Poa annua* seed germination.

Coincidentally, the recommended time (autumn) for application of these herbicides is often the time when turf is normally overseeded to increase vigor and density, as with bentgrasses and bluegrasses; or for winter color, as with bermudagrasses. The effect of preemergent herbicides applied for *Poa annua* control on the germination and establishment of the grasses used for such overseeding has not been exhaustively studied in Southern California.

The objective of these trials was to evaluate the performance of several selective, preemergent herbicides in the control of annual bluegrass, with special reference to residual properties, and to note their selective effect on the germination and establishment of certain cool season grass species commonly used for overseeding. It was projected that any information generated might also be applicable to golf greens where *Poa annua* problems in bentgrasses are of considerable economic importance.

PROCEDURE

These trials were conducted at the Los Angeles State and County Arborteum, Arcadia, California where an established Tifgreen bermudagrass turf, having a history of heavy annual bluegrass infestation, was used. Prior to and during the trials the area was maintained at 3⁄4" mowing height, fertilized at the rate of 6 lbs. nitrogen per 1000 sq. ft. per year, and irrigated as needed.

On October 1, 1968, the test site was renovated to soil level. No *Poa annua* had germinated by this date within the area. Forty plots, 5’ x 5’ were laid out in a randomized, complete block design; the ten chemical treatments were replicated four tmes. Each complete block was replicated four times for overseeding on successive dates, making a total of 160 sub-plots.

The herbicides Bensulide Bcnefin, DCPA, EPTC and Dichlobenil were tested at rates given in Table 1. Liquid and wettable powder materials were diluted with water and applied with a pressurized hand sprayer. Granular materials were applied by hand. All treatments were completed October 3 and the entire test area irrigated with 1/2" water.

The overseeded grasses that were evaluated and the seeding rates used per 1000 sq. ft. were: Seaside creeping bentgrass *(Agrostis palustris)* at 2 lbs.; rough stalk bluegrass *(Poa trivialis)* at 4 lbs.; creeping red fescue *(Festuca rubra)* at 4 lbs.; and annual ryegrass *(Lolium multiflorum)* at 15 lbs. The dates of ovcrseeding were October 24, November 14 and December 5, 1968, or three, six and nine weeks folowing herbicide application.

Evaluations included apparent phytotoxicity to the re-established bcrmudagrass (following renovation), *Poa annua* control, and the residual toxicity effect of the herbicides on the germination and establishment of the

*Carl Downing, University of California Agricultural Extension Service, Los Angeles County, retired.
H. Hamilton Williams, Turfgrass Research & Education, Los Angeles State and County Arboretum, Arcadia, California.
Victor A. Gibeault. Universitv of California Agricultural Extension Service, Reverside, California.
John Van Dam, University of California Agricultural Extension Service, Los Angeles County.
A. H. Lange, University of California Agricultural Extension Service, Parlier, California.

above mentioned overseeded grasses. The following rating system was used:

Phytotoxicity: 0 = No effect
10 = Complete control

Poa annual Control: 0 = No effect
10 = Severe damage

Overseeding: 0=No stand
10 = Complete stand

The data were subjected to the analyses of variance and Duncan's multiple range test for significance of difference among means.

RESULTS AND DISCUSSION

The evaluations of annual bluegrass control following herbicide application are presented in Table 1. Herbicidal phytotoxicity ratings are presented in Table 2. The germination and establishment ratings of the grass species used for overseeding are presented in Tables 3, 4, 5 and 6.

All herbicides tested provided significant levels of control at all observation dates in contrast to the untreated check plots. A greater initial control was ob served on plots treated with both rates of Dichlobenil and the high rate of Benefin, however, at the last reading date Bensulide at 20 lbs. per acre and Dichlobenil at 4 Ibs. per acre gave the highest control ratings. Bensulide at 20 lbs. was the only treatment that maintained its initial control level throughout the winter months. All other herbicides decreased in control response. The ap parent annual bluegrass increase over time, as viewed by decreased control readings, can be attributed to continued germination of the weed seed due to diminishing toxicity of the herbicides and/or growth of established plants through the trial period.

The results showed that the highest level of control was obtained with the high rates of Bensulide and Dichlobenil. Control was not complete, however, nor was it acheved without injury to the bermudagrass with two materials tested as can be seen in Table 2.

Three weeks following herbicide application, EPTC at 3 Ibs. and Dichlobenil at 2 and 4 lbs. gave the greatest injury to the bermudagrass turf. Of these, EPTC and the high rate of Dichlobenil were most phytotoxic. The remaining treatments did not significantly affect the ap pearance at this date.

The turfgrass injury observed on November 14, 1968 was much reduced in severity, however, bermudagrass treated with EPTC and the high rate of Dichlobenil continued to show significant phytotoxicity in comparison to the untreated control. DCPA plots at the 20 lb. rate also exhibited injury symptoms and this response continued into early spring. The bermudagrass in all plots, except those treated with DCPA, resumed normal growth in mid-spring, apparently unaffected by herbicide treatments the previous autumn.

A significant interaction was found between herbicides and grasses as shown in Tables 3, 4, 5 and 6. This indicated a differential response among the four species to the herbicides tested.

Annual ryegrass appeared most tolerant to herbicide treatment. Geimination and subsequent esetablishment was evidently reduced, however, when annual ryegrass was overseeded following application of the high rate of Bensulide. Cover by annual ryegrass was also restricted when overseeded on November 14 in plots treated with DCPA at 20 lbs. per acre. Under conditions of this test, it was concluded that annual ryegrass can be safely sown three, six and nine weeks following the applications of Benefin, EPTC and Dichlobenil. Bensulide residue was present throughout the overseeding period which interferred with the turf cover provided by annual ryegrass.

The initial establishment of red *fescue was curtailed on all chemically treated plots when seeded three weeks following herbicide applications. This response was temporary with several treatments, since on March 14 a poor stand of red fescue was noted only where Bensulide at 10 and 20 lbs. and DCPA at 20 lbs. were applied. Similar results were obtained with Bensulide and DCPA at 20 lbs. when red fescue was seeded on November 14 and December 5. The data suggest that an overseeding of red fescue can be successfully performed six and nine weeks following the application of Benefin, EPTC, Dichlobenil and the low rate of DCPA whereas an inferior stand can be expected following treatment with Bensulide and the high rate of DCPA.

An initial reduction in the establishment of rough stalk bluegrass was also noted on all treated plots that were seeded on October 24, however the inferior cover was only in evidence at the final reading date in the following treatments: Bensulfide at 20 lbs., Benefin at 3 lbs., and DCPA at 10 and 20 lbs. The high rates of Bensulide and DCPA were also injurious when rough stalk bluegrass was seeded six and nine weeks following treatment.

Creeping bentgrass appeared to be the most susceptible species to previously applied herbicides. A severe retardation of establishment was noted when this grass was seeded three weeks after herbicide treatment. The chemicals that gave the least effect in this regard were EPTC and th low rate of Dichlobenil. The subsequent cover recorded on March 14 in most treated plots was due to the stoloniferous growth habit of the species. A good stand of creeping bentgrass was obtained when overseeded on December 5, except in areas treated with both rates of DCPA.

SUMMARY

1. Varying degrees of *Poa annua* control were ob tained with all herbicides tested. Dichlobenil at 2 and 4 Ibs. and EPTC at 3 lbs. gave a high control response but were phytotoxic to the established bermudagrass. Bensulide at 20 Ibs. resulted in the greatest long range reduction in annual bluegrass with the least apparent injury to the existing bermudagrass turf. However, this treatment gave the greatest reduction in germination and growth of the overseeded grasses. This suggests that the most effective use of Bensulide would be in established turf where density could be increased or maintained by means other than overseeding.

2. Herbicides such as Dichlobenil and EPTC that initially cause severe but short lived injury may be useful in a program of *Poa annua* control that includes overseeding to maintain turf density.

3. DCPA at both rates displayed low initial toxicity to the bermudagrass turf. However, signficant damage was observed by November 14 to both bermudagrass and cool season grasses. This damage was even more pro-

nounced by the following March 14.

4. At least seven treatments showed severe retardation in the germination of bentgrass. Except for the DCPA treatments, these adverse effects were overcome by subsequent stoloniferous growth.

5. The species of cool season grasses used for overseeding showed variable tolerance to the herbicides tested. They may be ranked as follows: tolerant, annual ryegrass; moderately tolerant, creeping red fescue and rough stalk bluegrass; and least tolerant, creeping bentgrass.

6. While these trials indicate that complete control of annual bluegrass may not be accomplished in one year, significant decreases in its population can be expected from successive annual treatments of the more effective herbicides tested, aided by overseeding.

TABLE 1. *Poa annua* control on three dates following chemical treatment. Scale: 0 represents no control; 10 represents complete control.

Chemical	Rate (lb. ai/A)	Formulation	Control Ratings 12/5/68**	1/23/69	3/14/69
Bensulide	10	4 lb/gal	6.5 cd*	6.9 c	5.1 c
Bensulide	20	4 lb/gal	7.3 bc	8.1 b	7.5 a
Benefin	1.5	1.5 lb/gal	6.4 cd	5.3 d	3.4 d
Benefin	3.0	1.5 lb/gal	8.6 ab	7.6 b	5.6 bc
DCPA	10	75% WP	4.5 e	3.1 f	1.4 e
DCPA	20	75% WP	5.6 de	4.2 e	2.4 de
EPTC	3	6 lb/gal	7.2 bc	4.3 de	1.9 e
Dichlobenil	2	2% gran.	8.9 a	7.6 bc	5.1 c
Dichlobenil	4	2% gran.	9.7 a	9.2 a	6.6 ab
Control	—	—	1.9 f	0.9 g	0.3 f

* Values followed by common letters indicate no significant difference at the 5 percent level of probability.
** Dates of evaluation.

TABLE 2. Bermudagrass phytotoxicity at two dates following chemical treatment. Scale: 0 represents no injury; 10 represents very severe turfgrass injury.

Chemical	Rate lb. (ai/A)	Phytotoxicity Ratings 10/24/68**	11/14/68
Bensulide	10	0.50 d*	1.33 e
Bensulide	20	0.25 d	1.92 de
Benefin	1.5	0.25 d	2.50 cde
Benefin	3.0	0.75 d	2.83 bcd
DCPA	10	0.00 d	2.75 bcd
DCPA	20	0.75 d	3.92 ab
EPTC	3	8.00 a	3.50 abc
Dichlobenil	2	1.75 c	2.42 cde
Dichlobenil	4	5.50 b	4.58 a
Control	—	0.00 d	1.75 de

* Values followed by common letters are not significantly different at the 5 percent level of probability.
** Dates of evaluation.

TABLE 3. Annual ryegrass stand at three overseeding dates following chemical treatment. Scale: 0 represents no overseeded stand; 10 represents ideal turf cover.

Chemical	Rate lbs. ai/A	Seeded 10/24/68 11/14/68** 7.0 cd*	12/5/68 8.0 abc	3/14/69	Seeded 11/14/68 12/5/68	3/14/69	Seeded 15/5/68 3/14/69
Bensulide	10	6.0 d	6.8 c	8.2 ab	4.2 bc	7.5 ab	5.8 b
Bensulide	21.5	6.0 d	6.8 c	7.5 b	4.0 bc	4.2 c	4.5 b
Benefin	3.0	8.0 abcd	8.5 abc	9.8 ab	5.0 abc	7.5 ab	9.2 a
Benefin	3.0	7.0 cd	7.8 bc	9.5 ab	5.8 ab	7.5 ab	9.2 9.0 a a
DCPA		9.2 ab	9.0 ab	[illegible]	4.0 b		
DCPA	10	9.5 a	8.5 abc	9.8 ab	4.0 cb	7.5 ab	8.0 a
EPTC	20	7.2 abcd	9.2 ab	9.8 ab	6.0 ab	7.5 ab	8.8 a
Dichlobenil	2	9.2 a abc	9.2 ab	10.0 a	5.2 abc	9.2 a	9.5 a
Dichlobenil	4	8.8 abc	9.2 ab	9.5 ab	4.5 abc	8.5 a	8.8 a
Control	—	10.0 a	10.0 a	9.8 ab	6.5 a	8.0 a	9.5 a

* Values followed by common letters are not significantly different at the 5 percent level of probability.
** Dates of evaluation.

TABLE 4. Red fescue stand at three overseeding dates following chemical treatment. Scale: 0 represents no overseeded stand; 10 represents ideal turf cover.

Chemical	Rate lbs. ai/A	Seeded 10/24/68 11/14/68**	12/5/68	3/14/69	Seeded 11/14/68 12/5/68	3/14/69	Seeded 15/5/68 3/14/69
Bensulide	10	3.8 d*	3.5 ef	5.5 c	1.8 b	5.2 c	6.2 cd
Bensulide	20	0.5 e	2.0 f	2.8 d	1.8 b	4.5 c	4.8 d
Benefin	1.5	6.2 bc	—	8.8 ab	2.5 ab	9.5 a	8.8 ab
Benefin	3.0	4.5 cd	6.2 abcde	7.8 ab	3.8 ab	8.8 ab	8.5 ab
DCPA	10	4.2 cd	4.2 de	7.0 bc	3.0 ab	7.2 b	8.8 ab
DCPA	20	3.5 d	3.2 ef	3.0 d	1.8 b	4.2 c	6.8 bc
EPTC	2	8.2 bc	8.5 abc	9.8 a	4.5 a	5.5 a	10.0 a
Dichiobenil		6.8 b	6.8 ab	9.8 a	3.5 ab	9.2 a	10.0 a
Dichlobenil	4	4.2 cd	5.8 bcd	9.2 ab	2.8 ab	8.0 ab	8.8 ab
Control	—	9.2 a	8.2 a	9.5 a	3.5 ab	8.8 ab	9.0 a

* Values followed by common letters are not significantly different at the 5 percent level of probability.
** Dates of evaluation.

TABLE 5. Rough stalk bluegrass stand at three overseeding dates following chemical treatment. Scale: 0 represents no overseeded stand; 10 represents ideal turf cover.

Chemical	lbs. ai/A Rate	Seeded 10/24/68 11/14/68**	Seeded 10/24/68 12/5/68	Seeded 10/24/68 3/14/69	Seeded 11/14/68 12/5/68	Seeded 11/14/68 3/14/69	Seeded 12/5/68 3/14/69
Bensulide	10	4.5 bc* 1.0 d	5.8 e cd	3.0 7.8 cd a	3.0 cd	8.2 ab 5.8 c	8.2 abc
Bensulide	20	[illegible]			2.0 d	[illegible]	5.0 d
Benefin	1.5	6.5 b	6.8 bc	9.0 a	5.8 ab	9.5 a	
Benefin	3.0	3.0 cd	3.8 de	5.2 b	4.5 bc	8.8 ab	8.5 ab
DCPA	10	4.0 c	2.8 e	4.2 bc	3.0 cd	7.0 bc	7.2 abc
DCPA	20	3.0 cd	2.0 e	2.0 d	1.2 d	3:0 d	6.5 cd
EPTC	3	6.5 b	5.8 bcd	9.2 a	5.2 ab	9.2 a	9.5 a
Dichlobenil	2	6.5 b	7.2 b	9.5 a	4.8 bc	9.8 a	9.5 a
Dichlobenil	4	5.0 bc	6.8 bc	9.2 a	5.8 ab	9.5 a	9.0 ab
Control	—	10.0 a	9.5 a	9.8 a	7.0 a	a.6 ab	8.5 abc

* Values followed by common letters are not significantly different at the 5 percent level of probability.

** Dates of evaluation.

TABLE 6. Creeping bentgrass stand at three overseeding dates following chemical treatment. Scale: 0 represents no overseeded stand; 10 represents ideal turf cover.

Chemical	Rate lbs. ai/A	Seeded 10/24/68 11/14/68**	Seeded 10/24/68 12/5/68	Seeded 10/24/68 3/14/69	Seeded 11/14/68 12/5/68	Seeded 11/14/68 3/14/69	Seeded 12/5/68 3/14/69
Bensulide	10	1.5 cde*	3.5 d	9.5 a	2.5 abcd	9.2 a	8.8 ab
Bensulide Benefin	20 1.5	00 2.5 e cd	1.2 cd f	7.2 ab b	4.2 cd a	9.5 6.8 a bc	9.2 7.5 ah b
Benefin	3.0	2.0 cde	1.8 ef	4.0 c	1.5 bcd	5.5 c	9.2 ab
DCPA	10	0.5 de	f				5.5 c
DCPA	20	0.5 de	8.8.2 f	2.2 8.5 cd d	0.8 d	3.8 1.8 d e	1.0 d
EPTC	3	6.8 b	6.8 b	10.0 a	4.0 a	19.5 a	9.5 ab
Dichlobenil	a	5.8 b	5.8 bc	9.8 a	3.5 ab	9.5 a	9.8 a
Dichlobenil		3.2 c	6.0 bc	10.0 a	3.0 abc	[illegible] a	10.0 a
Control	—	9.8 a	8.8 a	9.8 a	3.5 ab	8.2 ab	8.2 ab

* Values followed by common letters are not significantly different at the 5 percent level of probability.

** Dates of evaluation.

LANDSCAPING TO PROTECT HOMES FROM WILDFIRES

By V. B. YOUNGNER

University of California, Riverside

The disastrous fires of this fall have reawakened an interest in methods for reducing the fire danger to homes in the vicinity. The first step, of course, is to build structures of nonflammable or fire resistant materials. However, after a home is built the question remains, what can be done to keep fire away and to further protect it from the wildfire threat? Considerable valuable information on this subject has been available from the University of California for many years. Unfortunately, interest in the subject wanes during the periods between highly damaging fires; the very time when protective measures should be developed.

After the Bel-Air fire of 1961 which destroyed 484 homes, a number of studies were conducted to provide a basis for recommendation on landscaping for fire prevention and flood or mud-slide control (Mckell et al, 1966). The information and discussion that follows is largely a result of these investigations. Much of this has already been published in various bulletins and journals but it is so important that it deserves re-emphasis at this time.

Landscaping for fire protection involves three main practices: 1. Clearing away highly flammable brush from the immediate home surroundings and pruning remaining plants to remove low growing branches and all dead material. 2. Selecting plant species which do not support fire readily. 3. Using them in the landscape in ways that will help protect the home and other structures. However, as Maire and Goodin (1967) have pointed out, "There is no such thing as a plant that will not burn. The term 'fire resistent' has been used and may be misleading. All plants will burn if there is enough heat and other conditions are right".

Observations of burned over areas from past fires all show that a well watered landscape is one of the best protections available regardless of the species used. Maire and Goodin (1967) have discussed this as follows:

> "During a major fire, any plant may burn, even though some may be slower to catch and carry a fire. However, recent large fires showed that plants on well-watered and well-maintained landscapes did not burn as readily as dry plantings. Tall trees often formed a barrier that prevented flying burning

material from reaching buildings. Irrigated ground covers, like ivy or iceplant, usually do not carry fire. Sprinkler systems that can be operated at critical periods can increase the effectiveness of the plant protection.

A wide choice of plants can be used in irrigated landscaping. However, caution must be used in placing coniferous evergreens and some resinous plants.

In recent California fires, well-pruned, cleanly maintained, irrigated landscapes held up remarkably well. Ground covers, especially of succulents, generally did not carry fire. Maintenance had an important influence in this for iceplant did carry fire where litter had accumulated and dead patches occurred. Plantings of Algerian ivy were often scorched or wilted by the heat, but did not burn or carry fire when they had been kept free of dead material."

They also point out that where water is not readily available measures can be taken to reduce the fire hazard.

"Dense chaparral is especially dangerous when it is growing in a canyon or other location below a house where a chimney draft situation might exist if a fire should occur there. In any case, fire tends to race uphill. Wherever feasible, chaparral should be replaced by a low or discontinuous ground cover that will produce less fuel.

With careful planning, you can prevent your unwatered landscape from becoming a fire hazard, although it will not equal the safety of the watered landscape. The most important step is to minimize the fire hazard. Separate the flammable native shrubs by removing adjacent plants. On the remaining shrubs, prune and remove old growth that would spread fire easily.

State law requires complete brush clearance within a minimum of 30 feet around all structures. If extra hazardous conditions exist, state law and some city and county fire codes require that, for an additional 70 feet, brush and other flammable vegetation must be removed or maintained at a height of 18 inches or less. A limited number of specimen shrubs may be permitted to remain. If landowners fail to comply, the work may be done by county crews, and the cost added to tax bills.

Ask your fire department for local regulations on how far to keep brush and grass from your buildings."

Choice of plant materials is especially important for unwatered landscape areas. Native chaparral plants should be avoided as much as possible. Succulents such as yuccas, *Agave* spp. Cacti and Aloe spp. are excellent background and specimen plants. For lower growing decorative and ground cover uses there is a wide choice of succulent plants available.

Variety and accent can be provided by drought resistant trees that also show some fire retarding characteristics. California pepper *(Schinus molle),* Carob (*Ceratonia siliqua),* and California laurel *(Umbellularia californiica)* are good choices. Palms, especially *Washingtonia* spp. are also useful if kept well trimmed to remove old fronds before they become a fire hazard.

TABLE 1. Drought tolerant shrubs for the dry landscape.

Common name	Scientific name
Oleander	Nerium oleander
Rockrose	Cistus vellosus, & C. ladaniferous
Italian Buckthorn	Rhamnus alaternus
Lemonade Berry	Rhus integrifolia
Yerba Santa	Erodictyon trichocalyx
Fremontia	Fremontia californica
Manzanita	Arctostaphylos spp.
Sugar bush	Rhus ovata

Some native shrubs may be retained in the dry landscape if well isolated by low growing grasses and ground covers that will not readily support wild fires. Toyon *(Heteromeles arbutifolia)* elderberry *(Sambucus glauca)* and *Ceanothus* spp. are especially attractive drought tolerant natives. A number of other drought tolerant shrubs that may be used are listed in Table 1. This is not intended to be an exhaustive list. Many others can be selected from the publications listed at the end of this article.

Most of these shrubs have no fire resistant or slow burning characteristics. Their usefulness for fire retardation lies in keeping them well separated from each other and well pruned of dead branches. Grasses and ground covers of low fuel value or slow burning characteristics may be used between them.

Many ground covers can be used in the well watered landscape areas. Most will have excellent fire retarding characteristics if kept trimmed and free of litter. Of course if they are allowed to become dry and filled with dead material they will become a fire hazard. Some promising species grown in tests at UCLA are described in Table 2. Many of these have natural fire retarding qualities and once established need little or no irrigation. Thus they may be valuable for areas where only limited irrigation is possible.

Establishment of cover on burned or cleared areas for soil erosion prevention is always of first importance. This should include both quickly established plants which are usually temporary and longer lived but slower growing perennials. Grasses and some legumes are especially good for such plantings as they provide excellent erosion control without creating a large amount of fuel, In the unirrigated landscape they serve as excellent ground covers to isolate the larger landscape plants previously mentioned.

The best fast starting temporary grasses are annual ryegrass *(lolium multiflorumj)* soft chess *(Bromus mollis),* and common barley *(Hordium vulgare).* Bur clover (*Medicago hispida* is a valuable legume in combination with these grasses. Other grasses and legumes can also be used but do not seem to offer any additional advantage.

Perennial grasses and legumes for the longer lasting cover are: Perennial ryegrass *(Lolium perenne),* Smilo *(Oryzopsis miliacea),* Hardinggrass *(Phaliaris tuberosa),* Birdsfoot trefoil *(Lotus corniculatus),* narrowleaf birdsfoot trefoil *(Lotus tenuis),* Tall fescue *(Festuca arundinacea)* and wheatgrasses *(Agropyron spp.).* Information on the adaptability of these and other grasses or legumes to a particular area can be obtained from the local Farm Advisors office.

Maire and Goodin have described recommended establishment procedures as follows:

"Slopes will have to be planted by hand or with a small planter, and the seed covered to the proper depth. If the soil at planting depth is dry, the seed will not germinate until it rains or the area is irrigated. If rainfall is not adequate to support the grasses, light irrigations with sprinklers may be necessary to establish a good stand. When seeding grass for erosion control, watercourses should be thickly planted. During rains, the heavy runoff will flatten grasses and run over the top, preventing serious erosion. Even so, grass covers will not prevent whole hillsides from slipping during unusually heavy rains.

For larger areas than those normally associated with residential landscaping, it may be desirable to plant perennial grasses. These grasses, in contrast to temporary ones such as annual ryegrass, are not fully effective in reducing soil erosion until the second or third year after seeding. However, they have a deeper root system and, once established, provide greater soil stability than do annuals. Perennial grasses also remain green long into the summer, thus reducing fire hazard early in the fire season. Some periodic removal of litter accumulation may be necessary."

Frequently hillsides will be accessible for irrigation but too steep for easy use of mowers and other equipment. Studies have shown that some grasses and ground covers can be grown on these areas with regular but not frequent irrigation and only two or three mowings annually at the most. These plants will remain short and produce a low dense meadow-like effect. Some of the better species for this purpose are listed in Table 3. However, adaptation to local climates and soils must be determined before planting. They should not be cut back closer than three inches from the ground. This should be done only when growth becomes too thick or too tall. Clippings should be removed.

Research seeking new and better answers to the wild-

TABLE 2. UCLA Plantings of Ground Cover Ornamentals

Common name	Species	Spacing used on UCLA plots	Comments
Saltbush	Atriplex breweri	**Open**	Silvery foliaged shrub to 6 ft. high. Flowers inconspicuous. Tolerates saline soils and adverse conditions. Slow- burning characteristics. Reseeds abundantly. Rapid growth.
Australian Saltbush	Atriplex semibaccata	**1 1/2 ft**	Prostrate perennial herb with inconscipuous flowers, Tolerates saline soils and adverse conditions. Not in the trade. Slow-burning characteristics.
Dwarf coyotebush	Baccharis pilularis 'Dwarf'	**2 ft**	To 24 inches high. Flowers inconspicuous. Drought resistant once established. Good surface erosion control.
White rockrose	Cistus hybridus	**2% ft**	Not noted for its beauty. Spreading growth 23 ft high and 4 ft wide. White flowers 2 inches across. Drought resistant once established. Slow-burning characteristics. Would not provide good intial erosion control.
	Cistus ladaniferous	———	Shrub to 6 ft high with sticky foliage. Flowers white, 3 inches across. Slow-burning characteristics.
Hairy canary clover	Dorycnium hirsutum	**2ft**	Low growing perennial with small pea-like flowers. Not in the trade. Drought resistant.
Yerba santa	Eriodictyon trichocalyx	**Open**	Glossy, dark-green leaves, shrub 3 to 5 ft high. Grows in thickets. Slow-burning characteristics. Drought resistant.
Parrot's beak	Lotus berthelotii	**2ft**	Gray refined foliage to 12 inches high. Striking scarlet flowers of narrow, sweet pea shape. Requires good drainage.
———	Portulacaria afra	———	Fleshy shrub eventually reaching 10 ft in height. Stems purple. Clusters of tiny, rosy, starlike flowers. Tolerates adverse conditions.
Arabian scurfpea	Psora lea bituminosa	———	Perennial herb. Shrub growth to approx. 2 ft. Small purple, pealike flowers. Drought resistant. Old plant residue may provide unwanted litter.
Dwarf rosemary	Rosmarinus officinalis 'Prostrate'	**2ft**	Woody shrub to 1 1/2 ft. Small light blue, sagelike flowers in spring. Drought resistant.
Gray santolina	Santolina chamaecyparissus	**2 ft**	1/2 inch flowers like bright yellow buttons. May require occasional shearing to prevent woodiness. Poor erosion protection initially. Excellent foliage contrast. Old flower heads and stems must be removed.
Green santolina	Santolina virens	**1% ft**	Soft yellow flowers like buttons. May require occasional shearing to prevent woodiness. Same general characteristics as gray santolina.
Prostrate germander	Teucrium chamaedrys	**11/2 ft**	Rose or red-purple, sagelike flowers in summer. Heat and drought resistant.

From McKell et al, 1966.

Figure 2. Experimental planting of grasses and groundcovers for irrigated slopes. Grasses have not been mowed so variations in height are clearly evident.

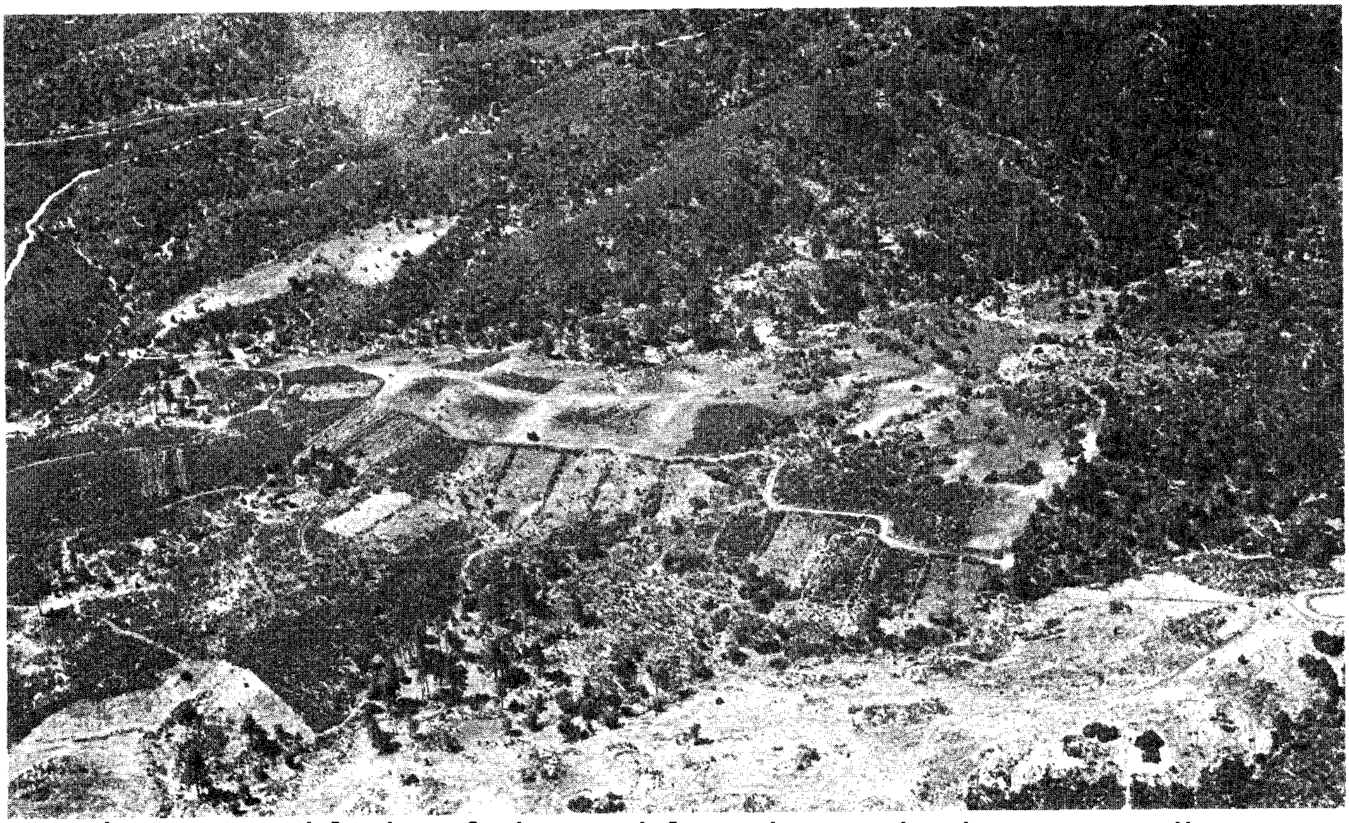

Figure 3. Aerial view of the greenbelt study area in the San Bernardino mountains. The various treatment plots can be seen across the the center of the photograph.

TABLE 3. Grasses and Ground Covers for Irrigated Slopes.

Species and Varieties	Comments
Zoysia spp. and hybrids	Slow growing and short but slow and difficult to establish. Mowing rarely required.
Cynodon spp. and hybrids (Tifway, Tifgreen, Santa Ana, Tifdawrf)	If not fertilized or irrigated too fre quently will require an occasional mowing or renovation only.
Festuca rubra, red fescue Festuca ovina, sheep fescue	Fine leaved fescues make fairly low cover and have good color if not over-watered.
Poa pratensis, Kentucky bluegrass (Merion, Fylking, Newport and others)	May require mowing every 4-8 weeks.
Lotus tenuis, Narrow leafed birdsfoot trefoil	Does not need mowing but cutting back old growth once a year recommended.
Lippia nodiflora, Lippia	Needs no mowing, drought tolerant, attracts bees.

fire threat continues. A study now underway in the San Bernardino mountains is designed to determine the feasibility of using sewage effluent or other waste water to create green-belts in arid wildlands. Creation of greenbelts across chaparral-covered mountainside in this way would serve multiple functions: 1, Provide wide fuelbreaks for fire control. 2, Conserve waste water without polluting streams, lakes and underground water supplies. 3, Creat new recreation areas. 4, Provide improved habitats for wildlife.

This investigation is conducted by the University of California, Riverside, in cooperation with the U.S. Forest Service, the California Division of Forestry, The Office of Water Resources Research of the Department of the Interior, and other governmental agencies. Various individual studies on the project will be carried out over a several-year period. However, if the project results only in a new method of reducing the wildfire hazard it will be worth the full investment of time and money.

LITERATURE CITED AND REFERENCES

Author unknown. Rural Fires. 1969. PA-907. Federal Extension Service and Forest Service, USDA.

Davis, William B., Joseph W. Osgood and D. Barry Leeson 1963. Landscaping Your Mountain Home. AXT-101. Agric. Extension Service.

Gilden, Ed. E. 1962. Fireproof Your Forest Home. 10 m rerun. AES.

Leonard, O. A. and W. A. Harvey. 1965. Chemical Control of Woody Plants. Bulletin 812, California Agricultural Experiment Station.

Maire, Richard G. and J. R. Goodin. 1967. Landscape For Fire Protection. AXT-254. Agric. Extension Service.

Mathias, Mildred E., Harlan Lewis, Marston H. Kimball and Woodbridge Metcalf. 1966. Native California Plants for Ornamental Use. AXT-99. Agric. Extension Service.

Mathias, M. E., W. Metcalf, M. H. Kimball, C. L. Hemstreet, D. E. Gilbert and W. B. Davis. 1968. Omamentals for California's Middle Elevation Desert. Bulletin 839. Calif. Agricultural Experiment Station.

McKell, Cyrus M., Vernon Stoutemyer, Chester Perry, Lyle Pyeatt and J. R. Goodin. December 1966. Hillside Clearing and Revegetation of Fire Hazard Areas. California Agriculture, 20(12) :8-9.

Perry, C. A. 1963. Clear Away Brush. AXT-69. Agric. Extension Service.

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Department of Agronomy, University of California
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