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In This Issue: FLOWER AND NURSERY INFORMATION
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Editor's Note: The enclosed reports were presented at the Eleventh Annual Ornamentals Short Course held at the Maui Community College, March 22-23, 1988, and represent the 16th Annual Protea Workshop.

WHAT'S NEW IN SOUTHERN HEMISPHERE CUT FLOWERS

A nearly ideal situation exists for testing many of the exotic flora from the southern hemisphere at the Maui Branch Station. At the 3000-foot elevation, the long summers are dry with moderate temperatures in the 70s, and the short winters are wet with temperatures which drop into the 50s. The object of the evaluation research being carried out is to determine what cut flowers can be produced here which have a competitive advantage over California and Florida.

Hawaii has water quality superior to that of California for the Proteaceae family which do not grow well in saline conditions. The dry summers of Hawaii are superior to Florida's humidity and summer storms which damage the soft foliage of many proteas. A continual parade of tourists are exposed to and buy our flowers to take back home with them. Thus, advantages like these have spurred the introduction and evaluation program for southern hemisphere cut flowers.

Although the Australian genus *Banksia* trials the South African genera in terms of the popularity of its flowers with florist, the smaller flowered red *Banksia coccinea* is becoming more popular.

In Leucospermums, small, thin leaves are sought so that less cleaning is needed and the foliage does not dominate when used in arrangements. Large flowers, long blooming seasons, novelties, bicolors, and lighter, brighter colors are desired. Two good parents have been the South African hybrids, 'Vlam' (Flame), and 'Red Sunset' (*L. linare* x *L. tottum*).

Three new *Leucospermum* selections produced by Dr. Phil Ito of the Beaumont Research laboratory in Hilo are being propagated, and names are being sought for them. At present, they are known as Hybrids 7, 14, and 24.

Hybrid 7 is a floriferous red with good stem length, and small, hard, and not-too-hairy leaves. Hybrid 14 is a cross between 'Hawaii Gold' and *L. incisum* with a lively mixture of red and gold. In Hybrid 24 (*L. linare* x *L. glabrum*) are combined some outstanding qualities of its two parents: the narrow foliage of *L.linare* and its long blooming season and the scarlet ribbons of *L. glabrum;* the moderate-sized flowers are borne on long stems with scattered bloom throughout the year.

Hawaii protea marketers have perceived an increase in the supermarket (one-stop-shopping) approach of their customers who want novelty and variety in the product they purchase from Hawaii. Thus, increased interest is developing in expanded product lines. At the Maui Branch Station a number of South African and Australian wildflowers are under evaluation.

Geraldton Waxflower (*Chamaelaucium uncinatum*) is native to northwest Australia where it is found in dry, sandy soils. It does appear to have a photoperiodic mechanism regulating flowering (short day plant) as it always flowers at the same time of year in its native habitat. Australian horticulturist, Greg Lamont, collected seed from wild populations, overcame its dormancy by excising the embryos, and grew out many seedlings from which he selected those with large flowers, good colors, and floriferousness. An assortment from Lamont's collection was planted at Kula, and the plants which survived (they are susceptible to *Phytophthora*) have begun to bloom. There is a lot of work to be done yet, but the potential is good because the Geraldton Waxflower is already in the markets and florists do not need to be educated.

A group of 'filter flowers' has been planted with fine promise for marketing. *Asastartea heteranthera* cv Winter Pink blooms year 'round at Kula. They now are productive bushes about 2.5 feet tall from six inch cuttings in 1986. A California wholesaler has been bringing it in from Australia, so it is 'in the market.' A related species, *A. fascicularis*, also is doing well at Kula. A third filler, with spike-like branches of tiny magenta flowers, is *Kunzea affinis*. It also appears to be easy to grow.

There has been much fuss made over Kangaroo Pawa in the USA trade literature both for cut flowers and as potted plants. It is 'beginning to happen' on the US mainland and Hawaii growers should not wait too long to get started. The plants at Kula have been in the ground only about 2 years from seed or tissue culture transplant and have been very productive during this time.

Anigozanthos manglesii is one of the most spectacular with large, bright red and green fuzzy bracts borne on 2-3 foot stems. It is readily grown from seed, blooming in mid-December 1986 from planting of seed in early April of the same year. The blooming season then extended to May. Unfortunately, the plant is susceptible to a fungus which causes 'Inky Disease' and turns the leaves black and causes the plants to deteriorate. The plants seemed to flourish their first year, but by the end of the second year, it was apparent that new plantings should be made.

A. viridens is smaller than *A. manglesii* and its flowers are a fluorescent green.

Australian hybridizers sought resistance to the Inky Disease and found it in *A. flavidus*, a coarse flowered, vigorous (to 6 foot tall) plant. The late Dr. Merv Turner provided a tissue-cultured collection of his 'Bush Gem' hybrids to the Station in April of 1986, which were set out and began to bloom 12 months later, producing some 50 six-foot tall stalks per plant. The four cultivars now available in Hawaii and in the US are; Sunset, Haze, Dawn, and Ruby.

The cool temperatures favor flowering, and the summer dryness minimizes the severity of the Inky Disease. The station is conducting research into keeping qualities and return of the plants to productivity after cutting.

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PROGRESS REPORT ON MICROPROPAGATION OF PROTEAS

The objectives of this project are (1) to develop a micropropagation system (clonal propagation through tissue culture techniques) for a selected protea cutflower cultivar and (2) to determine whether this system can be used for micropropagating other protea cultivars. If proteas can be micropropagated, clonal increase will be more rapid and, ultimately, upgrading of existing fields with superior cultivars can be done in a shorter time.

The micropropagation system is being developed with cultivar 'Hawaii Gold'. Although improvements in the different stages still must be made, one complete cycle of propagation has been accomplished. The stages of micropropagation are: (1) establishment of culture and increase of propagules, (2) shoot development, (3) rooting of derived shoots, and (4) establishment of rooted shoots under natural conditions.

Establishment of culture and increase of propagules. Prior to culture, the explants (plant organ to be cultured) were disinfested to eliminate or kill microorganisms that contaminate cultures. The disinfestation process consisted of (1) gently scrubbing apical cuttings in detergent solution, (2) rinsing in running tap water, (3) soaking sections of cutting in 10% Clorox solution for 10 min, (4) soaking of axillary buds after removal from cuttings in 5% Clorox for 20 min, and (5) rinsing of buds in sterile water. The axillary-bud explants were placed in liquid nutrient medium supplemented with 0.2 mg/liter Benzyladenine (BA). Cultures were maintained on a 0.4 rpm roller drum under continous illumination and at 25-28°C. Within 2 months, the explants developed into round, green proliferating propagules which increased rapidly with monthly transfer to fresh liquid medium.

Shoot development. When propagules were maintained on the roller drum, they did not produce shoots because of their being rotated continously. Also, propagules at this stage do not survive when transferred to agar nutrient medium. Therefore, they were placed on filter-paper bridges. Mortality was greatly reduced with this type of culture and shoots emerged from propagules. Paper-bridge culture was prepared by folding a filter paper strip into "M" shape with the "legs" immersed in the liquid medium. Propagules were placed on the bridge span which was above the liquid surface. Under this condition, propagules were constantly moist but remained stationary to allow shoot emergence. After shoots developed 4-6 leaves, they were transferred to agar medium of lower BA concentration (0.05 mg/liter) for faster shoot elongation. Shoots were separated from propagules when they attained height of more than 2 cm.

Once shoots were obtained, an alternate pathway to generate more shoots was developed. This procedure consisted of cycling shoot cuttings through a sequence of media containing different levels of BA to stimulate axillary bud emergence and elongation. Cuttings were cultured first in an agar nutrient medium supplemented with 0.2 mg/liter BA until axillary buds sprouted and then in agar medium of 0.05 mg/liter BA for axillary-shoot elongation. Elongated shoots were separated from cuttings and placed in the cycle again for more shoots.

Root development on derived shoots. Shoots did not root in agar media supplemented with 0.1–5.0 mg/liter Indolebutyric acid (IBA). Higher levels of IBA in the medium were phytotoxic to the shoots. Therefore, the basal portion of the shoots were first soaked in higher IBA solutions (50-100 mg/liter) for 4 days and shoots were then cultured in agar nutrient medium without IBA. When done in this manner, roots emerged on the shoot base in about 15 days.

Establishment of rooted shoots under natural conditions. Rooted shoots were established in pots of sphagnum moss placed under mist. Once roots became established, these plantlets were transferred to a potting mixture of 2 perlite: 2 peat moss : 1 soil for continued growth.

Further testing of this propagation system is being made with cultivars, 'Mayday' and 'Hybrid 24'. Explants of 'Mayday' have developed propagules from which shoots emerged and are being elongated in preparation for rooting, while explants of 'Hybrid 24' have developed into propagules.

The assistance of Dr. P. Parvin and Mr. Y. Otani, both of Kula Branch Station, and financial support by GACC are gratefully acknowledged.

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PROTEA POSTHARVEST BLACK LEAF

A critical problem in the marketing of *Protea eximia*, *P. neriifolia*, and to a lesser extent, *P. compacta* is a blackening of the leaves as the product moves through the distribution channels. Although some blackening may be associated with fungal problems, the majority is due to a physiological problem apparently related to water stress. The browning is a wounding response in which polyphenol oxidase, perioxidase and their substrate phenols are involved. However, no relationship has been found between these factors and browning due probably to their overwhelming amount and activities.

The water uptake rate of whole flowers is in the range 50 to 70 microliters per min. Removal of leaves significantly reduces the rate of water uptake, while flower removal does not significantly reduce water uptake rate. The leaves therefore seem to be the principal site of water loss. The rate of water uptake declines after harvest. The water uptake rate in the initial experiments is not greatly modified if packed for three days. The presence of preservative maintains water uptake and thereby delays the onset of leaf blackening.

Work at the University of Stellenbosch in South Africa has correlated high temperatures and low light conditions with an increase in rate of leaf blackening. At the University of Hawaii, the use of a chemical flower preservative before and after simulated shipping, shipping temperatures and packing in plastic bags has been investigated. A large number of preservatives have now been tested. The best so far, are the commercial preservatives; Florever and Floralife. The addition of amino-oxyacetic acid, an ethylene synthesis inhibitor, to these preservatives seems to improve their performance. This work is to be expanded. Most other preservatives recommended for Protea and other flowers were without effect in delaying the onset of leaf blackening. The use of Floralife and Florever (20g/l) delayed leaf blackening and wilting of the flower over the use of deionized water only, for all temperatures. Even when preservative slowed the rate of leaf blackening, the flower could still wilt. No preservative solution has been found yet which delays flower bract wilting.

Refrigeration, especially during prepacking and packing periods, has the most significant effect on delaying the onset of leaf blackening. The flower can withstand packing with ice for up to 3 days. Refrigeration only during the prepacking period is only marginally effective. The use of preservative (Florever and Floralife) before packing and especially post-unpacking are essential. The use of a preservative allowed warmer shipping temperatures, as at 13° C. Floralife and Florever were as good as or equal to water at 2°C or 7°C shipping temperatures. If the flower stems were held in a plastic bag rather than dry in a box and supplied with preservative prior to and after shipping, even the 20°C shipping temperature allowed as much delay to 50% leaf blackening as did dry shipping with no preservative use at 7°C. Since holding the flowers at low temperatures during shipping is most important, the next phase of the research will attempt to develop commercially viable methods for shipping at low temperatures.

Clonal differences were observed in the rate of leaf blackening. As much as 20% difference in the time to 50% leaf blackening was observed among clones in both water and preservative. This difference can be up to 20 days in the presence of preservatives. Flower maturity suggests more open flowers have a slightly better post-harvest life with respect to days to 50% leaf blackening and less life with respect to flower bract curling.

There are a number of additional approaches which need to be tested to delay the onset of leaf blackening. The first approach would be to reduce water loss by either closing the stomata or the blocking of these pores with antitranspirants. Additionally, after harvest delay in leaf blackening could possible by delayed by maintaining the flowers in a high relative humidity and lower temperature. Preservative vase solutions offer another approach to maintain functional water conduction tissue in the stem and inhibiting the blackening biochemical reactions. The most intriguing preservative is amino oxyacetic acid which shows promise in delaying blackening. These approaches will be tested with *Protea neriifolia*, the Pink Mink, which is the flower having the greatest leaf blackening problem. Since this flower has peak of production in September and October work will also be done on *P. exima* to the limit of flower availability. Attention will be given to the increased susceptibility of Minks to leaf blackening early in the season. It is possible that water uptake by these early flowers is restricted, due to their development during hot dry weather.

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POTENTIAL CUT FOLIAGES

Trends come and go in the flower business, but foliages are forever. Cut greens are used as backing for floral designs, as design elements, and seasonally in special uses as wreaths and dried arrangements. A 1983 study estimated the value of cut foliages in the US at $175 million with $25 million of this attributed to Christmas greens.

Aside from traditional Christmas greens, a great many different plants find their ways into the market as cut foliage. The most prominent foliages include leatherleaf fern (42%), chamadedorea palm (21%), huckleberry (7%), salal (6%), pittosporum (5%), and asparagus. Much of the US cut foliage comes from Florida, Oregon, Washington, and California. Some greens are imported from Central America and Colombia, but they do not rank as major competitors because shipping costs are high and unit values low.

The recent surge in interest in tropical cut flowers has generated an interest in exotic foliages to accompany them. Green ti is the only cut foliage Hawaii exports in large quantity, but there are many others which are included in mixed flower shipments sent directly to mainland florists. Shipments to wholesale houses tend to concentrate on fewer foliages: ti (green, red, variegated), palms, monstera, dracaena, lycopodium. The wholesale value of cut foliages in Hawaii for 1986 was $771,000.

At the Maui Branch Station of HITAHR at Kula, Maui, Dr. Phil Parvin has been engaged since 1986 with the introduction and testing of southern hemisphere plants--principally the proteas--for floral and landscape value. Although the diverse protea flowers have garnered most of the attention, many attractive foliages can be spotted in the station plantings. At the 1988 Ornamentals Short Course, Dr. Parvin presented a sample of 20 species with desirable cut foliage characteristics. Some of these have already achieved a reputation while others await the limelight of discovery. The Proteaceae family is prominent in his selections.

Leucadendron hybirds: 'Safari Sunset', 'Silvan Red', 'Pisa', 'Meridian'. Male and female flowers are borne on separate plants with the subtending foliage coloring to dark reds in 'Safari Sunset' and 'Silvan Red'. 'Pisa', on the other hand, is a shimmering green, while 'Meridian's silvery cones are set off by silvery green leaves. Large acreages of 'Pisa' have been planted in New Zealand where it has won wide acceptance for its long keeping quality and design characteristics. In New Zealand, 'Safari Sunset' grows to six-foot height and is cut back once a year to stimulate its vigorous growth. Cut branches of the *Leucadendrons* tend to be straight, the narrow leaves upright, and long-lasting. All are vigorous plants, but seasonal flowering renders some of the more colorful cultivars unavailable for part of the year. The species, *L. comosum*, resembles white pine as its leaves are very narrow and borne on the stem like pine needles.

Grevillea species and hybrids, on the other hand, are often more attractive without the little spikes of pink-to-red flowers. The leaves are often finely divided, silvery on the underside, and dark green on top. Among the most interesting are *G.* x 'Poorinda Peter', *G. hookerians.*

G. johnsonii. and *G.* x 'Ivanhoe'.

Banksia, another genus native to Australia, is noted for its stiff, bottlebrushlike flowers, but many species have attractive foliages as well. They are used for both design and filler purposes and fresh or dried. The leaves are usually leathery and dark green on top with a silvery or bronze underside. In appearance, the leaves range from small oakleaf shapes to fernlike to sawtoothed "rick-rack". Banksias are cut either as branches or as individual leaves. Small trees or shrubs, banksias can be quite vigorous, but they are sensitive to root diseases and high phosphorus fertilizer. Most have to be grown from seed. Some species to consider for foliage are *B. speciosa*, *B. praemorsa*, *B. brownii*, and *B. grandis*.

Several popular New Zealand foliages are represented at the Maui station: *Coprosma*, *Pittosporum, Lophomyrtus, Phormium*. The first three are popularly used a fillers while the *Phormium* (New Zealand flax) is sold at 10 cents a leaf in New Zealand for its design qualities. Some of *Coprosma* selections from New Zealand have found their way into the potted plant trade following their introduction via Denmark.

C. repens, or Mirror Plant, is a large shrub with shiny, oval leaves. The variegated form, 'picturata', 'Variegata', and 'Marble Queen' are handsome as lanscape plants and long-lived as cut foliage after a flush has matured.

With small leaves borne densely along the stem, *Pittosporum tenuifolium* selections are being grown as cut foliage and container plants in the milder parts of Europe. Still, in their native New Zealand, a number of foliage types and growth habits have been selected and can be found in the nurseries. The cultivar Irene Peterson was an immediate attraction with slender black stems setting off its small white variegated leaves. Other selections have yellow, pink, and tricolor variegation patterns.

Hybrids of Lophomyrtus are grown for straight, vertical branches covered with small, glossy, purple-to-bronze leaves. The cultivar Kathryn, with purplish foliage, is most widely grown because it retains its color well and has the best keeping life. Vegetative growth is vigorous, but a flush must be allowed to mature before harvesting it to prevent wilted tips.

Phormium tenax, or New Zealand flax, has been the target of hybridizers who have selected dwarf forms to contrast with the 5 to 8 foot tall species. The swordlike leaves come in a profusion of bronzes, reds, pinks, yellows, and variegations. They are often coated lightly with a leaf shine or baby oil when used as design elements in arrangements. Selected as a Plant of the year, the cultivar Dazzler is an eye-catcher with brilliant red leaves about 2 foot long. 'Yellow Wave' is a tall-growing selection with broad yellow stripes similar to the variegated pandanus, while 'Tricolor' blends red, yellow, and light green stripes on 2 foot leaves.

While the name "Paperbark" often refers to a fast-spreading, almost weedy tree, an attractive golden-foliaged *Melaleuca* has potential when managed (=frequent pruning back) for its foliage. 'Revolution Gold' was selected in Australia as a landscape plant. In full sun its foliage is a light, bright yellow while the interior, shaded leaves are a light yellow-green. It may require some shading to prevent leaf scorch during the summer.

At present, the station has little information on management practices for many of these foliages, but a cordial invitation is extended to Hawaii's growers to stop by to evaluate the potential of these plants for their own operations.

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WEED CONTROL STRATEGIES FOR HAWAIIAN GROWN PROTEA

A major constraint to the commercial production of Protea for cut flowers is the time and cost associated with weed control. Damage to shallow rooted Proteas can also become a problem through the use of hand hoeing to remove weeds. The current method of weed control is to spot treat living weeds with a 1% solution of roundup (glyphosate, Monsanto). This approach can become very expensive in addition to the risk of accidental spray drift onto desirable plants. Research was initiated to evaluate various means of weed control in the commercial Protea production area of Kula.

Materials and Methods

Preemergence experiment

Seedling or rooted cuttings of the following Proteas were planted in experimental plots at the Kula Branch Research Station of the University of Hawaii: *Leucadendron* 'Safari Sunset', *Leucospermum cordifolium*, *Banksia mensiesii*, and *Protea neriifolia*. The experiment began on 16th of April 1986 and treatments are shown in Table 1.

All plots were hand-weeded and chemical treatments reapplied at three month intervals after the start of the experiment. Weed control was evaluated by visually rating each plot on a scale of 0–10 (10 = a complete kill of the rated plants, and 7 = commercially acceptable control) 90 days after the previous herbicide application. After 1 year of repeated herbicide applications, the stem circumference of each plant was taken. Circumferences were taken again 1 year later to determine growth in response to the various treatments.

Postemergence experiment

This trial was conducted to evaluate the phytotoxicity of fluazifop-P (Fusilade 2000, ICI Americas Inc.) on 9 established protea species (Table 3) at a commercial protea farm in Kula, Maui. Test plants were sprayed twice with fluazifop-P concentrations of 1/2X, 1X (the manufactures recommended spot treatment rate) and 4X on 12/19/85 and 1/23/86. A wetting agent (Ortho's X-77) at .1% v/v was added to each chemical spray. Each treatment was applied to four individual plants. Control treatments included a wetting agent blank and unsprayed plants. Treatments were evaluated using a visual injury rating scale of 0 for no injury and 10 for complete kill. Crop injury ratings were made immediately before the second herbicide application and 41 days after the second spray application. Only those data collected after the second spray will be reported here.

At the time of the second spray, a 2 x 4.5 m area of kikuyu grass (*Pennisetum clandestinum*) was sprayed; plots were not replicated. When herbicide was applied, the grass was growing in a natural uncut state (height 60-75 cm) and was not under drought stress. The plot areas were completely covered with spray, no Protea plants were growing in these grass plots.

Results and Discussion

Preemergence experiment

Weed control ratings made on 15th Jan. 1987, 90 days after the previous (3 rd) herbicide application, are shown in Table 1. Commercially accepted weed control was obtained on all of the weed species present with the exception of the leguminous weeds (*Medicago truncalata* and *Trifolium repens*). All rates of oryzalin showed weakness in controlling these weeds. Near perfect preemergence weed control was obtained with oxadiazon, and oxyflurofen 2%+oryzalin 1%. The black plastic woven ground cover (BPWGC) suppressed all weed growth. There was a problem with the polyester geotextile fabric (PGF) because it allowed soil to accumulate on the surface allowing weed seed germination and growth. Several weeds were also found sprouting from the PGF even though no soil was present. Cost and accumulation of water carried soil makes this material an unacceptable mulch for weed control.

Growth measurements indicated that all Proteas except PNER were significantly affected by weed pressure in the unweeded control (Table 2). Both types of synthetic mulch provided for excellent crop growth. Many growers were initially skeptical of synthetic mulches due to a possible problem of excessive heat build-up. These fears proved to be unfounded and the use of BPWGC has become a commonly used form of weed control in the Kula area. None of the herbicides caused a reduction in crop growth when compared to weeded controls.

Postemergence experiment

The data indicate that all *Banksia* species and *Leucospermum cordifolium* sustained unacceptable injury at the 4X concentration of fluazifop-P (Table 3). Significant but acceptable injury was also observed on *Protea compacta* at the 4X concentration. There was no unacceptable injury observed on any species at the 1/2X and 1X concentration.

The data on kikuyu grass indicate that the 1X and 4X concentrations are effective for control (Table 4). It is believed that fluazifop-P can be safely used on all Protea species included in this trial provided that contact to foliage of sensitive species is minimized. In situations where sensitive species are present, direct and complete coverage will cause only slight injury at the 1X use rate of fluazifop-P. It is not advisable to extrapolate these data to Protea species not included in this experiment.

To conclude, BPWGC and the preemergence herbicides evaluated in this experiment can effectively control weeds occurring at the Kula research station, without a detrimental effect on Protea growth. Grassy weeds can be safely removed from a Protea canopy with fluazifop-P at the manufactures recommend concentration. Contact of finished sprays of fluazifop-P onto Protea flower buds or open flowers should be minimized to avoid potential injury.

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Table 1. Weed control rating of 15th Jan. 1986, 90 days after the previous (3rd.) herbicide application.

	Treatment	Rate lb ai/A[y]	Weed control ratings by species[z]					
			PECL[1]	SCOL[2]	RCCM[3]	MDTN[4]	TIRP[5]	OENO[6]
1	Weeded control	-	0.0C[x]	0.0B	7.5A	0.0F	0.0D	2.5B
2	Unweeded control	-	0.0C	2.5B	2.5B	0.0F	0.0D	7.5A
3	Oxadiazon	4.0	9.0AB	9.8A	10.0BC	7.8BC	7.5BC	9.5A
4	Oxyfluorfen 2% + Oryzalin 1%	3.0	8.8AB	10.0A	10.0A	7.5CD	7.8BC	8.8A
5	Oxyfluorfen 2% + Oryzalin 1%	6.0	8.8AB	10.0A	10.0A	7.5BCD	8.3ABC	9.3A
6	Oxyfluorfen 2% + Oryzalin 1%	9.0	10.0A	10.0A	10.0A	7.5BCD	8.8ABC	9.5A
7	Oryzalin	2.0	7.3B	10.0A	9.0A	5.5DE	7.0C	8.8A
8	Oryzalin	4.0	8.8AB	10.0A	8.8A	5.3E	8.3ABC	10.0A
9	Oryzalin	6.0	8.5AB	10.0A	9.8A	6.0CDE	7.5BC	10.0A
10	Black plastic woven ground cover (BPWGC)	-	10.0A	9.3A	10.0A	10.0A	10.0A	10.0A
11	Polyester geotextile fabric (PGF)	-	9.5A	8.3A	10.0A	9.5AB	9.0AB	9.5A

z Weed control rating: 0 = no control, 10 = complete control.

y Pounds of active ingredient per acre.

x Means within a column followed by the same letter are not significantly different according to Duncans multiple range test at the 1% level.

1 PECL = *Pennisetum clandestinum*
2 SCOL = *Sonchus oleraceus*
3 RCCM = *Ricinus communis*
4 MDTN = *Medicago truncata*
5 TIRP = *Trifolium repens*
6 OENO = *Oenothera spp.*

Table 2. The increase in trunk diameter in response to weed control treatments. Growth measurements for 367 days following a 1 year establishment period.

Treatment	Rate lb ai/A	Increase in trunk diameter BKMS[a]	LCHY[b]	LCOR[c]	PNER[d]
			(mm)		
Weeded control	-	19 c[e]	18 b	20 a	24 abc
Unweeded control	-	5 d	9 c	5 b	18 bcd
Oxadiazon	4.0	34 ab	24 ab	20 a	23 abc
Oxyfluorfen 2% + Oryzalin 1%	3.0	24 bc	24 ab	21 a	27 abc
Oxyfluorfen 2% + Oryzalin 1%	6.0	30 ab	24 ab	22 a	33 a
Oxyfluorfen 2% + Oryzalin 1%	9.0	32 ab	25 a	22 a	15 cd
Oryzalin	2.0	33 ab	21 ab	18 a	26 abc
Oryzalin	4.0	29 ab	24 ab	22 a	16 bcd
Oryzalin	6.0	29 ab	21 ab	22 a	9 d
Black plastic woven ground cover	-	38 a	25 a	19 a	31 ab
Polyester geotextile fabric	-	31 ab	25 a	15 ab	23 abc

[a] BKMS = *B. menziesii*

[b] LCHY = *L. hyb.*

[c] LCOR = *L. cordifolium*

[d] PNER = *P. neriifolia*

[e] Means within a column followed by the same letter are not significantly different according to Duncan's multiple range test at the 5% level.

Table 3. Phytotoxicity data of 9 protea species sprayed with fluazifop-P and wetting agent control. Ratings of phytotoxicity were made 41 days after 2nd spraying.

	Crop injury rating[x]				
	Fluazifop-P			Control	
Species	1/2X	1X	4X	X-77	Unsprayed
Banksia prinotes	0.0	2.0	5.5	0.0	0.0
Banksia victoria	0.3	0.0	5.3	0.0	0.0
Banksia speciosa	0.3	0.3	5.3	0.0	0.0
Protea eximia	0.0	0.0	0.0	0.0	0.0
Protea repens	0.0	0.5	2.0	0.0	0.0
Protea nerifolia	0.0	0.0	0.5	0.0	0.0
Protea cynaroides[1]	0.0	0.0	0.5	0.0	0.0
Protea compacta[2]	0.0	0.8	2.3	0.0	0.0
Leucospermum cordifolium[3]	0.5	0.0	3.5	0.0	0.0

x Crop injury rating: 0 = no effect, 10 = complete kill.

1 *P. cynaroides*, Flower injury: at 4X some flower buds killed.

2 *P. compacta*, Leaf injury: slight leaf crinkle at 1X more pronounced at 4X.

3 *L. cordifolium*, Flower injury: at 4X, flowers in bud stage are killed, opened flowers are misshaped due to death of tissue on one side.

Table 4. Weed control ratings on kikuyu grass sprayed with fluazifop-P and wetting agent control. Ratings of phytotoxicity were made 41 days after spraying (DAS). Plot size 2 x 4.5m, treatments not replicated.

Treatment	Weed control rating[x]
CONTROL X-77	0
CONTROL UNTREATED	0
1/2 X fluazifop-P	6 (STILL ALIVE, NO REGROWTH)
1X fluazifop-P	10
4X fluazifop-P	10

x Injury is rated on a scale of 0 - 10, with 0 = no effect and 10 = complete kill.

NOTE: The use of trade names is for the convenience of readers only and does not constitute an endorsement of these products by the University of Hawaii, the College of Tropical Agriculture and Human Resources, the Hawaii Cooperative Extension Service, and their employees.

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