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16. Abstract

Experiments were conducted at six locations to determine methods for eliminating or controlling existing weeds on highway rights-of-way prior to planting, and preventing weed infestations after planting, without injuring or interfering with normal growth and development of desirable plant material.

Four experiments were conducted to determine herbicide programs for eliminating weeds in natural stands of kinnikinnick (Arctostaphylos uva-ursi [L.] Sprang) and salal (Gaultheria shallon Pursh.) on highway rights-of-way, permitting these plants to form solid covers of uniform attractive vegetation.

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SUMMARY

Experiments were conducted at six locations to determine methods for eliminating or controlling existing weeds on highway rights-of-way prior to planting, and preventing weed infestations after planting, without injuring or interfering with normal growth and development of desirable plant material.

Preplant treatments were applied the first year, after which the area was mulched with ground bark and subplots were planted with various landscape plants and treated with herbicides to evaluate postplant weed control.

One to three preplant applications of glyphosate controlled most grasses and broadleaf weeds. A rate of 2 lb/A (2.2 kg/ha) was sufficient in some cases, but a higher rate was needed under some conditions or for the more difficult to control weeds such as field bindweed[1]. One year of preplant treatment was not a long enough period of time for eliminating field bindweed.

Addition of silvex to glyphosate reduced control of hard fescue and crested wheatgrass from the first application. Broadleaf weed control was better the following year where the first glyphosate application was followed in 10 days with an application of paraquat.

Treatment with a residual herbicide in the fall, before applying mulch, prolonged into the next season the control obtained with one or more glyphosate applications. Herbicides that were effective were trifluralin, dichlobenil, simazine, oryzalin, and a combination of pronamide with oxadiazon. A fall application of oryzalin maintained control of field bindweed through most of the following year.

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[1] Scientific names of weed species are listed in Appendix A, Page 104.

An application of amitrole-T + dalapon in May, followed by a second amitrole-T application in September, gave broadleaf weed control into the next season comparable to a May application of glyphosate followed by paraquat in 10 days and a second application of glyphosate in September. In another experiment, amitrole-T + dalapon applied in May and September controlled hard fescue and crested wheatgrass as well as did three applications of glyphosate. In a third experiment, May and September applications of amitrole-T + dalapon did not control quackgrass as well as a single application of glyphosate.

Amitrole-T + dicamba applied in May and September controlled field bindweed through the following year better than three applications of glyphosate at 4 lb/A (4.5 kg/ha), and as well as three applications of glyphosate at 2 lb/A (2.2 kg/ha) followed by fall application of oryzalin.

A rate of 6 lb/A (6.7 kg/ha) was used for postplant applications of simazine because adsorption on bark mulch reduces the amount of chemical available for controlling weeds. At this rate simazine controlled velvetgrass well and was moderately effective against fescues. It controlled several broadleaf weeds well, including chickweeds, red and white clovers, birdsfoot trefoil. and black medic. It was less effective against vetches. Buckhorn plantain was controlled 70 to 100%. Common groundsel was not controlled.

Dichlobenil at 4 lb/A (4.5 kg/ha) controlled some of the same broadleaf weeds as simazine, including chickweeds and buckhorn plantain. It also controlled common groundsel and other Composite family weeds. Lambsquarters, black medic, clovers, birdsfoot trefoil and most grasses were not controlled well.

Oxadiazon controlled buckhorn plantain, lambsquarters, dandelion, common vetch, and tiny vetch. Other Composite family species, other leguminous species, and chickweeds were not controlled. Grass control varied from fair (85%) for velvetgrass to poor for other grasses. Bittercress control was 100% where oxadiazon was used with dichlobenil.

Napropamide supplemented simazine for 100% control of vetches and redroot pigweed, and 90% control of lambsquarters. This combination also controlled redstem filaree. Napropamide supplemented oxadiazon for 100% control of common and mouseear chickweeds.

Oryzalin supplemented dichlobenil to give the only satisfactory control of Russian thistle. The combination also controlled redroot pigweed, lambsquarters, barnyardgrass, and wild buckwheat. Oryzalin + oxadiazon controlled wild buckwheat, field bindweed and redstem filaree.

Alachlor applied with simazine controlled common dandelion 99%.

Oxyfluorfen applied as a semi-directed spray controlled most annual broadleaf weeds without injuring landscape plants.

Several herbicides moved down the slope of the treated area at two locations, resulting in two to six times as much herbicide at the lower end as at the upper end of the plots. However, residual amounts in the surface soil at the lower end of the plots after two years did not exceed the rates applied.

At the high rate used in this study, postplant applications of simazine caused phytotoxic symptoms on California privet[1] and staghorn sumac, and severely injured paxistima, 'Moonlight' broom, and 'Baltic' ivy. Symptoms were less severe on California privet and staghorn sumac where napropamide

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[1] Scientific names of landscape plants are listed in Appendix B, Page 109.

was applied with simazine, and injury to 'Moonlight' broom and 'Baltic' ivy was reduced or eliminated.

Oregon grape plants treated for 2 years with oxadiazon + napropamide were 11% shorter than untreated plants.

Glyphosate sprays that contacted the foliage of landscape plants severely injured all except Oregon grape, 'Tamariscifolia' juniper, 'Bar Harbor' juniper, 'Moonlight' broom, and paxistima.

Four experiments were conducted to determine herbicide programs for eliminating weeds in natural stands of kinnikinnick and salal on highway rights-of-way, permitting these plants to form solid covers of uniform attractive vegetation.

Several treatments controlled weeds and resulted in an increase in area covered by kinnikinnick. Combinations of pronamide and dichlobenil were among the better treatments. Diuron + simazine, or glyphosate in the fall followed by diuron + bromacil + simazine in early spring, also were good treatments, and these partially controlled Scotch broom.

Salal was injured by treatments that included bromacil, and the plot area covered by salal was reduced. Two applications of dichlobenil, especially where it was in combination with bromacil, also reduced the plot area covered.

The area covered by salal increased 122% in plots treated with pronamide in November, followed by amitrole-T in February, and then by simazine + alachlor in the spring and pronamide in the fall of that year and the following year.

CONCLUSIONS and RECOMMENDATIONS

Preplant Treatments

1. One to three applications of glyphosate at 2 or 4 lb/A (2.2 or 4.5 kg/ha) controlled most grass and broadleaf weeds. Where field bindweed is present, the higher rate should be used, and more than one year should be allowed for satisfactory control.
2. Two applications of amitrole-T + dalapon at 4 + 12 lb/A (4.5 + 13.4 kg/ha) gave control of broadleaf weeds, hard fescue, and crested wheatgrass comparable to two or three applications of glyphosate, but control of quackgrass and field bindweed were better with glyphosate. At current prices, the herbicide cost for two applications of amitrole-T + dalapon would be about 10% more than for three applications of glyphosate at 2 lb/A (2.2 kg/ha).
3. Two applications of amitrole-T + dicamba, both at 4 lb/A (4 kg/ha), almost completely controlled field bindweed through the following year.
4. Residual herbicides can be used in the fall, before applying mulch, to prolong into the next season the control obtained with one or more glyphosate applications. Oryzalin used in this way maintained control of field bindweed most of the year but did not prevent eventual regrowth. Plant size was severely reduced where simazine preplant was followed 8 months later by a high rate of simazine postplant. This combination should be avoided with plants that are not highly tolerant of simazine. Other preplant residual herbicides did not adversely affect landscape plants, with the possible exception of phytotoxicity symptoms on Japanese barberry leaves after preplant application of dichlobenil.

Postplant Treatments

1. Simazine is well established as a herbicide for weed control in a wide range of ornamental plants. At the high rate used in this study in an effort to overcome the effect of bark mulch, simazine induced phytotoxic symptoms on California privet and staghorn sumac but did not affect plant height. It did, however, severely injure paxistima, 'Moonlight' broom, and 'Baltic' ivy. Simazine should be used only within the registered label rates.
2. The only other adverse effect observed from postplant residual herbicides used in this study was an 11% reduction in height of Oregon grape plants by a combination of oxadiazon + napropamide.
3. Simazine, dichlobenil, and oxadiazon all controlled a broad spectrum of weeds, but each failed to control certain weeds. Combinations of these three herbicides with alachlor, napropamide, or oryzalin broadens the spectrum to cover weeds missed when they are applied separately.
4. Application of glyphosate in landscape plantings should be done only as a carefully directed spray, avoiding all contact with foliage or green bark. Applied in this way it is a useful chemical for controlling perennial weeds. 'Tamariscifolia' juniper, 'Bar Harbor' juniper, Oregon grape, 'Moonlight' broom, and paxistima apparently tolerated foliage contact with glyphosate. Label modification to permit foliage contact as needed to control perennial weeds in tolerant plants should be encouraged.
5. Oxyfluorfen has potential use as a directed or semi-directed spray for weed control in landscape plantings. It controls small weeds postemergence and remains on the soil surface for preemergence control. It is not registered for use in ornamentals at the present time.

Natural Stands of Kinnikinnick and Salal

1. Most kinds of weeds can be removed from natural stands of kinnikinnick by various herbicides or combinations of herbicides, allowing the kinnikinnick to spread into the areas from which grass and other weeds are removed. The best treatments from the standpoint of increase in area covered by kinnikinnick were annual applications of pronamide in the fall followed by dichlobenil in February or March, the two herbicides applied together in November, or dichlobenil applied alone in February or March. Diuron + simazine, or glyphosate in the fall followed by diuron + bromacil + simazine in the spring were other good treatments, and these had the advantage of partially controlling Scotch broom.
2. Salal increased in treatments that did not include bromacil or more than one application of dichlobenil. The largest increase was in plots treated with pronamide in November, followed by amitrole-T in February, and then simazine + alachlor in the spring and pronamide in the fall of that year and the following year. The adverse effect of more than one application of dichlobenil recorded in these experiments, and the observation that salal planted in the SeaTac Rest Area experiment was spreading only in plots not treated with dichlobenil, suggests that dichlobenil should not be used in salal plantings.
3. Fosamine controlled blackberries and salmonberry with no apparent effect on kinnikinnick or salal.

IMPLEMENTATION

Four preemergence herbicides have been registered for use in ornamental plants since the start of this project. These are oryzalin, napropamide, oxadiazon, and alachlor. All of them were shown in the study to be useful for weed control in landscape plantings used either separately or in combinations with dichlobenil or simazine.

To the extent that their labeling permits use in the plant materials in highway landscape plantings, these herbicides will be used by the Department in weed control programs. Where label changes are required to include additional plant materials, efforts will be made to have those changes made at the Federal level or through Washington State Department of Agriculture on a special local needs basis.

Among the plants used in this study, the following are not listed on the labels of any of the six herbicides listed above: Staghorn sumac, snowberry, evergreen huckleberry, salal, shrubby cinquefoil, St. Johns Wort, 'Moonlight' broom, Boston ivy, and skunkbush sumac. Paxistima, spirea, and kinnikinnick are only on the dichlobenil label. Photinia is listed only on the dichlobenil and oryzalin labels, caragana is only on the dichlobenil and simazine labels, and sand cherry is covered only by the genus Prunus on the napropamide label. All of the others are on labels of three or more of the six herbicides.

Since the start of the project, glyphosate received registration for preplant application and for directed application in certain ornamental trees and shrubs. Of the plants used in the study, only dogwood, juniper, pine and privet are on the glyphosate label. Efforts will be made to expand the list to include other species that are used in highway landscape plantings.

INTRODUCTION

Vegetation must be managed to protect the structural integrity of the traveled way and contribute to its safe use, improve the aesthetics of the roadside, minimize necessary manpower expenditures, and reduce dollar expenditure on a continuing basis.

With increased concern for environmental quality, we must establish background knowledge on the minimum rates of chemicals that must be introduced into the environment to give the necessary control of undesirable vegetation yet not detrimentally affect desirable species of vegetation.

The loss of chemicals as management tools would result in increased cost for vegetation control through use of manual and mechanical control methods. Presently available funds are inadequate to support manual and/or mechanical operations for control of vegetation without reducing the level of service on some elements of the highway system.

After state maintenance forces have taken over a contract planted landscape area, a weed control program must be implemented. Many times state forces have to eliminate existing weeds before they can maintain a weed-free condition. Knowledge as to types and rates of herbicides that can be used on ornamental plant materials growing in a field condition is lacking. For native ornamental materials this necessary information is almost nonexistent. The problem is one of economics. As a general rule those crops (wheat, corn, cotton, etc.) which have the largest market value are investigated the most intensively. Unfortunately, ornamental plant materials do not fall into this category. In order to develop and execute an effective weed control program we need hard factual data, such as ornamental plant tolerance levels to herbicides under highway environmental conditions.

The tolerance of a plant to a herbicide, as well as the effectiveness of the herbicide in controlling weeds, is influenced by such factors as soil type, temperature, amount and distribution of rain or irrigation, and the presence of bark or sawdust mulch.

A weed-free condition on a planting site can be established most efficiently before planting. Elimination of weeds prior to planting will greatly reduce later costs by facilitating maintenance of a weed-free condition after planting. When herbicides are used to establish a weed-free condition on a planting site, there must be confidence there will be no residual effect of those herbicides on ornamentals planted in the area. There also must be knowledge of the kinds and rates of herbicides that can be used to maintain the area weed-free after planting without injuring the landscape materials.

LITERATURE REVIEW

Preplant Treatments

Much of the research on preplant control of perennial grasses has been concerned with quackgrass. A number of herbicides have been investigated and recommended for this purpose. These include TCA (trichloroacetic acid) (55), dalapon (31), amitrole (63), amitrole + atrazine or simazine (37, 78), and amitrole + dalapon (59).

The combination of amitrole-T + dalapon was more effective than amitrole-T alone against several grasses, and somewhat more effective than dalapon against quackgrass, Kentucky bluegrass, and creeping red fescue (57, 58). Creeping red fescue was less sensitive than reed canarygrass to dalapon, and creeping red fescue and Kentucky bluegrass were less sensitive than reed canarygrass and quackgrass to amitrole-T (58).

Amitrole-T followed seven days later by paraquat was more active against quackgrass than either of the two herbicides applied separately or together in one application. Regrowth after treatment with amitrole-T was reduced by the subsequent paraquat spray or by removal of top growth by cutting (82). In another study, Amitrole-T followed by paraquat after 8 to 15 days also gave better control of quackgrass and several other perennial grasses and broadleaf weeds (84). In a third study, however, treatment with amitrole-T alone was superior to the sequential treatment with paraquat when the interval between was less than two weeks (95).

Paraquat at 0.5 lb/A (0.6 kg/ha) with simazine or diuron at 4 lb/A (4.5 kg/ha) was more phytotoxic against quackgrass than either herbicide applied singly, and the enhanced activity was more than additive. Paraquat applied to the shoots increased susceptibility of quackgrass to simazine action through the soil (83).

Control of quackgrass with glyphosate was first reported in 1971 (16). Spring applications of glyphosate gave best results in some cases (6, 15), particularly at the 3 to 6 leaf stage (15, 30). In other trials, application at the bud stage (13), late summer or fall applications (18, 39, 107), or split applications (16, 56) were more effective.

Temperatures of 75°F (24°C) or higher following application are less favorable for control than 61°F (16°C) or lower temperatures (15, 18, 32). High humidity favors penetration and as a result appears to enhance glyphosate toxicity (32).

There are reports of increased control of quackgrass from plowing or tilling one or more days after spraying with glyphosate (30, 107).

Addition of amitrole to glyphosate resulted in less control of perennial grasses when evaluated the following summer (98, 108). On the other hand the effects of 2,4-D and amitrole were at least additive and sometimes synergistic with glyphosate on nutsedge (109).

Treatments reported for preplant control of field bindweed include 2,4-D (79), dicamba (97), 2,4-D + dicamba (60, 77), picloram (46, 71), and glyphosate (72). Treatment with glyphosate was most effective at budding and flowering stages (99). Even with properly timed applications of glyphosate, some regrowth usually occurs later in the year or the following year and additional treatments are required for complete control (56, 65, 99).

Dicamba controlled field bindweed better than glyphosate in a series of experiments in California (65). Average control from dicamba at 4 lb/A (4.5 kg/ha) in two experiments was 9.2 (0-10 scale), compared with an average of 7.7 from glyphosate at 4 lb/A (4.5 kg/ha) in six experiments, and 6.4 from glyphosate at 2 lb/A (2.2 kg/ha) in four experiments.

Adequate soil moisture is essential for good results from glyphosate, and high humidity following application favors penetration. Control is not satisfactory on field bindweed under moisture stress.

Herbicides for Russian knapweed control include picloram (51) and dicamba (60). Dicamba applied at 17.9 lb/A (20 kg/ha) for Russian knapweed control left no residue in maize leaves 11 months after application, while picloram at 1.3 lb/A (1.5 kg/ha) showed a residue two years later (64).

Sugarbeet seedlings appeared normal where 2,4-D had been applied 8 months earlier, but over 90% of the seedlings were killed in plots treated with dicamba (97).

Rush skeletonweed is controlled with 2,4-D (67), picloram (94), and dicamba (94). The best control of Dalmatian toadflax has been from silvex (86).

Postplant Treatments

Numerous herbicides were evaluated for weed control in woody ornamentals in western Washington during the ten year period 1957 to 1967 (73, 74, 75). Three of these were found more useful than the others (74, 75), and were suggested in the Washington State University Chemical Weed Control Handbook for use in nurseries. These chemicals, simazine, dichlobenil, and norea (Trade name HERBAN) were found to be among the most useful in ornamentals in other areas (5, 29, 33, 37, 68, 80, 85, 110, 111). Norea is no longer available. The other two herbicides, simazine and dichlobenil, continue to be recommended in the Washington State University Weed Control Handbook and are widely used in nurseries and ornamental plantings.

More recent studies have included additional herbicides for use in nurseries and landscaped areas (88, 89, 90). Three have been added to the Washington State University recommendations for control of annual weeds. Two of these, napropamide and oryzalin, are particularly useful in supplementing other herbicides for control of annual grasses. The third material, oxadiazon, has a broad spectrum of weed control but must be supplemented with other herbicides for control of chickweed species. A fourth herbicide, pronamide, was added to the recommendations after extensive evaluation for control of quackgrass (92). Glyphosate will be included in the next Handbook for use as a directed spray to control various perennial weeds (91).

All of these herbicides have been evaluated thoroughly for use in ornamentals by other researchers. Napropamide was found to be effective against annual grasses and certain broadleaf weeds without injury to ornamentals (45). Good weed control from oryzalin with nursery crop tolerance was reported first in containers (36, 41), and later in the field (9, 28).

Another herbicide that is particularly effective against annual grasses but also controls some broadleaf weeds is alachlor (17, 22, 44). As with napropamide and oryzalin, it has been suggested primarily for use in conjunction with other herbicides such as simazine to broaden the weed control spectrum.

Oxadiazon gave better control of broadleaf weeds than annual grasses in some studies (17), but in others it gave excellent control of both annual grasses and broadleaf weeds, and also some control of bigroot morning glory (81). Oxadiazon generally controls a broad spectrum of weeds and is well tolerated by a wide range of woody ornamentals (69, 113). It is especially useful for control of bittercress (42). Oxadiazon also has been reported to control field bindweed (61). It appears to be more effective as a postemergence application rather than preemergence for this purpose (38).

November or December applications of pronamide have given good control of quackgrass and other grasses without injury to various ornamentals (8, 53). November applications gave better control of quackgrass than January or later applications except in years of unusually high rainfall during the period of February to May (92).

Glyphosate has been evaluated extensively for control of perennial weeds in ornamentals. Most ornamental plants are injured to some degree if glyphosate is sprayed on foliage or on green bark. Out of 45 species or cultivars on which two or three branches were sprayed with glyphosate at 3 lb/A (3.4 kg/ha) in August, 12 kinds did not show injury at the end of one month following spraying (106). Most of these were conifers or broadleaf evergreen ground-covers. Conifers in general are more tolerant than deciduous plants, and conifers are more tolerant when dormant or fully mature than when growing (6, 24). When only the lower 15 to 18 inches (38 to 46 cm) of trunk was sprayed two successive years on 45 kinds of shade and small ornamental trees, most were not injured (10, 104, 105).

Certain ground covers such as English ivy (Hedera Helix L.), Japanese spurge (Pachysandra terminalis Siebold & Zucc.), carpet bugleweed (Ajuga reptans L.), and common periwinkle (Vinca minor L.) may tolerate low rates of glyphosate (26).

Fosamine is a new herbicide that controls deciduous trees, brush and vines by preventing spring bud-break if application is made in late summer or early fall within 2 months of leaf senescence (1). It has been reported to control European blackberry (Rubus fruticosus L.) (35, 70, 76) and salmonberry (48).

Oxyfluorfen is a new herbicide showing promise for use in ornamentals. Good weed control was reported in firethorn (Pyracantha spp.) with good plant growth after temporary leaf spotting (43). Oxyfluorfen is of particular interest because it has postemergence activity on small annual weeds and also on certain perennial weeds. It has given postemergence and preemergence control of little mallow, prostrate knotweed, and Erodium and Solanum species (101).

Published information on tolerance of ornamental plants used in this project (or closely related species or cultivars) is summarized in Appendix C (Page 111).

OBJECTIVE

The objective of the research project was to determine methods of eliminating or controlling existing weeds and preventing weed infestations in highway right-of-way plantings without injuring or interfering with normal growth and development of desirable plant material.

EXPERIMENTAL PROCEDURES

The following steps were taken to accomplish the objective of the project.

1. Desirable plant materials which have been a problem to maintain in a weed-free condition were listed.
2. Hard-to-control weeds most frequently occurring in the planted areas were listed.
3. A review was made of the herbicide products available for use on these problems.
4. Herbicide manufacturers were consulted regarding prospects for new registrations, changes in current registrations, and state registrations.
5. An intensive review was made of the literature pertaining to herbicide use on those ornamental plants which are being used or will be used in the future in highway plantings, and herbicides for control of the problem weeds.
6. Experimental plot areas representative of various environmental conditions throughout the state were located.
7. Herbicides were applied.
8. Weed control from various herbicides and rates was evaluated in relation to the following environmental factors:
    a. Soil type
    b. Topographic features such as slope and exposure
    c. Soil and air temperature
    d. Soil moisture as affected by amount and distribution of rain or irrigation

9. Tolerance of ornamental plants to the various herbicides and rates was evaluated in relation to the same environmental factors.

Preplant and postplant treatments. Six experiments were established on highway rights-of-way to evaluate herbicide treatments for preplant preparation of landscape sites, and for maintenance of weed control after planting. The location and other information on each experiment are shown in Figure 1 (Page 26) and Table 1 (Page 49).

All experiments were in randomized complete block design with split plots and three replications. Main plot treatments were for the purpose of eliminating erosion control grasses and weeds in preparation for planting. After one season of preplant treatment the entire area was covered with bark mulch. The main plots were then divided into subplots and planted. Planting was done in the same year as the preplant treatments at the SeaTac Rest Area site. At Tukwila, Walla Walla and the Spokane irrigated site, it was done the following spring. Planting at the Spokane non-irrigated site was delayed a year until March 1977 because of low soil moisture in 1976, and it was delayed until April 1977 at Yakima because of uncertainty as to availability of irrigation water in 1976.

Each subplot was planted with two kinds of plants alternating in the row and spaced 2 ft (0.6 m) apart. All subplots were 4 ft (1.2 m) wide and 20 to 24 ft (6.1 to 7.3 m) long. At the Tukwila site and both Spokane sites, untreated strips 2 ft (0.6 m) wide were left between subplots. The plants used at each location are listed in Appendix B (Page 109).

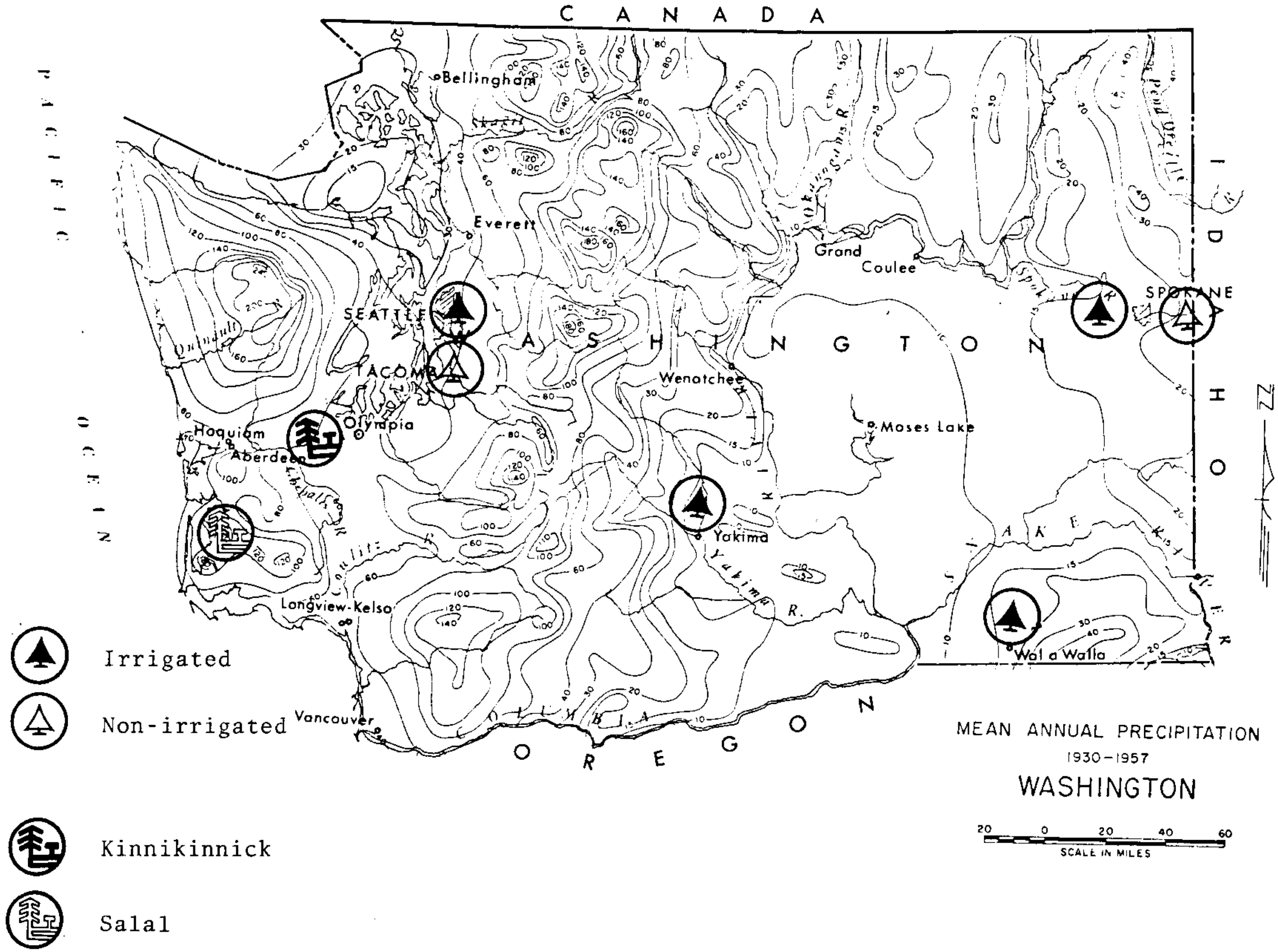

Figure 1. Map of Washington State showing location of experiments.

Subplot treatments for maintaining weed control were applied a month after planting. These were repeated in successive years or supplemented with other treatments, in some cases the same season. All spray applications were made at 25 gal/A (234 liters/ha) using a backpack sprayer with compressed air as the propellent. Granular formulations were applied by hand using shaker bottles.

Weed control was recorded periodically, visual symptoms of phytotoxicity on the ornamental plants were recorded, and measurements of some of the plants were made to determine effects on growth.

Because the experimental design limited the number of main plots treatments to a maximum of 7 (including the untreated check), secondary plots were treated at some locations to evaluate additional site preparation treatments. In most cases these secondary plots were not divided into subplots for planting and evaluation of postplant treatments.

Amounts of precipitation and irrigation at the various locations are shown in Appendix D, E, F and G (Pages 116-119). Precipitation amounts immediately following dates of application are grouped according to specific days of rainfall.

Kinnikinnick and salal. Two experiments were established in 1975 to determine herbicide programs for eliminating weeds in natural stands of kinnikinnick and salal on highway rights-of-way, permitting these plants to form solid covers of uniform attractive vegetation. Location and other information on each experiment is shown in Table 2 (Page 50).

Two additional experiments were established in 1976 on the basis of preliminary information from the first two. The kinnikinnick experiments were located in the median strip and the westbound side of State Road 8, 16 miles

(26.4 km) west of Olympia. Plots were 16 x 24 ft (4.9 x 7.3 m) except for certain treatments in the second experiment. A split plot design was used in the 1977 experiment, with the 8 x 24 ft (2.5 x 7.3 m) subplots fertilized or not fertilized at the time of spring 1977 herbicide applications. In the checks, and in treatments that started with the fall 1976 herbicide application, the plots were 24 x 24 ft (7.3 x 7.3 m), with three subplots. One subplot was fertilized at the time of the fall herbicide application, another was fertilized in the spring, and the third one was not fertilized. The fertilizer treatments consisted of 16-16-16 fertilizer (Ortho Unipel) applied at the rate of 100 lb of N per acre (112 kg/ha). A 2 ft (0.6 m) untreated space was left between plots.

The salal experiments were on State Road 101, 14 miles (23 km) southwest of South Bend. The first one was on the westbound side of the highway, and the second one was on the eastbound side.

Plots were 12 x 20 ft (3.7 x 6.1 m) in the first experiment and 12 x 18 ft (3.7 x 5.5 m) in the second one, except for 18 x 18 ft (5.5 x 5.5 m) plots in certain treatments that started with fall applications, as was noted for the second kinnikinnick experiment. Subplots were fertilized in the second salal experiment the same as in the second kinnikinnick experiment.

A randomized complete block design with three replications was used in all kinnikinnick and salal experiments. Spray applications in these experiments were at 30 gal/A (280 liters/ha).

Analysis of variance was conducted on all data, and Duncan's multiple range test was applied where significant differences were indicated. In all tables, unless otherwise noted, means within columns followed by the same letter are not significantly different at the 5% level. Letters are omitted from columns in which there are no significant differences.

RESULTS

Preplant Weed Control

SeaTac Rest Area. All treatments gave complete control by the end of July. After rainfall began in August (Appendix D, Page 116), emergence of new weed seedlings and some regrowth of perennial weeds occurred. These were controlled with September 11 herbicide applications. Very little regrowth of grass occurred in 1976, and there were no significant differences in grass control in 1976 from the 1975 treatments (data not shown).

There were fewer broadleaf weeds in 1976 in plots treated with amitrole-T + dalapon in 1975 than in plots treated with glyphosate (Table 3, Page 51, 94% fewer vetch plants and 84% fewer buckhorn plantain plants). Where the first glyphosate application was followed with paraquat in 10 days, there were significantly fewer broadleaf weeds in 1976 than where only glyphosate was applied. The effect was consistent, with a range of 47% reduction for miscellaneous weeds to 76% reduction in number of common chickweed plants.

Application of trifluralin in October 1975, following May and September applications of glyphosate, resulted in complete control of common chickweed and buckhorn plantain in 1976, and good control of other weeds, including grasses (Table 3, Page 51).

Tukwila. Control of grass in August 1976 was 96% or higher from all glyphosate treatments (Table 4, Page 52). The paraquat + simazine combination was not satisfactory. Broadleaf weed control in August was 95 to 97%, with no significant differences among treatments. In March, 1977, control of grass and broadleaf weeds was equally good from all glyphosate treatments applied the previous year, regardless of the supplemental herbicide application in October before the mulch was applied.

By September, differences in control due to the October 1976 applications were evident (Table 5, Page 53). There was nearly complete control of Composite family weed species and buckhorn plantain where dichlobenil was applied.

Analysis of soil samples collected July 14, 1977 showed less than 0.45 lb/A (0.5 kg/ha) of any herbicide remaining from the October 7, 1976 preplant applications of residual herbicides (Table 6, Page 54).

None of the secondary plot preplant treatments were superior to the main treatments (Table 7, Page 55). Weed control was not significantly different where the first glyphosate application was May 12 instead of June 4.

An initial application of amitrole-T plus dalapon followed by an August 24 application of glyphosate was inferior, when observed the following March, to two applications of glyphosate (Table 7, Page 55). Where the August application was amitrole-T, control was not significantly different from two applications of glyphosate.

Walla Walla. One application of glyphosate at 4 lb/A (4.5 kg/ha) appeared to control crested wheatgrass completely (Table 8, Page 57). There was some reoccurrence by September 1977, possibly from new seedlings. The 2 lb/A (2.2 kg/ha) rate of glyphosate was less effective than the 4 lb/A (4.5 kg/ha) rate.

One application of the combination of amitrole-T + dicamba was less effective early in the season than glyphosate (Table 8, Page 57). After a second application of the combination in September, control remained good through 1977. There was no advantage from a September application of alachlor or oryzalin, without satisfactory elimination of the existing stand of crested wheatgrass by glyphosate at the 2 lb/A (2.2 kg/ha) rate.

Field bindweed was not controlled by the first two applications of glyphosate, but after a third application at the 4 lb/A (4.5 kg/ha) rate in

September, control was good through the following year (Table 9, Page 58). Three applications of glyphosate at the 2 lb/A (2.2 kg/ha) rate did not give satisfactory control through 1977. Application of oryzalin in September, after three applications of glyphosate at 2 lb/A (2.2 kg/ha), did maintain good control through 1977. Subsurface or incorporated applications of trifluralin have been shown to control field bindweed (14, 40), and an application of oryzalin covered with bark mulch in this experiment may have had the same effect. One application of the amitrole-T + dicamba combination controlled field bindweed very well early in the season, and a second application in September gave 100% control through 1977.

Glyphosate at 4 lb/A (4.5 kg/ha) and the amitrole-T + dicamba combination both gave excellent control of sweetclover and alfalfa through 1977 (Table 10, Page 59). The 2 lb/A (2.2 kg/ha) rate of glyphosate appeared to be less satisfactory, but it was not significantly different.

Spokane, Irrigated. Two applications of glyphosate gave 86 to 92% control of creeping red fescue through the following July (Table 11, Page 60). One application of glyphosate in June 1976 plus simazine or dichlobenil in September controlled creeping red fescue and broadleaf weeds completely through July 1977. A small amount of clover and/or black medic was present in these plots by September, but grass was still controlled completely (Table 12, Page 61). Control by September 1977 was not satisfactory from application of glyphosate in 1976 without the September application of residual herbicide.

Spokane, Non-irrigated. Hard fescue was not well controlled by May and July applications of glyphosate (Table 13, Page 62). The May application of glyphosate at 2 lb/A (2.2 kg/ha) was more effective initially than amitrole-T at 4 lb/A (4.5 kg/ha), but by July 29 there was no difference between the two treatments. A combination of amitrole-T + dalapon was more effective against hard fescue than amitrole-T alone. At the July 29th observation, this treatment appeared superior to any other treatment including glyphosate. Addition of silvex to a May application of glyphosate reduced its effectiveness.

Another application of amitrole-T + dalapon was not made until September because there did not appear to be enough live grass in this treatment to justify reapplication in July. After the September application, control of hard fescue remained at 100% through 1977 (Table 14, Page 63). Control also remained close to 100% in 1977 after the third application of glyphosate in September of 1976.

Control of crested wheatgrass was 95 to 98% in July 1976 from a May application of glyphosate at 2 lb/A (2.2 kg/ha) (Table 13, Page 62). A second application in July maintained control at 93 to 97% by September. The September application of glyphosate resulted in 96% control early in 1977, but control declined to 52% by July, possibly because of new seedlings (data not shown). Differences among treatments were not significant in 1977.

Addition of silvex to the May application of glyphosate reduced its effectiveness against crested wheatgrass, the same as it did against hard fescue (Table 13, Page 62).

One application of the amitrole-T + dalapon combination in May resulted in 97% control of crested wheatgrass in July, but by September this treatment was unsatisfactory (Table 13, Table 62).

Wild buckwheat covered 25% of the glyphosate treated plots by July 1977 (Table 14, Page 63). This infestation of buckwheat was almost completely prevented by application of oryzalin in September 1976, after the three applications of glyphosate. Field bindweed, Dalmatian toadflax, and rush skeletonweed covered a total of 13% of the untreated main check plot area in July 1977, but their occurrence was too variable for significant differences in control (data not shown). They were 92 to 100% controlled by glyphosate treatments.

Yakima. Control from all treatments was close to 100% in July (Table 15, Page 64). Crested wheatgrass and quackgrass had made considerable regrowth by September in plots treated with amitrole-T + dalapon. The paraquat + simazine treatment (Secondary plot) was unsatisfactory again, as it was at Tukwila.

Control of grasses by all glyphosate treatments remained close to 100% into June 1977 (Table 16, Page 65). A second application of amitrole-T + dalapon in September 1976 increased control of quackgrass in April 1977, but by June, control was down to 71% compared with 99 to 100% control for the glyphosate treatments.

A combination of pronamide and oxadiazon, applied on half plots in October 1976, controlled downy brome and foxtail barley that germinated in the fall of 1977 and matured in the spring of 1978 (Table 17, Page 66). A combination of amitrole-T and dicamba applied June 30, 1977 controlled downy brome 94%, compared with 72% for a glyphosate application on the same date. After planting was postponed because of a possible water shortage, the 1977 treatments were made to gain additional control of perennial weeds and to evaluate effects of an amitrole-T + dicamba combination on plant growth the following year.

Postplant Weed Control

SeaTac Rest Area. Grasses were controlled 87 to 98% the first year by postplant treatments (Table 18, Page 67). Common vetch and tiny vetch were controlled by dichlobenil, simazine + napropamide, and all oxadiazon treatments.

They were less well controlled by simazine alone than by simazine + napropamide. Chickweeds were well controlled by dichlobenil or simazine. Control was not as good from oxadiazon, but the oxadiazon + napropamide combination gave complete control. Buckhorn plantain was equally well controlled by all treatments, as were other broadleaf weeds.

After a second postplant herbicide application, fescues were still well controlled by all treatments (Table 19, Page 68). As in 1976, vetches were not controlled by simazine alone, but were controlled by the simazine + napropamide combination, and by the oxadiazon treatments. They were partially controlled by dichlobenil. Also, as in 1977, chickweed was controlled by all treatments except oxadiazon alone. Common groundsel was controlled completely by dichlobenil, and by combinations of simazine or oxadiazon with napropamide, but not by simazine or oxadiazon separately. Other Composite family weeds were controlled 94% or higher by all treatments except oxadiazon at 3 lb/A (3.4 kg/ha).

Soil samples were collected from under the bark mulch in plots treated with dichlobenil for 3 years at 4 lb/A (4.5 kg/ha). Analysis of these samples showed that in five out of six plots sampled, the level of dichlobenil was higher near the lower end of the slope than near the top of the slope (Table 20, Page 69). The mean level of dichlobenil was twice as high near the low end of the slope as at the upper end of the slope.

Tukwila. Velvetgrass was well controlled the first year by all treatments, and other grasses except quackgrass were partially controlled (Table 21, Page 70).

Composite family weeds were well controlled by dichlobenil, but not by simazine alone or with oryzalin, or by oxadiazon (Table 22, Page 71). On the other hand, clovers and birdsfoot trefoil were well controlled by simazine, but not by dichlobenil or oxadiazon. Buckhorn plantain was well controlled by all treatments except oxadiazon or simazine applied separately.

All grasses were eliminated by application of glyphosate and oxyfluorfen in September 1977, and nearly eliminated by addition of oxyfluorfen and pronamide to simazine (Table 23, Page 73). Glyphosate without oxyfluorfen was as effective as the combination in the much more heavily infested subplots of the main plot that was treated preplant with paraquat + simazine (Table 24, Page 74). Pronamide only partially controlled the grasses.

Glyphosate + oxyfluorfen also completely controlled broadleaf weeds (Table 25, Page 75). Oxyfluorfen alone gave almost complete control. Bittercress was controlled by the dichlobenil + oxadiazon combination but not by dichlobenil alone.

The effectiveness of glyphosate in controlling quackgrass and other grasses was shown on secondary plots treated in June or September 1977 (Table 26, Page 76). Dichlobenil controlled field horsetail about 90% (compared with oxadiazon + glyphosate).

The amounts of herbicide remaining from the April 6, 1977 application were not more than 0.4 lb/A (0.4 kg/ha) except in plots which had dichlobenil in October 1976 and also in April 1977 (Table 27, Page 77). In those plots, samples from the lower end of the slope showed 0.85 lb/A (0.95 kg/ha) of dichlobenil, compared with 0.26 lb/A (0.29 kg/ha) at the upper end. Plots treated with oxadiazon in April 1977 also had more than three times as much herbicide at the lower end of the plots in July as at the upper end.

Analysis of samples collected June 29, 1978 showed approximately twice as much dichlobenil at the lower end of the slope as at the upper end in plots treated with dichlobenil preplant and also postplant, two applications, April 1977 and April 1978 (Table 28, Page 78). The difference between upper and lower ends of the plots was smaller where no application was made in October 1976. In plots treated with oxadiazon in April 1977 and April 1978, the amount of residual herbicide was six times as high at the lower end of the plots as at the upper end. The amount of residual pronamide was more than twice as much at the lower end of the plots as at the upper end. The amount of simazine and oryzalin was approximately twice as much at the bottom of the plots as at the top.

Walla Walla. The plot area covered by crested wheatgrass, sweetclover, or field bindweed was not significantly reduced by any of the postplant herbicide treatments (Table 29, Page 80). However the oxadiazon + napropamide combination did significantly reduce the amount of sweetclover compared to oxadiazon alone. The combinations of oxadiazon + dichlobenil, oxadiazon + napropamide and oxadiazon + alachlor all reduced the number of plants of prickly lettuce, whereas the effect of oxadiazon alone, or oxadiazon + oryzalin was not statistically significant. After a second year of herbicide application, observations on June 19, 1978 showed not more than 1% of the plot area covered with crested wheatgrass and other grasses, and only an occasional plant of prickly lettuce, horseweed or salsify (data not shown).

Spokane, Irrigated. Dandelions were completely controlled by dichlobenil and well controlled by several other treatments (Table 30, Page 81). White clover was controlled by all simazine treatments but not by dichlobenil or oxadiazon. Black medic was controlled by most of the simazine treatments but not by dichlobenil or oxadiazon. Lambsquarters was controlled by all treatments except dichlobenil. Control of creeping red fescue was poor to fair (67 to 86%) from all treatments except oxadiazon, which controlled only 17%.

Spokane, Non-irrigated. Three months after herbicide application, the percent of plot area covered with hard fescue was much less where oryzalin was applied with oxadiazon than where napropamide was applied with oxadiazon, or where oryzalin was applied with dichlobenil (Table 31, Page 82). Simazine + oxyfluorfen controlled fescue better than simazine + napropamide.

Wild buckwheat was completely controlled by simazine + oxyfluorfen (Appendix H, Page 120). Control was 68 to 97% from other treatments. Field bindweed was present in some plots but control was extremely variable. Redstem filaree was controlled 84 to 99% by all treatments except simazine + napropamide.

Oxadiazon has been shown to maintain control of field bindweed after one or two applications of glyphosate. Oryzalin appeared to have this effect in the Walla Walla experiment (see Page 31 and Table 9, Page 58), and the combination of oxadiazon + oryzalin appeared to be one of the best treatments for control of field bindweed in the Spokane non-irrigated experiment.

Yakima. Control of grasses was variable, and there were no significant differences between treatments (data not shown). Redroot pigweed was completely controlled by simazine + napropamide and by dichlobenil + oryzalin, and well controlled by most of the other treatments (Table 32, Page 83). Lambsquarters was controlled 90 to 100% by simazine + napropamide and dichlobenil + oryzalin, and partially controlled by most of the other treatments. Dichlobenil + oryzalin was the only combination that gave fairly good control of Russian thistle.

Treatments applied in September 1978 to evaluate downy brome control did not give conclusive results (Appendix I, Page 121). Control was 79 to 96% where napropamide was applied, and 46 to 71% where oryzalin was applied.

The wide variation in amount of downy brome also led to inconclusive data in evaluating control with pronamide (Appendix J, Page 122). However, pronamide did control downy brome in the mulched plots. No downy brome emerged in the pronamide treated non-mulched plots, but so little occurred in the untreated plots that the effect of pronamide was not established.

Effects on Landscape Plants

<u>SeaTac Rest Area</u>. Simazine caused phytotoxicity symptoms in California privet and staghorn sumac leaves. These symptoms occurred on fewer plants and were less severe where napropamide was applied with simazine (Table 33, Page 84). Other studies confirmed this effect of napropamide in reducing the simazine phytotoxicity symptoms.

The Oregon grape plants treated for two years with oxadiazon + napropamide were significantly shorter than the untreated check plants when measured in November 1977 (Table 34, Page 85). Oregon grape plants also were affected by preplant treatments. They averaged 38 inches (97 cm) tall in plots treated preplant with amitrole-T + dalapon + atrazine, compared with 36 inches (92 cm) in plots treated with amitrole-T + dalapon + paraquat (data not shown).

The privet plants in some treatments were significantly taller than the untreated check plants, possibly due to elimination of weed competition. None of the treatments resulted in privet or sumac plants shorter than the check plants.

No data was obtained on size of evergreen huckleberry or salal plants. Survival of these two species was not affected significantly by any treatment (Appendix K, Page 123). The survival rate was 87 to 93% for evergreen huckleberry and 70 to 97% for salal. Salal plants were observed to be spreading rhizomatously in some plots not treated with dichlobenil.

Tukwila. The glyphosate + oxyfluorfen treatments severely injured forsythia, photinia, firethorn and snowberry (Table 35, Page 86). This treatment completely killed the potentilla plants (data not shown). Oregon grape was not significantly injured by any of the treatments (data not shown). Oxyfluorfen alone did not significantly affect any of the plants.

Glyphosate sprayed over the top of ornamental plants in the secondary plots severely injured photinia, snowberry, forsythia, firethorn and potentilla (Table 36, Page 87), as noted previously for the partially directed applications in the main plots (Table 35, Page 86). Oregon grape, 'Moonlight' broom, 'Tamariscifolia' juniper, and 'Bar Harbor' juniper were not injured.

Walla Walla. The height of the red-osier dogwood plants was not affected significantly by any of the postplant herbicide treatments (Table 37, Page 88). Dogwood plants in the oxadiazon + dichlobenil subplots were about 50% taller in the main plots that were given a preplant treatment of amitrole-T and dicamba, compared with the ones in the main plots that had a preplant treatment of glyphosate. On the other hand where subplot treatment was oxadiazon + napropamide, the plants were over 50% taller in the main plot that had a preplant treatment of glyphosate rather than amitrole-T + dicamba. The reason for these differences in growth is not apparent. The mean height for all subplots was not significantly affected by the preplant treatment. Width of the potentilla and rose plants was not affected significantly by any treatment (data not shown). No data was obtained on size of mugho pine or St. John's Wort plants.

Spokane, Irrigated. Simazine at 6 lb/A (6.7 kg/ha) severely injured paxistima (Table 38, Page 89). From 24 to 36% of the plants died in the simazine treatments compared with 7 to 10% in the other treatments and the untreated check plots.

Paxistima plants in plots treated with simazine both preplant and postplant were significantly smaller than plants in the untreated check plots, or in plots treated with simazine preplant and dichlobenil postplant (Table 39, Page 90). Plants in the subplots treated with simazine or simazine + napropamide postplant without any simazine preplant were smaller than the corresponding plants in plots treated with dichlobenil. The smallest paxistima plants were in the check plots of the main plots that were not treated with simazine preplant. They probably were smaller because of competition from a heavy stand of grass and other weeds that resulted from only a single application of glyphosate in 1976 without residual herbicide in the fall (see page 31, and Table 11, Page 60).

'Tamariscifolia' juniper plants also were smallest in the check plots of the main plots that were not treated with simazine, probably for the same reason (Table 39, Page 90). There was no other effect of preplant or postplant herbicide treatment on size of juniper plants. Glyphosate applied over the plants in October 1977 did not affect the size of paxistima or juniper.

'Moonlight' broom plants were severely injured by postplant applications of simazine (Table 40, Page 91). Application of napropamide with simazine greatly reduced the injury from simazine in plots that had not also had a preplant application of simazine. Forty percent of the broom plants died in 1977 in plots treated with simazine alone, compared with only 6% where napropamide was applied with simazine, and with none in the untreated checks and the plots treated with dichlobenil or oxadiazon.

After 2 years of postplant herbicide applications, the phytotoxicity symptoms on 'Moonlight' broom remained less severe in plants treated with napropamide + simazine than in plants treated with either simazine alone or simazine + alachlor (Table 40, Page 91). Symptoms also were less severe on plants treated with oryzalin + simazine than on plants treated with simazine alone, but more severe than on plants treated with napropamide + simazine. Broom plants treated with simazine and all simazine combinations were shorter than untreated plants at the end of the second year. However, plants treated with napropamide + simazine were taller than plants treated with simazine alone.

Moderate to severe phytotoxicity symptoms were apparent in many of the Japanese barberry plants in September 1977 (Table 41, Page 92). Symptoms were consistently more severe in plots treated with dichlobenil in September 1976 before the bark mulch was applied. However, differences were not statistically significant. The simazine + oryzalin treatment was the only exception. Symptoms were as severe in the check plots which received no postplant herbicide application as in any of the plots which received a postplant application.

Japanese barberry plants were severely injured or killed by an application of glyphosate over the plants on October 7, 1977 (Table 41, Page 92). There was high mortality of Boston ivy plants even in the untreated check plots, and differences between treatments were not significant (data not shown).

'Baltic' ivy plants were moderately to severely injured by simazine alone or in combination with other herbicides, as indicated by the phytotoxicity ratings and the percent mortality in Table 42 (Page 93). Surviving plants were smaller in plots treated with simazine or simazine + alachlor than in plots treated with dichlobenil or oxadiazon. Where napropamide or oryzalin was applied with simazine, plants were larger than where simazine or simazine + alachlor were applied, and not smaller than in plots treated with dichlobenil or oxadiazon.

Spokane, Non-irrigated. Skunkbush sumac, caragana, and red-osier dogwood were tallest in plots treated with simazine + oxyfluorfen, possibly because wild buckwheat was completely controlled by this treatment (Table 43, Page 94). Caragana plants were significantly taller in the simazine + oryzalin plots than in the check. Red-osier dogwood plants were significantly taller in the oxadiazon + oryzalin plots than in the check plots. This treatment controlled wild buckwheat, field bindweed and redstem filaree 93 to 99% (Appendix H, Page 120). There were no significant effects of preplant or postplant treatments on plant survival (Appendix L, Page 124).

Yakima. The favorable effect of the dichlobenil + oryzalin combination on plant growth as a result of eliminating weed competition is evident in Table 44 (Page 95). The forsythia and staghorn sumac plants in plots treated with the dichlobenil + oryzalin combination were taller than plants in any other treatment. The spirea, snowberry, and 'Bar Harbor' juniper plants in that treatment were among the largest (data not shown). No postplant herbicide treatment reduced plant size.

Forsythia plants were 19% shorter in the main plots treated with amitrole-T + dicamba in June 1977, than in the ones treated with glyphosate at that time (Table 45, Page 96). However, this effect probably was not due to the amitrole-T + dicamba. The original preplant treatment in these main plots was amitrole-T + dalapon, and quackgrass was not controlled as well as by glyphosate (Table 16, Page 65). In July 1978, 18.5% of the plot area was covered by quackgrass, compared with 1.4% in the main plots treated with glyphosate + napropamide in 1976 and glyphosate in 1977 (data not shown). There was a negative correlation (correlation coefficient -.718, significant at 1% level) between subplot area covered with quackgrass and height of forsythia plants, indicating a competitive effect from the quackgrass. Sumac plants were as tall in main plots where the 1977 preplant was amitrole-T + dicamba as where it was glyphosate. Quackgrass was not a factor in these plots.

Kinnikinnick and Salal

No significant effects of the fertilizer treatments were observed in the kinnikinnick and salal experiments, and data on these treatments are not shown. Data from the unfertilized and spring fertilized subplots are combined in all cases and presented as whole plot data.

Kinnikinnick Experiment 1. Grass control appeared good (9.3 to 10 on a 0 to 10 scale) in February after treatments that included dalapon in July but control was not satisfactory at the end of one year (Table 46, Page 97). Grass control was 98% in July from February application of diuron + bromacil + amitrole-T. It was 94% from application of pronamide in November followed by amitrole-T + simazine + napropamide in April, but not when the latter three herbicides were applied in February. Control was 90% from glyphosate applied in September, followed by simazine in November.

Broadleaf weed control was extremely variable. The combination of pronamide in November followed by amitrole-T + simazine + napropamide in April controlled broadleaf weeds 98% (Table 46, Page 97). Unfortunately this treatment also showed the most injury to kinnikinnick in July as a result of the amitrole-T applied in April (Table 47, Page 99). Amitrole-T applied in July 1975 or February 1976 was less injurious. Dalapon applied in July caused severe injury, as indicated in the February 3 observations. The injury was less apparent by July. The combination of glyphosate in September and simazine in November caused very little injury. There was heavy invasion of broadleaf weeds (spotted catsear, smooth hawksbeard, and Virginia pepperweed) after grass was nearly eliminated by the September application of glyphosate (Table 46, Page 97).

Severe injury to kinnikinnick resulted from application of hexazinone or tebuthiuron, particularly after a second application in February 1977 (Appendix M, Page 125).

Sweet vernalgrass was eliminated from plots treated with pronamide + simazine in November 1977, and simazine again in March 1978 (Appendix N, Page 126). This treatment also nearly eliminated creeping red fescue and colonial bentgrass. Pronamide + dichlobenil or pronamide + simazine + napropamide maintained control of all grasses. Dichlobenil allowed reinfestation of sweet vernalgrass after it had been controlled by February 1977 application of tebuthiuron. September and March applications of simazine eliminated sweet vernalgrass, bentgrass and 90% of the fescue from plots heavily infested with these grasses, and simazine maintained control in plots that were free of grass after February 1977 application of tebuthiuron.

The amount of plot area covered by kinnikinnick had increased up to 52% by February 1977 in some treatments (Appendix O, Page 127).

By August 1977, plots of several treatments showed significant increases in area covered (Table 48, Page 100). There was a 50% increase from the amitrole-T + dalapon application in July 1975, followed by diuron + bromacil in September. This treatment caused severe injury initially, with nearly complete recovery by July 1976, as pointed out in Table 47 (Page 99). Because of the severe injury from dalapon, this treatment was not repeated in 1976. Three other treatments that caused a significant increase in the kinnikinnick area in 1977 were combinations with pronamide. The increase was less where amitrole-T was applied in April 1976 than where it was applied in February because of the more severe injury from the April application. After recovery from the April application injury, kinnikinnick grew well in this treatment (Table 49, Page 101).

The February 1976 application of diuron + bromacil + amitrole-T caused moderately severe injury to kinnikinnick (Table 47, Page 99), and the increase in area covered by kinnikinnick was less than in some other treatments (Table 48, Page 100).

Dichlobenil applied in March following pronamide the previous November gave at least as good weed control as amitrole-T + simazine + napropamide in February following pronamide (Table 46, Page 97), and the increase in area covered by kinnikinnick was about the same in the two treatments (Table 48, Page 100). These two treatments still had the greatest increase in area covered by kinnikinnick in September 1978 and they were among the better treatments in June 1979 (Table 49, Page 101). The severely injurious effect of hexazinone and tebuthiuron was indicated by the 73% and 94% reduction in area covered by kinnikinnick by September 1978.

Pacific blackberry was controlled 75% by one application of fosamine in September 1977, and completely controlled by a second application in September 1978 (Table 50, Page 102). Kinnikinnick was not affected by the treatments.

Kinnikinnick Experiment 2. Colonial bentgrass and creeping red fescue were controlled 95 to 100% by all treatments listed in Table 51 (Page 103). The wettable powder formulation of dichlobenil applied at 8 lb/A (9 kg/ha) in February 1977 and March 1978 did not control these grasses, whereas the granular formulation applied at the same time controlled them 99% (data not shown). Scotch broom was controlled 98% by diuron at 10 lb/A (11.2 kg/ha)

+ simazine at 6 lb/A (6.7 kg/ha), and partially controlled by all other treatments that included diuron or bromacil (Appendix P, Page 128).

The combination of bromacil + dichlobenil caused moderately severe injury in 1977 (Table 51, Page 103). There is no explanation for the lack of injury in the treatment which had diuron in addition to the bromacil + dichlobenil. Treatments that resulted in significant increase in area covered by kinnikinnick (compared with a 24% decrease in check plots) were diuron + simazine, granular dichlobenil applied in November 1976 and November 1977 or in February 1977 and March 1978, pronamide + dichlobenil, and glyphosate in September 1976 followed by diuron + bromacil + simazine in February 1977 and March 1978.

Control of Pacific blackberry in 11 plots treated with fosamine at 4 lb/A (4.5 kg/ha) in September 1978 averaged 99% on May 16 and 87% on June 20, 1979 (data not shown).

Salal Experiment 1. Grass was controlled 95 to 99% in July by February application of amitrole-T + diuron + bromacil (Appendix Q, Page 129). This treatment at both rates of diuron + bromacil also gave the best grass control in the first kinnikinnick experiment (Table 46, Page 97). A combination of amitrole-T + simazine in February followed by alachlor in April, controlled grass 88% (Appendix Q, Page 129). Control was not improved by addition of pronamide the previous November (data not shown). Pronamide in November followed by amitrole-T + dichlobenil in February controlled grass 86%.

Amitrole-T applied in July followed by diuron + bromacil in September controlled spotted catsear, the predominant broadleaf weed, better than the combination applied in February (Appendix Q, Page 129).

Grass appeared to be more severely injured in April 1976 by the treatment which included dalapon with amitrole-T in July 1975, than where dalapon was not included (Appendix Q, Page 129), and by September there was less colonial bentgrass and creeping red fescue where dalapon was included (Appendix R, Page 130). Pronamide in November followed by amitrole-T + dichlobenil in February controlled fescue but allowed sweet vernalgrass to become dominant by September. This is in contrast with the partial to complete control of sweet vernalgrass obtained from pronamide in November plus dichlobenil in March in the first kinnikinnick experiment (Appendix N, Page 126). Sweet vernalgrass was controlled where simazine + alachlor were used in place of dichlobenil (Appendix R, Page 130).

Australian burnweed became the dominant weed where grass was well controlled with a February application of amitrole-T, and the residual herbicides were diuron + bromacil (Appendix R, Page 130). It was controlled where the residual herbicide was dichlobenil, or simazine + alachlor. Spotted catsear became abundant where the residual herbicides were simazine + alachlor, rather than dichlobenil.

Injury to salal in 1977 was more severe in all subplot treatments that included bromacil and diuron than where these two herbicides were not applied (Appendix S, Page 131). There was a reduction in area covered by salal in all subplots that were treated with bromacil and diuron. There was a 122% increase in area covered by salal in plots that were treated with pronamide in November 1975, amitrole-T in February 1976, then simazine + alachlor in spring 1976 and 1977 and pronamide again in November 1976 and 1977. This compares with the slight decrease where dichlobenil was applied instead of simazine + alachlor. Hexazinone killed or severely injured salal (data not shown).

Salal Experiment 2. Colonial bentgrass was controlled by all the herbicide treatments listed in Appendix T (Page 133) (data not shown). Sweet vernalgrass was controlled by treatments including diuron, simazine or bromacil. It was not controlled by dichlobenil applied in November 1976 or in March 1977, but was controlled when pronamide was applied with dichlobenil. This confirms the results with pronamide + dichlobenil in the first kinnikinnick experiment.

The area covered by salal had decreased by October 1978 in plots that were treated with bromacil, or two applications of dichlobenil (Appendix T, Page 133). The greatest decrease in area covered by salal was in plots treated with bromacil + two applications of dichlobenil. The area covered by salal was not adversely affected by 2 years of diuron + simazine; by one application of dichlobenil + diuron a year later; by 2 years of pronamide + one of dichlobenil and one of diuron; or by a high rate of simazine (12 lb/A; 13.4 kg/ha).

The area covered by blackberries and salmonberry remained constant or increased between September 1977 and October 1978, except in plots treated with fosamine in September 1977, where there was a 93% decrease (Appendix U, Page 135). Only trailing blackberries remained in those plots. The small amount of other blackberries and salmonberry present in 1977 (less than 2% of the plot area) was eliminated by the fosamine application.

Table 1. Description of experimental sites and times of treatment. Preplant and postplant experiments.

	SeaTac Rest Area	Tukwila	Walla Walla	Spokane Irrigated	Spokane Non-irrigated	Yakima
Highway Right-of-Way	SR 5, Median	SR 5, SR 405	SR 12, Area V	SR 90, SR 195	SR 90	SR 12, Area DD
Slope	2:1	3:1	2:1	Level	Level	Level
Aspect	West	East	South	-	-	-
Soil type (surface soil)	Sandy loam	Loam, sandy loam	Silt loam	Sandy loam	Loam, sandy loam	Loam, sandy loam
Organic matter, percent	5.3 to 6.5	5.6 to 6.7	0.3 to 1.1	0.5 to 0.7	3.2 to 4.6	1.3 to 1.7
No. of main plots	7	7	6	7	7	7
No. of subplots	7	7	6	7	7	7
Main plot size	28 x 20 ft (8.5 x 6.1m)	40 x 24 ft (12.1 x 7.3m)	24 x 20 ft (7.3 x 6.1m)	40 x 22 ft (12.1 x 6.7m)	40 x 24 ft (12.1 x 7.3m)	28 x 20 ft (8.4 x 6.1m)
Subplot size	4 x 20 ft (1.2 x 6.1m)	4 x 24 ft (1.2 x 7.3m)	4 x 20 ft (1.2 x 6.1m)	4 x 22 ft (1.2 x 6.7m)	4 x 24 ft (1.2 x 7.3m)	4 x 20 ft (1.2 x 6.1m)
Preplant application						
First non-selective	5-29-75	6-4-76	5-23-76	5-21-76	5-22-76	5-23-76
Last non-selective	9-11-75	8-26-76	9-29-76	9-28-76	9-16-76	9-23-76
Residual herbicide	10-14-75	10-7-76	9-29-76	9-29-76	9-28-76	10-6-76
Bark mulch applied	10-15-75	10-12-76	10-5-76	9-29-76	9-29-76	10-7-76
Supplemental treatments	-	-	-	-	8-3 and 10-5-77	6-30-77
Planted	10/16-22/75	3/7-9/77	4/6-8/77	4/26-27/77	3/14-15/78	5/25-26/78
First postplant application	11/12-18/75	4/6-7/79	5/4-6/77	5/24-26/77	4/12-14/78	5/25-26/78

Table 2. Description of kinnikinnick and salal experimental sites, and times of treatment.

	Kinnikinnick No. 1	Kinnikinnick No. 2	Salal No. 1	Salal No. 2
Location	16 mi. (25.7 km) west of Olympia	16 mi. (25.7 km) west of Olympia	14 mi. (22.5 km) southwest of South Bend	14 mi (22.5 km) southwest of South Bend
Highway Right-of-way	SR 8 Median	SR 8 Median and North side	SR 101 North side	SR 101 South side
Soil type (surface soil)	sandy loam, silt loam	loamy sand to silt loam	silt loam	loam, silt loam
Organic matter, percent	10 to 16	2 to 16	21	20 to 21+
Main plot size	16 x 24 ft. (4.9 m x 7.3 m)	16 x 24 ft. (4.9 m x 7.3 m) or 24 x 24 ft. (7.3 m x 7.3 m)	12 x 20 ft. (3.7 x 6.1 m)	12 x 18 ft. (3.7 x 5.5 m) or 18 x 18 ft. (5.5 x 5.5 m)
Subplot size (fertilizer)	8 x 24 ft. (2.4 m x 7.3 m)	8 x 24 ft. (2.4 m x 7.3 m)	10 x 12 ft. (3.0 x 3.7 m)	6 x 18 ft. (1.8 x 5.5 m)
First application	7-9-75	9-30-76	7-9-75	12-1-76
Last application	9-13-78	9-26-78	3-21-78	3-22-78

Table 3. Control of broadleaf weeds in 1976 from preplant herbicide applications in 1975. SeaTac Rest Area.

Herbicide	Rate (active ingredient)[z]		Dates applied 1975	Mean number of weeds in untreated subplots[y]				
	Lb/A	Kg/ha		Vetch[x]	Common chick-weed	Buckhorn plan-tain	Other BL weeds[w]	All BL weeds
Amitrole-T + dalapon[v] + amitrole-T	4 + 12 4	4.5 + 13.4 4.5	5-29 9-11	1a[u]	6ab	6a	18ab	31ab
Amitrole-T + dalapon + atrazine[v] + amitrole-T	4 + 12 + 4 4	4.5 + 13.4 + 4.5 4.5	5-29 9-11	9ab	3ab	7a	24b	44b
Amitrole-T + dalapon[v] + paraquat + amitrole-T	4 + 12 2 4	4.5 + 13.4 2.2 4.5	5-29 6-10 9-11	9ab	6ab	9a	10ab	33b
Glyphosate	2	2.2	5-29, 9-11	16b	20b	31b	24b	90c
Glyphosate + paraquat	2 2	2.2 2.2	5-29, 9-11 6-10	7ab	5ab	10a	12ab	33b
Glyphosate + trifluralin 4EC	2 2	2.2 2.2	5-29, 9-11 10-14	2a	0a	0a	6a	8a

[z] Rates of dalapon are in terms of acid equivalent.

[y] Weeds were counted and removed from untreated subplots in all main plots on 5-26-76. Additional weeds that emerged were counted on 7-20-76. Data in this table are means of the totals for the two observations.

[x] Common vetch and tiny vetch.

[w] Other broadleaf weeds were predominantly (50 to 80%) species in the Composite family. Other species included bittercress and white clover.

[v] Tank mix.

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

Table 4. Weed control from summer and fall preplant herbicide applications. Tukwila. Main plots.

Herbicide	Rate (active ingredient)		Dates of application 1976	Weed control (%)[z]			
				Grass[y]		Broadleaf[x]	
	Lb/A	Kg/ha		8-24-76	3-8-77	8-24-76	3-8-77
Glyphosate + napropamide 50WP	2 3	2.2 3.4	6-4, 8-26 10-7	99a[v]	99a	96	99a
Glyphosate + simazine 80WP[w] + alachlor 4EC	2 2.4 + 5	2.2 2.7 + 5.6	6-4, 8-26 10-7	100a	99a	97	100a
Glyphosate + dichlobenil G4	2 4	2.2 4.5	6-4, 8-26 10-7	97a	100a	97	100a
Glyphosate + simazine 80WP	2 3.2	2.2 3.6	6-4, 8-26 10-7	98a	99a	97	99a
Paraquat + simazine 80WP[w] + paraquat	1 + 3 1	1.1 + 3.4 1.1	6-4, 8-26 7-22	73b	80b	96	90b
Glyphosate + simazine 80WP[w] + napropamide 50WP	2 2.4 + 3	2.2 2.7 + 3.4	6-4, 8-26 10-7	98a	100a	95	100a

z Visual estimate of percent control.

y Grass was predominantly creeping red fescue and common bentgrass, with occasional areas of velvetgrass, orchardgrass, tall fescue, and quackgrass.

x Broadleaf weeds included common dandelion, bittercress, common chickweed, mouseear chickweed, and buckhorn plantain.

w Tank mix.

v Means within a column followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 5. Weed control in 1977 from preplant residual herbicides applied in 1976 following glyphosate. Tukwila - Main plots.

Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Dates applied 1976	Plot area covered (%)[z] Composite family[y]	Plot area covered (%)[z] Buckhorn plantain
Glyphosate + napropamide 50WP	2 3	2.2 3.4	6-4, 8-26 10-7	6.7b[w]	3.6ab
Glyphosate + simazine 80WP + alachlor 4EC[x]	2 2.4 + 5	2.2 2.7 + 5.6	6-4, 8-26 10-7	4.7b	4.5b
Glyphosate + dichlobenil 4G	2 4	2.2 4.5	6-4, 8-26 10-7	0.2a	0.1a
Glyphosate + simazine 80WP	2 3.2	2.2 3.6	6-4, 8-26 10-7	3.6b	3.2ab
Glyphosate + simazine 80WP + napropamide 50WP[x]	2 2.4 + 3	2.2 2.7 + 3.4	6-4, 8-26 10-7	4.3b	3.2ab

[z] Observations September 22, 1977.

[y] Includes common dandelion, common groundsel, bull thistle, smooth hawksbeard, annual sowthistle, and spotted catsear. (69% of the area covered by composite family weeds was covered by common dandelion, 19% by common groundsel.)

[x] Tank mix.

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

Table 6. Residual herbicide from preplant applications. Tukwila.

Herbicide applied 10-7-76	Rate (active ingredient)		Residual herbicide 7-14-77[z]			
			(lb/A)		(kg/ha)	
	Lb/A	Kg/ha	Upper end	Lower end	Upper end	Lower end
Napropamide 50WP	3.0	3.4	.14	.12	.16	.13
Simazine 80WP	2.4	2.7	.04	.03	.04	.03
+ alachlor 4EC	5.0	5.6	.02	.04	.02	.04
Dichlobenil 4G	4.0	4.5	.43	.36	.48	.40
Simazine 80WP	3.2	3.6	.04	.02	.04	.02

[z] These are means of samples from 3 subplots. Samples were collected 4 ft (1.2 m) from the upper end and 4 ft (1.2 m) from the lower end of each subplot. Samples were from the upper 1 inch (2.5 cm) of soil under the bark mulch.

Table 7. Weed control from 1976 preplant herbicide applications. Tukwila - Secondary plots.

Herbicide (Secondary plots)	Rate (active ingredient)[z]		Dates of application	Weed control (%)[y]					
				Grass[x]			Broadleaf[w]		
				1976		1977	1976		1977
	Lb/A	Kg/ha		7-21	8-24	3-8	7-21	8-24	3-8
Glyphosate	2	2.2	5-12, 8-4	82b[ts]	100a	77ab	83b[r]	100a	98a
Glyphosate	2	2.2	6-4, 8-26	99a	91abc	83a	99a	97ab	98a
Glyphosate + simazine 4G	2 3	2.2 3.4	6-5, 8-26 6-8	100a	98ab	98a	100a	98ab	98a
Paraquat + simazine 4G + paraquat	1 + 3 1	1.1 + 3.4 1.1	6-4 7-22, 8-26	77b	75c	77ab	78b	99a	86ab
Amitrole-T + dalapon[v] + amitrole-T	4 + 12 4	4.5 + 13.4 4.5	6-4 8-26	99a	81bc	73ab	100a	96ab	98a
Amitrole-T + dalapon[v] + glyphosate	4 + 12 2	4.5 + 13.4 2.2	6-4 8-26	98a	92abc	53b	100a	90b	77b
Glyphosate + amitrole-T[v] + glyphosate	2 + 8 2	2.2 + 9.0 2.2	6-4 8-26	97a	83bc	83a	100a	99a	99a
(Main plots)[u]									
Glyphosate + napropamide 50WP	2 3	2.2 3.4	6-4, 8-26 10-7	100	99	-	100	96	-
Paraquat + simazine 80WP[v] + paraquat	1 + 3 1	1.1 + 3.4 1.1	6-4, 8-26 7-22	91	73	-	86	96	-

(Continued)

Table 7. Weed control from 1976 preplant herbicide applications. Tukwila - Secondary plots - cont.

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[z] Rates of dalapon are in terms of acid equivalent.

[y] Visual estimate of percent control.

[x] Grass was predominantly creeping red fescue and common bentgrass, with occasional areas of velvetgrass, orchardgrass, tall fescue, and quackgrass.

[w] Predominant broadleaf weeds were:

7-21-76	Common dandelion, buckhorn plantain, common vetch.
8-24-76	Common dandelion, annual sowthistle, buckhorn plantain.
3-8-77	Common dandelion, bittercress, common and mouseear chickweeds, buckhorn plantain.

[v] Tank mix.

[u] Data from two of the main plots are shown here for comparison (also see Table 4), but they were not analyzed with the secondary plot data because the two sets of plots were in separate adjacent areas.

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

[s] Control in this treatment was 99% on June 16.

[r] Control in this treatment was 100% on June 16.

Table 8. Control of crested wheatgrass from preplant herbicide treatments. Walla Walla.

Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Dates applied 1976	Control[z] 1976 6-17	Control[z] 1976 7-30	Control[y] 1977 6-9	Control[y] 1977 9-1
Check	-	-	- -	-	-	(11)[x]	(8)
Glyphosate	4	4.5	5-23, 7-30, 9-29	100a[w]	98a	93ab	88a
Glyphosate	2	2.2	5-23, 7-30, 9-29	88a	73b	80b	70a
Glyphosate + alachlor 4EC[v]	2 5	2.2 5.6	5-23, 7-30, 9-29 9-29	77ab	53b	81b	77a
Glyphosate + oryzalin 75WP	2 4	2.2 4.5	5-23, 7-30, 9-29 9-29	83ab	75b	82ab	88a
Amitrole-T + dicamba[u]	4 + 4	4.5 + 4.5	5-23, 9-29	50b	77ab	100a	99a

[z] Data for 1976 are from estimates of weed control based on appearance of weeds.

[y] Data for 1977 are based on plot area covered with live weeds compared with untreated check plots.

[x] Numbers in parenthesis are percent of check plot area covered with grass.

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

[v] Applied separately, not with glyphosate.

[u] Tank mix.

Table 9. Control of field bindweed from preplant herbicide applications. Walla Walla.

Herbicide	Rate (active ingredient) Lb/A	Kg/ha	Dates applied 1976	Control-1976[z] 6-17	7-30	9-29	Control-1977[z] 5-4	6-9[y]	9-1
Check	-	-	- - -	-	(10)[x]	(10)	(13)	-	(38)
Glyphosate	4	4.5	5-23, 7-30, 9-29	47b[w]	41ab	30ab	99	96ab	82 bc
Glyphosate	2	2.2	5-23, 7-30, 9-29	30b	34b	0b	96	94b	65 d
Glyphosate + alachlor 4EC[v]	2 5	2.2 5.6	5-23, 7-30, 9-29 9-29	37b	39ab	17b	97	94b	68 cd
Glyphosate + oryzalin 75WP[v]	2 4	2.2 4.5	5-23, 7-30, 9-29 9-29	20b	39ab	21b	100	99a	92 ab
Amitrole-T + dicamba[u]	4 + 4	4.5 + 4.5	5-23, 9-29	97a	98a	84a	100	100a	99.7a

[z] Except as noted in footnote 7, data are based on plot area covered with live weeds compared with untreated check plots.

[y] Data for 6-9-77 are based on counts of plants compared with the number in untreated check plots.

[x] Numbers in parenthesis are percent of check plot area covered with weeds.

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

[v] Applied separately, not with glyphosate.

[u] Tank mix.

Table 10. Control of sweet clover and alfalfa in 1977 from preplant herbicide treatments in 1976. Walla Walla.

Herbicide	Rate (active ingredient) Lb/A	Kg/ha	Dates applied 1976	Control-1977[z] 6-9	9-1
Check	-	-	- - -	(33)[y]	(8)
Glyphosate	4	4.5	5-23, 7-30, 9-29	99a[x]	97
Glyphosate	2	2.2	5-23, 7-30, 9-29	96ab	72
Glyphosate + alachlor 4EC[w]	2 5	2.2 5.6	5-23, 7-30, 9-29 9-29	94b	63
Glyphosate + oryzalin 75WP	2 4	2.2 4.5	5-23, 7-30, 9-29 9-29	98ab	82
Amitrole-T + dicamba[v]	4 + 4	4.5 + 4.5	5-23, 9-29	100a	99

[z] Data are based on plot area covered with live weeds compared with untreated check plots.

[y] Numbers in parenthesis are percent of check plot area covered with weeds.

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

[w] Applied separately, not with glyphosate.

[v] Tank mix.

Table 11. Weed control in 1977 from preplant herbicide applications in 1976. Spokane, Irrigated.

Herbicide	Rate (active ingredient)		Dates applied 1976	Weed control-1977 (%)[z]			
				Creeping red fescue		Broadleaf weeds[y]	White clover and black medic
	Lb/A	Kg/ha		5-26	7-22	7-22	7-22
Check	-	-	-	(33)[w]	(57)	(2.5)	(2.8)
Glyphosate	2	2.2	5-21	23b[v]	61c	0b	17b
Glyphosate[x]	2	2.2	5-21	66ab	74bc	26b	48b
Glyphosate	2	2.2	5-21, 9-28	86a	92ab	15b	50b
Glyphosate + dichlobenil 4G	2 4	2.2 4.5	5-21 9-29	100a	100a	100a	100a
Glyphosate + simazine 80WP	2 4	2.2 4.5	5-21 9-28	98a	100a	100a	100a
Glyphosate + simazine 80WP	2 4	2.2 4.5	5-21, 9-28 9-29	100a	100a	100a	100a

[z] Based on plot area covered with live weeds compared with untreated check plots. Data for 5-26 are from entire area of main plots at the time of applying postplant treatments. Data for 7-22 are from an untreated subplot within each main plot.

[y] Excluding white clover and black medic.

[x] Two sets of plots were treated with one application of glyphosate with no residual herbicide. The application of residual herbicide scheduled for the second set was not made because bark mulch was inadvertently applied ahead of schedule on those plots.

[w] Numbers in parenthesis are percent of area covered in check plots.

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

Table 12. Weed control in September 1977 from preplant herbicide applications in 1977. Spokane, Irrigated.

Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Dates applied 1976	Plot area covered 9-21-77 (%) Grass[z]	White clover and black medic	Field bindweed
Glyphosate	2	2.2	5-21	21.7c	6.9b[y]	6.0b
Glyphosate[x]	2	2.2	5-21	12.0b	3.5ab	1.0a
Glyphosate	2	2.2	5-21, 9-28	6.5ab	3.2ab	1.0a
Glyphosate + dichlobenil 4G	2 4	2.2 4.5	5-21 9-29	0a	0.7a	0a
Glyphosate + simazine 80WP	2 4	2.2 4.5	5-21 9-28	0a	0.2a	0.2a
Glyphosate + simazine 80WP	2 4	2.2 4.5	5-21, 9-28 9-29	0.1a	0.2a	0.9a

[z] Grass was 95% creeping red fescue and 5% Kentucky bluegrass.

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

[x] Two sets of plots were treated with one application of glyphosate with no residual herbicide. The application of residual herbicide scheduled for the second set was not made because bark mulch was inadvertently applied ahead of schedule on those plots.

Table 13. Grass control in 1976 from preplant herbicide treatments. Spokane, Non-irrigated.

Herbicide (Main plots)	Rate (active ingredient)[z] Lb/A	Rate (active ingredient)[z] Kg/ha)	Dates applied 1976	Weed control (%)[y] Hard fescue 6-17	Hard fescue 7-29	Hard fescue 9-15	Crested wheatgrass 7-29	Crested wheatgrass 9-15
Glyphosate	2	2.2	5-22, 7-29, 9-16	87a[w]	73b	57abc	95a	97a
Glyphosate + oryzalin	2 4	2.2 4.5	5-22, 7-29, 9-16 9-28	80ab	78b	60ab	98a	93a
Glyphosate + silvex[x] + glyphosate	2 + 4 2	2.2 + 4.5 2.2	5-22, 9-16 7-29	43d	43c	33cd	55c	30b
Amitrole-T + silvex[x]	4 + 4	4.5 + 4.5	5-22, 9-16	73abc	63b	20de	93a	7c
Amitrole-T + 2,4-D[x]	4 + 4	4.5 + 4.5	5-22, 9-16	67bc	77b	40bcd	87ab	10bc
Amitrole-T + dalapon[x]	4 + 12	4.5 + 13.4	5-22, 9-16	83a	95a	67a	97a	30b
(Secondary plots)								
Amitrole-T	4	4.5	5-22, 9-16	57cd	73b	17de	75b	10bc
Amitrole-T + dicamba[x]	4 + 4	4.5 + 4.5	5-22, 9-16	67bc	63b	7e	75b	0c

[z] Rates of silvex, 2,4-D, dalapon and dicamba are expressed in terms of acid equivalent.

[y] Data are from visual ratings of percent control.

[x] Tank mix.

[w] Means within a column followed by the same letters are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 14. Weed control in 1977 from 1976 preplant herbicide applications. Spokane, Non-irrigated.

Herbicide (Main plots)	Rate (active ingredient)[z]		Dates applied 1976	Control (%)[y]		Plot area covered (%)
				Hard fescue		Wild buckwheat
	Lb/A	Kg/ha		5-27	7-22	7-22
Check	-	-	-	(24)[w]	(29)	0.3a
Glyphosate	2	2.2	5-22, 7-29, 9-16	99a[v]	96a	25 bc
Glyphosate + oryzalin	2 4	2.2 4.5	5-22, 7-29, 9-16 9-28	100a	100a	0.3a
Glyphosate + silvex[x] + glyphosate	2 + 4 2	2.2 + 4.5 2.2	5-22, 9-16 7-29	98a	98a	21 abc
Amitrole-T + silvex[x]	4 + 4	4.5 + 4.5	5-22, 9-16	88a	53b	15 abc
Amitrole-T + 2,4-D[x]	4 + 4	4.5 + 4.5	5-22, 9-16	94a	65ab	12 abc
Amitrole-T + dalapon[x]	4 + 12	4.5 + 13.4	5-22, 9-16	100a	100a	33 c
(Secondary plots)						
Amitrole-T	4	4.5	5-22, 9-16	50a	64ab	6 ab
Amitrole-T + dicamba[x]	4 + 4	4.5 + 4.5	5-22, 9-16	97a	98a	1 ab

[z] Rates of silvex, 2,4-D, dalapon and dicamba are expressed in terms of acid equivalent.

[y] Data are based on percent plot covered with grass, compared with untreated check plots.

[x] Tank mix.

[w] Numbers in parenthesis are percent of check plot area covered.

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

Table 15. Weed control in 1976 from 1976 preplant herbicide applications. Yakima.

Herbicide (Main plots)	Rate (active ingredient)[z]		Dates applied 1976	Weed control (%)				
				7-30-76[y]		9-23-76[x]		
	Lb/A	Kg/ha		Crested wheatgrass	Quackgrass	Broadleaf weeds	Crested wheatgrass	Quackgrass
Check	-	-	-	-	-	98	66 b	52 c
Amitrole-T + dalapon[w]	4 + 12	4.5 + 13.4	5-23	94b[v]	96a	99	83 ab	82 ab
Glyphosate	2	2.2	5-23	100a	100a	99	99.6a	99.7ab
Glyphosate + paraquat	2 1	2.2 1.1	5-23 6-9	100a	100a	99	99.7a	99.9ab
(Secondary plots)								
Glyphosate	2	2.2	5-5	100a	100a	100	100 a	100 a
Paraquat + simazine[w]	1 + 3	1.1 + 3.4	5-23	93b	90b	83	88 ab	77 bc

z Rate of dalapon is expressed in terms of acid equivalent.

y Based on visual estimate of control.

x Based on percent of plot area free of live weeds.

w Tank mix.

v Means within a column followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 16. Weed control in 1977 from 1976 preplant herbicide applications. Yakima.

Herbicide (Main plots)	Rate (active ingredient)[z]		Dates applied 1976	Area free of weeds (%)				
				4-18-77		6-25-77		
	Lb/A	Kg/ha		Crested wheatgrass	Quackgrass	Crested wheatgrass	Quackgrass	Annual broadleaf weeds[y]
Check	-	-	-	73 b[w]	70 b	87 b	50 b	100a
Amitrole-T + dalapon[x]	4 + 12	4.5 + 13.4	5-23, 9-23	100 a	92 a	99 a	71 b	99a
Glyphosate	2	2.2	5-23	100 a	99.6a	97 a	99 a	97a
Glyphosate + paraquat	2 1	2.2 1.1	5-23 6-9	99.9a	99.7a	99 a	98.9a	95a
Glyphosate + napropamide 50WP	2 4	2.2 4.5	5-23 10-6	99.9a	99.8a	99.5a	99.6a	97a
Glyphosate + oryzalin 75WP	2 4	2.2 4.5	5-23 10-6	99.8a	99.9a	99 a	99.9a	99a
Glyphosate + pronamide 50WP	2 3	2.2 3.4	5-23 10-6	100 a	99.9a	99.9a	100 a	98a
(Secondary plot)								
Glyphosate	2	2.2	5-5	100.0a	100.0a	99.9a	99.7a	94a

[z] Rate of dalapon is expressed in terms of active ingredient.

[y] Predominant annual broadleaf weeds were Russian thistle (47% of total) and lambsquarters (43%).

[x] Tank mix.

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

Table 17. Grass control in 1978 from herbicides applied in 1976 and 1977. Yakima.

Herbicides applied 5-23-76	Herbicides applied 10-6-76	Rate (active ingredient)		Herbicides applied 6-30-77	Rate (active ingredient)		Area free of grass (%) 6-3-78	
		Lb/A	Kg/ha		Lb/A	Kg/ha	Downy brome	Foxtail barley
Amitrole-T + dalapon	-	-	-	amitrole-T + dicamba[y]	4 4	4.5 4.5	99.9a[x]	100
Glyphosate	-	-	-	glyphosate	2	2.2	72 b	75
Glyphosate	pronamide 50WP + oxadiazon 3F[z]	3 4	3.4 4.5	glyphosate	2	2.2	100 a	100
Glyphosate + paraquat	-	-	-	amitrole-T + dicamba[y]	4 4	4.5 4.5	94 a	99
Glyphosate + paraquat	pronamide 50WP + oxadiazon 3F[z]	3 4	3.4 4.5	amitrole-T + dicamba[y]	4 4	4.5 4.5	100 a	100
Glyphosate	napropamide 50WP	4	4.5	glyphosate	2	2.2	97 a	100
Glyphosate	oryzalin 75WP	4	4.5	glyphosate	2	2.2	83 ab	100
Glyphosate	pronamide 50WP	3	3.4	glyphosate	2	2.2	98 a	100

[z] Applied separately, not tank mix.

[y] Tank mix. Rate of dicamba is expressed in terms of acid equivalent.

[x] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 18. Weed control in 1976 from postplant treatments in 1975. SeaTac Rest Area.

Herbicide[z]	Rate (active ingredient)		Weed control (%)[y] 7-20-76				
	Lb/A	Kg/ha	Grass[x]	Vetch[w]	Chickweed[v]	Buckhorn plantain	Other broadleaf weeds[u]
Check	-	-	(6)[t]	(7)	(6)	(11)	(16)
Dichlobenil	4	4.5	87	90ab[s]	95ab	90	99
Simazine	8	9.0	100	69b	100a	100	97
Simazine + napropamide	8 + 6	9 + 6.7	98	97a	100a	100	98
Oxadiazon	3	3.4	89	97a	59bc	96	95
Oxadiazon	6	6.7	89	100a	45c	100	97
Oxadiazon + napropamide	3 + 6	3.4 + 6.7	95	100a	100a	100	98

[z] Applied November 12 to 19, 1975. All herbicides were in granular formulations.

[y] Based on weed counts compared with untreated check plots.

[x] Grass was predominantly soft chess, creeping red fescue and Kentucky bluegrass.

[w] Common vetch and tiny vetch.

[v] Common and mouseear chickweed.

[u] Includes smooth hawksbeard (26% of the weeds in the check plots), common dandelion (22%), spotted catsear (19%), bittercress (15%), white clover (4%), and up to 3% of several other species.

[t] Figures in parenthesis are numbers of weeds in check plots.

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

Table 19. Weed control after two years of postplant herbicide applications. SeaTac Rest Area.

Herbicide[z]	Rate (active ingredient)		Weed control (%) 5-21-77[y]				
	Lb/A	Kg/ha	Vetch[x]	Common chickweed	Composites[w] except groundsel	Common groundsel	Fescue[v]
Check	-	-	(7)[u]	(2)	(31)	(2)	(7)
Dichlobenil	4	4.5	79b[t]	94a	100a	100a	100a
Simazine	8	9	0c	98a	95bc	44c	100a
Simazine + napropamide	8 + 6	9 + 6.7	100a	100a	97ab	100a	100a
Oxadiazon	3	3.4	93ab	24b	89c	71bc	98a
Oxadiazon	6	6.7	100a	0b	97ab	77b	92a
Oxadiazon + napropamide	3 + 6	3.4 + 6.7	96ab	100a	94bc	100a	100a

[z] Herbicides were applied November 12 to 19, 1975 and September 23 to October 1, 1976; all were granular formulations.

[y] Based on plot area covered compared with untreated check plots.

[x] Common vetch and tiny vetch.

[w] Composite family weed species included smooth hawksbeard (61%), common dandelion (19%), spotted catsear, and annual sowthistle (3%).

[v] Hard fescue and rattail fescue.

[u] Figure in parenthesis under vetch is the mean number of vetch seedlings in untreated plots, 96 square feet (29.3 square m) each; for other weeds it is the estimated area occupied by that weed or group of weeds (% of plot area).

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

Table 20. Residual dichlobenil after three annual applications. SeaTac Rest Area.

Location on slope[z]	Amount of dichlobenil Sample no.[y]						Means
	1	2	3	4	5	6	
				(lb/A)			
Top	1.67	.66	1.57	1.08	1.01	.71	1.12
Bottom	1.13	2.82	2.00	2.09	1.37	4.00	2.23
Means	1.39	1.74	1.79	1.59	1.19	2.35	1.67
				(kg/ha)			
Top	1.87	.74	1.76	1.21	1.13	.79	1.25
Bottom	1.26	3.16	2.24	2.34	1.53	4.47	2.50
Means	1.56	1.95	2.00	1.78	1.33	2.63	1.87

[z] Samples were collected 4 ft (1.2 m) from the upper end (Top) of the plot and 4 ft (1.2 m) from the lower end (Bottom) of the plot. Samples were from the upper 1 inch (2.5 cm) of soil under the bark mulch.

[y] All samples were from plots treated with dichlobenil at 4 lb/A (4.5 kg/ha) on November 14 to 19, 1975; October 1, 1976; and December 5, 1977. Samples for analysis were collected June 28, 1978.

Table 21. Control of grasses in 1977 from postplant herbicide treatments. Tukwila.

Herbicide[z]	Rate (active ingredient)		Plot area covered (%), 9-22-77[y]		
	Lb/A	Kg/ha	Velvetgrass	Quackgrass	Other[x] grasses
Check	-	-	7.2b[u]	2.2a	4.1
Dichlobenil 4G	4	4.5	1.1a	3.4ab	1.9
Dichlobenil 4G[w]	4	4.5	0.9a	2.2a	1.5
Dichlobenil 4G + oxadiazon 2G	4 + 4	4.5 + 4.5	0a	7.0b	2.4
Oxadiazon 2G	4	4.5	1.0a	2.1a	2.4
Simazine 80WP + oryzalin 75WP[v]	6 + 4	6.7 + 4.5	0.1a	2.8a	2.9
Simazine 80WP	6	6.7	0.2a	1.5a	1.6

[z] Herbicides were applied April 6-7, 1977.

[y] Data are from subplots in all main plots except the one treated preplant with paraquat + simazine.

[x] Includes colonial bentgrass (35%), perennial ryegrass (34%), creeping red fescue (22%), and Kentucky bluegrass (9%).

[w] This treatment was the same as the one above it until December, when pronamide was applied.

[v] Applied separately, not tank mix.

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

Table 22. Control of broadleaf weeds in 1977 from postplant herbicide treatments. Tukwila.

	Rate (active ingredient)		Weed control (%)[y]			
			6-14-77	9-22-77		
Herbicide[z]	Lb/A	Kg/ha	Broadleaf weeds[x]	Composite family[w]	Clovers and trefoil[v]	Buckhorn plantain
Check	-	-	(3)[s]	(8)	(16)	(12)
Dichlobenil 4G	4	4.5	93	93a[r]	59b	92 ab
Dichlobenil 4G[u]	4	4.5	86	91a	64b	95 a
Dichlobenil 4G + oxadiazon 2G	4 + 4	4.5 + 4.5	96	94a	74ab	99.7a
Oxadiazon 2G	4	4.5	81	12c	55b	67 c
Simazine 80WP + oryzalin 75WP[t]	6 + 4	6.7 + 4.5	97	40bc	99a	94 ab
Simazine 80WP	6	6.7	95	49b	94a	84 b

[z] Herbicides were applied April 6-7, 1977.

[y] Based on plot area covered, compared with untreated check plots. Data are from subplots in all main plots except the one treated preplant with paraquat + simazine.

[x] Does not include vetch.

[w] Includes common dandelion (70%), bullthistle (11%), common groundsel (7%), smooth hawksbeard, annual sowthistle, and spotted catsear.

[v] White and red clover and birdsfoot trefoil.

[u] This treatment was the same as the one above it until December, when pronamide was applied.

(continued)

Table 22. Control of broadleaf weeds in 1977 from postplant herbicide treatments. Tukwila. - Cont.

[t] Applied separately, not tank mix.

[s] Numbers in parenthesis are percent of check plot area covered.

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

Table 23. Grass control in 1978 from 1977 supplemental postplant applications of pronamide, glyphosate and oxyfluorfen. Tukwila.

Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Date applied	Plot area covered (%), 3-20-78[z] Velvetgrass	Quackgrass	Other[y] grasses
Check	-	-	-	12.6b[v]	3.2a	4.0c
Dichlobenil 4G	4	4.5	4-6	3.7a	6.4ab	3.2bc
Dichlobenil 4G + oxadiazon 2G	4 + 4	4.5 + 4.5	4-6	0a	12.5b	1.0a
Dichlobenil 4G + pronamide 50WP	4 4	4.5 4.5	4-6 12-16	0.9a	3.7a	1.5ab
Oxadiazon 2G + glyphosate + oxyfluorfen 4EC[x] + pronamide 50WP	4 2 + 2 4	4.5 2.2 + 2.2 4.5	4-6 9-26 12-16	0a	0a	0a
Simazine 80WP + oryzalin 75WP[w] + glyphosate + oxyfluorfen 4EC[x]	6 + 4 2 + 2	6.7 + 4.5 2.2 + 2.2	4-6 9-26	0a	0a	0a
Simazine 80WP + oxyfluorfen 4EC + pronamide 50WP	6 2 4	6.7 2.2 4.5	4-6 9-26 12-16	0a	0.9a	0.4a

[z] Data are from all subplots except in the main plot treated preplant with paraquat + simazine. Some subplots in that main plot received different treatments in September than the ones listed in this table.

[y] Includes perennial ryegrass (35%), creeping red fescue (28%), colonial bentgrass (25%), and Kentucky bluegrass (15%).

[x] Tank mix.

[w] Applied separately.

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

Table 24. Grass control from 1977 postplant herbicide applications in main plot treated preplant with paraquat + simazine. Tukwila.

Herbicide	Rate (active ingredient) Lb/A	Kg/ha	Date applied	Plot area covered (%)
Check	-	-	-	50.0c[xw]
Dichlobenil 4G + glyphosate	4 2	4.5 2.2	4-6	0.2a
Dichlobenil 4G + oxadiazon 2G + glyphosate	4 + 4 2	4.5 + 4.5 2.2	4-6 4-6	0.1a
Dichlobenil 4G + pronamide 50WP	4 4	4.5 4.5	4-6 12-16	18.0ab
Oxadiazon 2G + pronamice 50WP	4 4	4.5 4.5	4-6 12-16	37.0bc
Simazone 80WP + oryzalin 75WP[z] + glyphosate + oxyfluorfen 4EC[y]	6 + 4 2 + 2	6.7 + 4.5 2.2 + 2.2	4-6 9-26	0.5a
Simazine 80WP + pronamide 50WP	6 4	6.7 4.5	4-6 12-16	12.7ab

[z] Applied separately, not tank mix.

[y] Tank mix.

[x] Includes Kentucky bluegrass (57% of area covered by grass was covered by this species), colonial bentgrass (30%), and quackgrass (13%).

[w] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 25. Broadleaf weed control in 1978 from 1977 supplemental postplant applications of pronamide, glyphosate and oxyfluorfen. Tukwila.

Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Date applied	Weed control (%), 3-20-78[z] White and red clover	Buckhorn plantain	Bittercress	Composite family[y]	Buttercup
Check	-	-	-	(10)[v]	(3)	(4)	(4)	(1)
Dichlobenil 4G	4	4.5	4-6	62b[u]	88b	24b	88ab	70
Dichlobenil 4G + oxadiazon 2G	4 + 4	4.5 + 4.5	4-6	76b	98a	99a	95a	88
Dichlobenil 4G + pronamide 50WP	4 4	4.5 4.5	4-6 12-16	70b	95ab	34b	99a	72
Oxadiazon 2G + glyphosate + oxyfluorfen 4EC[x] + pronamide 50WP	4 2 + 2 4	4.5 2.2 + 2.2 4.5	4-6 9-26 12-16	100a	100a	100a	100a	100
Simazine 80WP + oryzalin 75WP[w] + glyphosate + oxyfluorfen 4EC[x]	6 + 4 2 + 2	6.7 + 4.5 2.2 + 2.2	4-6 9-26	100a	100a	100a	97a	100
Simazine 80WP + oxyfluorfen + pronamide	6 2 4	6.7 2.2 4.5	4-6 9-26 12-16	98a	76c	100a	74b	100

[z] Based on plot area covered compared with untreated check plots. Data are from all subplots except in the main plot treated preplant with paraquat + simazine. Some subplots in that main plot received different treatments in September than the ones listed in this table.

[y] Includes common dandelion (59%), common groundsel (29%), smooth hawksbeard (7%), and spotted catsear (5%).

[x] Tank mix.

[w] Applied separately, not tank mix.

[v] Numbers in parenthesis are percent of check plot area covered.

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

Table 26. Control of grass and field horsetail by postemergence herbicide applications. Tukwila, secondary plots.

Herbicide	Rate (active ingredient)		Date applied	Plot area covered (%)				
				9-30-77			3-31-78	
	Lb/A	Kg/ha		Quackgrass	Other grasses[z]	Field horsetail	Quackgrass	Other grasses[y]
Part A								
Dichlobenil 4G	4	4.5	4-6-77	60b[x]	4a	3a	32b	9a
Dichlobenil 4G + glyphosate	4 2	4.5 2.2	4-6-77 6-8-77	7a	0a	6a	4a	2a
Dichlobenil 4G + glyphosate	4 2	4.5 2.2	4-6-77 9-30-77	52ab	19b	1a	0a	3a
Part B								
Dichlobenil 4G + glyphosate	4 2	4.5 2.2	4-6-77 6-8-77	2a	1a	1a	4a	20b
Oxadiazon 2G + glyphosate	4 2	4.5 2.2	4-6-77 6-8-77	4a	1a	30b	4a	16ab
Dichlobenil 4G + glyphosate	4 2	4.5 2.2	4-6-77 9-30-77	42b	20b	5a	0a	3a

[z] Includes Kentucky bluegrass (covering 50% of the area covered by grasses), tall fescue (33%), colonial bentgrass (11%), creeping red fescue, perennial ryegrass and orchardgrass.

[y] Includes perennial ryegrass (covering 53% of the area covered by grasses), velvetgrass (38%), creeping red fescue and tall fescue.

[x] Means within a column within Part A or within Part B followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 27. Residual herbicide from preplant and postplant applications. Tukwila.

Herbicide applied 10-7-76	Rate (active ingredient)		Herbicide applied 4-6-77	Rate (active ingredient)		Residual herbicide 7-14-77[z] (lb/A)		Residual herbicide 7-14-77[z] (kg/ha)	
	Lb/A	Kg/ha		Lb/A	Kg/ha	Upper end	Lower end	Upper end	Lower end
Dichlobenil 4G	4	4.5	Dichlobenil 4G	4	4.5	.26	.85	.29	.95
-			Dichlobenil 4G	4	4.5	.14	.13	.16	.14
Simazine 80WP	2.4	2.7	Simazine 80WP	6	6.7	.04	.03	.05	.03
-			Simazine 80WP	6	6.7	nd[y]	.01	nd	.01
-			Oxadiazon 2G	4	4.5	.10	.36	.11	.40
-			Oryzalin 75WP	4	4.5	.04	.03	.05	.03

[z] These data are means from subplots in 1 to 4 main plots. Samples were collected 4 ft (1.2 m) from the upper end or 4 ft (1.2 m) from the lower end of 24 ft (7.3 m) long plots extending down the slope. Samples were from the top 1 inch (2.5 cm) of soil under the bark mulch.

[y] nd = none detected.

Table 28. Residual herbicide after postplant applications. Tukwila.

Applied 4-6-77 and 4-3-78	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Position on slope[z]	Residual herbicide 6-29-78[y]			
				Dichlobenil			
				Lb/A	Kg/ha		
Dichlobenil 4G	4	4.5	Top	.28	.31		
Dichlobenil 4G	4	4.5	Top	.40	.45		
			Mean	.34	.38		
Dichlobenil 4G	4	4.5	Bottom	.38	.42		
Dichlobenil 4G	4	4.5	Bottom	.79	.89		
			Mean	.58	.65		
				Oxadiazon			
				Lb/A	Kg/ha		
Oxadiazon 2G	4	4.5	Top	.41	.46		
Oxadiazon 2G	4	4.5	Top	.35	.39		
			Mean	.38a	.43a[w]		
Oxadiazon 2G	4	4.5	Bottom	3.45	3.86		
Oxadiazon 2G	4	4.5	Bottom	1.50	1.68		
			Mean	2.47b	2.77b		
				Simazine		Oryzalin	
				Lb/A	Kg/ha	Lb/A	Kg/ha
Simazine 80WP	6	6.7					
+ oryzalin 75WP[x]	4	4.5	Top	.08	.09	.08	.09
Simazine 80WP	6	6.7					
+ oryzalin 75WP[x]	4	4.5	Top	.03	.03	.11	.12
			Mean	.05	.06	.09	.10
Simazine 80WP	6	6.7					
+ oryzalin 75WP[x]	4	4.5	Bottom	.04	.05	.05	.06
Simazine 80WP	6	6.7					
+ oryzalin 75WP[x]	4	4.5	Bottom	.16	.18	.28	.31
			Mean	.10	.11	.17	.19
				Pronamide			
				Lb/A	Kg/ha		
Pronamide	4	4.5	Top	.25	.28		
Pronamide	4	4.5	Top	.27	.30		
			Mean	.26a[w]	.29a		
Pronamide	4	4.5	Bottom	.74	.83		
Pronamide	4	4.5	Bottom	.53	.59		
			Mean	.64b	.72b		

Continued

Table 28. Residual herbicide after postplant applications. Tukwila. - Cont.

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[z] Samples were taken 4 ft (1.2 m) from the upper end (Top) and 4 ft (1.2 m) from the lower end (Bottom) of 24 ft (7.3 m) long plots extending down the slope.

[y] Samples were from the top 1 inch (2.5 cm) of soil under the bark mulch. Analyses were expressed as ppm, dry soil weight, and converted to lb/A or kg/ha.

[x] Tank mix in 1978 on March 27; applied separately in 1977.

[w] Means not followed by the same letter are significantly different at the 5% level.

Table 29. Weed control in 1977 from postplant herbicide applications. Walla Walla.

Herbicide[z]	Rate (active ingredient)		Plot area covered (%)[y]			Prickly lettuce (No. of plants)
	Lb/A	Kg/ha)	Crested wheatgrass	Sweet clover	Field bindweed	
Check		-	1.9	1.2abc[x]	6.7	3.6b
Oxadiazon 2G + dichlobenil 4G	3 + 4	3.4 + 4.5	0.7	1.9bc	6.9	0.1a
Oxadiazon 2G	3	3.4	0.9	2.4c	6.3	1.5ab
Oxadiazon 2G + napropamide 50W	3 + 6	3.4 + 6.7	1.2	0.5a	9.9	0.8a
Oxadiazon 2G + alachlor 4E	3 + 6	3.4 + 6.7	0.5	1.1ab	6.0	0.5a
Oxadiazon 2G + oryzalin 75W	3 + 4	3.4 + 4.5	0.8	1.1abc	4.7	1.4ab

[z] Herbicides were applied May 4 to 6, 1977.

[y] Observations September 1, 1977.

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

Table 30. Weed control from postplant herbicide treatments. Spokane, Irrigated.

Herbicide[z]	Rate (active ingredient)		Weed control 9-21-77 (%)[y]				
	Lb/A	Kg/ha	Common dandelion	White clover	Black medic	Lambs-quarters	Creeping red fescue
Check	-	-	(1.1)[w]	(0.4)	(4.2)	(1.4)	(15)
Dichlobenil 4G	4	4.5	100a[v]	63ab	0c	40b	67a
Simazine 80WP	6	6.7	75b	100a	95ab	100a	70a
Simazine 80WP + alachlor 4E[x]	6 + 4	6.7 + 4.5	99a	100a	100a	100a	86a
Simazine 80WP + napropamide 50WP[x]	6 + 4	6.7 + 4.5	88ab	100a	67ab	86ab	76a
Simazine 80WP + oryzalin 75W[x]	6 + 4	6.7 + 4.5	95ab	100a	100a	100a	84a
Oxadiazon 75WP	4	4.5	94ab	51b	51bc	100a	17b

z Applied May 26, 1977.

y Based on plot area covered compared with check plots.

x Tank mix.

w Numbers in parenthesis are estimated percent of check plot area covered.

v Means within a column followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 31. Control of hard fescue in July from postplant herbicide application in April. Spokane, Non-irrigated.

Herbicide[z]	Rate (active ingredient) Lb/A	Kg/ha	Control (%)[y]
Check	-	-	(2)[x]
Oxadiazon 2G + napropamide 50WP	4 + 4	4.5 + 4.5	4c[w]
Oxadiazon 2G + oryzalin 75WP	4 + 4	4.5 + 4.5	66ab
Simazine 80WP + napropamide 50WP	4 + 4	4.5 + 4.5	16bc
Simazine 80WP + oryzalin 75WP	4 + 4	4.5 + 4.5	47abc
Simazine 80WP + oxyfluorfen 2EC	4 + 2	4.5 + 2.2	81a
Dichlobenil G4 + oryzalin 75WP	4 + 4	4.5 + 4.5	27abc

[z] Applied April 13-14, 1978.

[y] Recorded July 20, 1978. Based on plot area covered compared with untreated check.

[x] Percent of check plot area covered.

[w] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 32. Weed control from postplant herbicide applications. Yakima.

Herbicides[z]	Rate (active ingredient)		Plot area covered (%)[y]		
	Lb/A	Kg/ha	Redroot pigweed	Lambs-quarters	Russian thistle
Check	-	-	4.1b[w]	7.8b	6.7bc
Oxadiazon 2G + napropamide 50WP	4 + 4	4.5 + 4.5	1.1a	1.7a	5.3b
Oxadiazon 2G + oryzalin 75WP	4 + 4	4.5 + 4.5	0.2a	3.2ab	3.9ab
Simazine 80WP + napropamide 50WP[x]	4 + 4	4.5 + 4.5	0a	0.8a	10.4c
Simazine 80WP + oryzalin 75WP[x]	4 + 4	4.5 + 4.5	0.1a	1.9a	4.7ab
Dichlobenil 4G + napropamide 50WP	4 + 4	4.5 + 4.5	0.6a	1.9a	6.0bc
Dichlobenil 4G + oryzalin 75WP	4 + 4	4.5 + 4.5	0a	0a	1.2a

[z] Herbicides were applied May 25-26, 1978.

[y] Observations July 26, 1978. Other weeds present in small amounts included crested wheatgrass (3% of check plot area), barnyardgrass (1%), prickly lettuce (2%), common mallow (1%), tumble mustard (1%), salsify, sweetclover, prostrate knotweed, and puncturevine.

[x] Tank mix.

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

Table 33. Effect of napropamide on simazine phytotoxicity in California privet and staghorn sumac.[z] SeaTac Rest Area.

	7-26-76		8-16-77	
	Simazine[y]	Simazine + napropamide[y]	Simazine	Simazine + napropamide
Plants with symptoms (%)				
California privet	57	30	10	7
Staghorn sumac	80	23*[x]	67	40
Rating of symptoms (0-10)				
California privet	1.7	0.9	0.5	0.1
Staghorn sumac	3.2	0.7*	2.3	0.8*

[z] Planted October 16 to 24, 1975.

[y] Herbicides applied November 12 to 18, 1975 and September 23 to October 1, 1976: Simazine at 8 lb/A (9 kg/ha); napropamide at 6 lb/A (6.7 kg/ha); both herbicides in granular formulations.

[x] Means for the simazine + napropamide combination marked with an asterisk are significantly different from the corresponding means for simazine, at the 5% level.

Table 34. Effects of postplant herbicides on growth of staghorn sumac, Oregon grape and California privet.[z] SeaTac Rest Area.

Herbicide[y]	Rate (active ingredient)		Plant height 11-8-77 (inches)			Plant height 11-8-77 (cm)		
	Lb/A	Kg/ha	Staghorn sumac	Oregon grape	California privet	Staghorn sumac	Oregon grape	California privet
Check	-	-	40.3ab[x]	36.5a	41.8bc	102ab	93a	106bc
Dichlobenil	4	4.5	38.7b	38.4a	44.7a	98b	98a	114a
Simazine	8	9.0	44.4a	39.5a	44.3ab	113a	100a	113ab
Simazine + napropamide	8 + 6	9.0 + 6.7	38.8b	36.7a	44.8a	99b	93a	114a
Oxadiazon	3	3.4	44.2a	38.1a	41.4c	112a	97a	105c
Oxadiazon	6	6.7	42.1ab	39.0a	45.2a	107ab	99a	115a
Oxadiazon + napropamide	3 + 6	3.4 + 6.7	37.7b	32.5b	43.8abc	96b	83b	111abc

[z] Planted October 16 to 24, 1975.

[y] Herbicides applied November 12 to 18, 1975 and September 23 to October 1, 1976, all in granular formulations.

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

Table 35. Phytotoxicity from glyphosate and oxyfluorfen. Tukwila.

Herbicide	Rate (active ingredient)		Supplemental Herbicide[z]	Rate (active ingredient)		Phytotoxicity (0-10)[y] 3-20-78			
	Lb/A	Kg/ha		Lb/A	Kg/ha	Forsythia	Photinia	Firethorn	Snowberry
Check	-	-				0.6bc[t]	2.0b	0.3a	0.1a
Dichlobenil 4G[x]	4	4.5				1.1c	2.1b	0.8a	0.2a
Dichlobenil 4G[x] + oxadiazon 2G[x]	4 4	4.5 4.5				0ab	1.0ab	1.5ab	0.9a
Dichlobenil 4G[x] + pronamide 50WP[u]	4 4	4.5 4.5				0.2ab	0.6a	1.3ab	0.6a
Oxadiazon 2G[x] + pronamide 50WP[u]	4	4.5	glyphosate + oxyfluorfen 4EC	2 2	2.2 2.2	6.3d	5.6c	3.5b	6.3b
Simazine 80WP[w] + oryzalin 75WP[v]	6 4	6.7 4.5	glyphosate + oxyfluorfen 4EC	2 2	2.2 2.2	7.0e	5.6c	3.1b	5.8b
Simazine 80WP[w] + pronamide 50WP[u]	6 4	6.7 4.5	oxyfluorfen 4EC	2	2.2	0.5abc	1.7ab	1.8ab	1.4a

[z] Applied September 26, 1977.

[y] Rated on a 0 to 10 scale: 0 = no injury, 10 = dead.

[x] Applied April 6, 1977 and April 3, 1978.

[w] Applied April 6, 1977 and March 27, 1978.

[v] Applied April 7, 1977 and March 27, 1978.

[u] Applied December 16, 1977.

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

Table 36. Phytotoxicity from glyphosate applied over the top of several ornamental species previously treated with dichlobenil. Tukwila - Secondary plots.

	Phytotoxicity rating (0-10)[z]	
	Herbicide[y] and rate (active ingredient)	
	Dichlobenil 4G 4 lb/A (4.5 kg/ha)	Dichlobenil 4G + glyphosate 4 + 2 lb/A (4.5 + 2.2 kg/ha)
Photinia	0.7	7.2[x]
Oregon grape	0.7	1.8
Snowberry	0.3	7.7*
Forsythia	0.8	4.7*
Potentilla	1.0	6.0*
Pyracantha	0.5	7.5*
Broom	2.5	1.1
Juniper 'Tamariscifolia'	0	0
Juniper 'Bar Harbor'	0	0

[z] Observations September 30, 1977. Rated on a 0 to 10 scale: 0 = no injury, 10 = dead.

[y] Dates of application: Dichlobenil, April 6, 1977; glyphosate, June 8, 1977.

[x] Means in this column that are significantly different at the 5% level from corresponding means in the first column are indicated by an asterisk.

Table 37. Effects of postplant and preplant herbicide treatment on survival and growth of red-osier dogwood. Walla Walla.

Herbicide[z]	Rate (active ingredient)		Survival	Height[y] (inches)		Height[y] (cm)	
	Lb/A	Kg/ha	(%)	A[x]	B[w]	A[w]	B[v]
Check	-	-	80	43ab[v]	37ab	108ab[v]	93ab
Oxadiazon 2G + dichlobenil 4G	3 + 4	3.4 + 4.5	57	31b	48a	78b	122a
Oxadiazon 2G	3	3.4	83	43ab	36ab	109ab	91ab
Oxadiazon 2G + napropamide 50WP	3 + 6	3.4 + 6.7	60	51a	31b	129a	78b
Oxadiazon 2G + alachlor 4EC	3 + 6	3.4 + 6.7	76	34b	38ab	86b	97ab
Oxadiazon 2G + oryzalin 75WP	3 + 4	3.4 + 4.5	86	43ab	42ab	108ab	107ab
Means				41	39	103	98

[z] Applied May 4 to 6, 1977 and March 28 to 30, 1978.

[y] Observations October 26, 1978. Planted April 6 to 8, 1977.

[x] Data in column A are from plots treated preplant with glyphosate at 2 lb/A (2.2 kg/ha) on May 23, July 30, and September 29, 1976.

[w] Data in column B are from plots treated preplant with amitrole-T at 4 lb/A (4.5 kg/ha) and dicamba at 4 lb/A (4.5 kg/ha) on May 23 and September 29, 1976.

[v] Means in both columns followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 38. Effects of postplant herbicide applications on phytotoxicity symptoms and mortality of paxistima[z]. Spokane, Irrigated.

Herbicide[y]	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Phytotoxicity rating (0-10)[x]	Plant mortality (%)
Check	-	-	1.2a[v]	10ab
Dichlobenil G4	2	4.5	0.3a	7a
Simazine 80WP	6	6.7	6.1b	30bc
Simazine 80WP + alachlor 4EC[w]	6 + 4	6.7 + 4.5	6.7b	36c
Simazine 80WP + napropamide 50WP[w]	6 + 4	6.7 + 4.5	6.0b	36c
Simazine 80WP + oryzalin 75WP[w]	6 + 4	6.7 + 4.5	5.7b	24abc
Oxadiazon 2G	4	4.5	1.1a	10ab

[z] Planted April 27-28, 1977.

[y] Applied May 26, 1977.

[x] Evaluated September 21, 1977 on a 0 to 10 scale: 0 = no injury, 10 = dead.

[w] Tank mix.

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

Table 39. Effects of postplant and preplant herbicide treatments on paxistima and 'Tamariscifolia' juniper. Spokane, Irrigated.

Herbicides applied 5-26-77 and 4-15-78	Rate (active ingredient)		Plant width 10-18-78							
			Paxistima[z]				'Tamariscifolia' juniper[z]			
			(inches)		(cm)		(inches)		(cm)	
	Lb/A	Kg/ha	A[y]	B[x]	A	B	A	B	A	B
Check	-	-	5.8f[v]	13.3abc	15f	34abc	15.8c	19.9b	40c	51b
Dichlobenil 4G	4	4.5	15.9a	14.4ab	40a	37ab	22.2a	21.4ab	56a	54ab
Simazine 80WP	6	6.7	11.7bcd	7.8def	30bcd	20def	22.3a	21.1ab	57a	54ab
Simazine 80WP + napropamide 50WP[w]	6 + 4	6.7 + 4.5	10.0cde	6.3ef	25cde	16ef	22.1a	21.5ab	56a	55ab

[z] Planted April 27-28, 1977.

[y] Data in column A are from plots treated with glyphosate at 2 lb/A (2.2 kg/ha) over the plants October 7, 1977.

[x] Data in column B are from plots treated preplant with simazine at 4 lb/A (4.5 kg/ha) September 29, 1976, before applying mulch.

[w] Tank mix.

[v] Means in both columns followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 40. Effects of preplant and postplant herbicide treatments on 'Moonlight' broom on plant mortality and symptoms of phytotoxicity. Spokane, Irrigated.

Herbicide[z]	Rate (active ingredient)		Phytotoxicity rating 9-21-77 (0-10)[y]		Mortality 9-21-77[v] (%)	Phytotoxicity rating 6-9-78[v] (0-10)[y]	Plant height 10-18-78[v]	
	Lb/A	Kg/ha	A[x]	B[w]			(inches)	(cm)
Check	-	-	0a[t]	1.1a	0a[s]	0.7a[s]	20.1a	51.0a[s]
Dichlobenil 4G	4	4.5	0a	1.5ab	0a	1.2ab	18.6a	47.3a
Simazine 80WP	6	6.7	6.7cd	4.0bc	40bc	8.0d	11.4cd	29.0cd
Simazine 80WP + alachlor 4EC[u]	6 + 4	6.7 + 4.5	8.1d	6.0cd	50c	8.4d	10.4d	26.5d
Simazine 80WP + napropamide 50WP[u]	6 + 4	6.7 + 4.5	1.5ab	6.0cd	6a	2.4b	14.2b	36.0b
Simazine 80WP + oryzalin 75WP[u]	6 + 4	6.7 + 4.5	4.3bc	5.6cd	20ab	4.6c	13.1bc	33.3bc
Oxadiazon 2G	4	4.5	0a	0.8a	0a	0.5a	20.5a	52.0a

[z] Planted April 27-28, 1977; postplant herbicide applications May 26, 1977 and April 15, 1978.

[y] Rated on a 0 to 10 scale: 0 = no injury; 10 = dead.

[x] No preplant residual herbicide.

[w] Simazine at 4 lb/A (4.5 kg/ha) September 29, 1976, before bark mulch was applied.

[v] Data only from the main plots not treated preplant with residual herbicides.

[u] Tank mix.

[t] Means in both columns followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

[s] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 41. Effects of postplant and preplant herbicide treatments on Japanese barberry.[z] Spokane, Irrigated.

Herbicides applied 5-26-77 and 4-15-78	Rate (active ingredient)		Phytotoxicity (0-10)[y]			
			9-21-77		6-19-78	
	Lb/A	Kg/ha	A[x]	B[w]	A	B
Check	-	-	2.9	0	1.7a[u]	1.9a
Dichlobenil 4G	4	4.5	2.3	1.5	3.0a	7.7b
Simazine 80WP	6	6.7	3.0	1.7	3.0a	7.5b
Simazine 80WP + alachlor 4EC[v]	6 4	6.7 4.5	1.8	1.0	1.9a	8.8b
Simazine 80WP + napropamide 50WP[v]	6 4	6.7 4.5	1.9	0.2	1.9a	8.3b
Simazine 80WP + oryzalin 75WP[v]	6 4	6.7 4.5	2.5	3.1	2.4a	9.0b
Oxadiazon 2G	4	4.5	2.4	0.1	2.7a	7.4b
Main plot means			2.4	1.1	2.3a	7.2b

[z] Planted April 27-28, 1977.

[y] Rated on a 0 to 10 scale: 0 = no injury; 10 = dead.

[x] Data in column A are from plots treated preplant with dichlobenil at 4 lb/A (4.5 kg/ha) September 29, 1976 before applying bark mulch.

[w] Data in column B are from plots treated with glyphosate applied at 2 lb/A (2.2 kg/ha) over the plants on October 7, 1977.

[v] Tank mix.

[u] Means in both columns followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 42. Effects of herbicides on phytotoxicity, plant mortality and plant size of 'Baltic' ivy.[z] Spokane, Irrigated.

Herbicides applied 5-26-77 and 4-15-78	Rate (active ingredient)		Phytotoxicity rating (0-10)[y]		Mortality 10-18-78 (%)	Plant width 10-18-78	
	Lb/A	Kg/ha	9-21-77	6-19-78		(inches)	(cm)
Check	-	-	0a[w]	5.9ab	13a	7.9bc	20bc
Dichlobenil 4G	4	4.5	0a	6.3abc	20a	9.8ab	25ab
Simazine 80WP	6	6.7	2.4b	6.8bc	53b	6.3c	16c
Simazine 80WP + alachlor 4EC[x]	6 + 4	6.7 + 4.5	2.2b	8.0c	57b	6.7c	17c
Simazine 80WP + napropamide 50WP[x]	6 + 4	6.7 + 4.5	2.3b	7.9c	57b	10.2ab	26ab
Simazine 80WP + oryzalin 75WP[x]	6 + 4	6.7 + 4.5	1.8b	5.5abc	57b	10.2ab	26ab
Oxadiazon 2G	4	4.5	0a	4.9a	7a	10.6a	27a

[z] Planted April 27-28, 1977.

[y] Rated on a 0 to 10 scale: 0 = no injury, 10 = dead.

[x] Tank mix.

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

Table 43. Effects of postplant herbicides on growth of landscape plants.[z] Spokane, Non-irrigated.

Herbicide[y]	Rate (active ingredient)		Plant height 4-16-79 (inches)			Plant height 4-16-79 (cm)		
	Lb/A	Kg/ha	Skunkbush sumac	Caragana	Red-osier dogwood	Skunkbush sumac	Caragana	Red-osier dogwood
Check	-	-	15.2b[w]	23.2c	29.0b	39b	59c	74b
Oxadiazon 2G + napropamide 50WP	4 + 4	4.5 + 4.5	15.6b	25.4bc	31.2ab	40b	65bc	79ab
Oxadiazon 2G + oryzalin 75WP	4 + 4	4.5 + 4.5	16.7ab	27.0abc	33.2a	42ab	69abc	84a
Simazine 80WP + napropamide 50WP[x]	4 + 4	4.5 + 4.5	15.8b	27.4abc	30.4ab	40b	70abc	77ab
Simazine 80WP + oryzalin 75WP[x]	4 + 4	4.5 + 4.5	16.7ab	28.8ab	30.2ab	42ab	73ab	77ab
Simazine 80WP + oxyfluorfen 2EC[x]	4 + 2	4.5 + 2.2	17.9a	31.5a	33.0a	45a	80a	84a
Dichlobenil 4G + oryzalin 75WP	4 + 4	4.5 + 4.5	16.3ab	27.7abc	30.2ab	41ab	70abc	77ab

[z] Planted March 14-15, 1978.

[y] Applied April 13-14, 1978.

[x] Tank mix.

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

Table 44. Effects of postplant herbicide treatments on plant size. Yakima.

Herbicides[z]	Rate (active ingredient)		Juniper width		Plant height 10-25-78[y] (inches)		Plant height 10-25-78[y] (cm)	
	Lb/A	Kg/ha	(inches)	(cm)	Forsythia	Staghorn sumac	Forsythia	Staghorn sumac
Check	-	-	21.2c[w]	54c	22.2c	47.5bc	56c	121bc
Oxadiazon 2G + napropamide 50WP	4 + 4	4.5 + 4.5	24.8[x]	63b	26.8b	54.5ab	68b	138ab
Oxadiazon 2G + oryzalin 75WP	4 + 4	4.5 + 4.5	27.1ab	69ab	27.5b	52.7ab	70b	134ab
Simazine 80WP + napropamide 50W[x]	4 + 4	4.5 + 4.5	28.7a	73a	28.8ab	50.7abc	73ab	129abc
Simazine 80WP + oryzalin 75WP[x]	4 + 4	4.5 + 4.5	29.3a	74a	29.1ab	44.4c	74ab	113c
Dichlobenil 4G + napropamide 50WP	4 + 4	4.5 + 4.5	27.5ab	70ab	28.0b	53.4ab	71b	136ab
Dichlobenil 4G + oryzalin 75WP	4 + 4	4.5 + 4.5	28.2a	72a	32.7a	57.7a	83a	147a

[z] Applied May 25-26, 1978.

[y] Planted April 26-27, 1978.

[x] Tank mix.

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

Table 45. Effect of preplant herbicide treatments on size of forsythia, 'Bar Harbor' juniper, and staghorn sumac plants.[z]

Herbicides applied in 1976	Herbicides applied 6-30-77	Rate in 1977 (active ingredient)[y] Lb/A	Rate in 1977 (active ingredient)[y] Kg/ha	Forsythia height (inches)	Forsythia height (cm)	'Bar Harbor' juniper width (inches	'Bar Harbor' juniper width (cm)
Amitrole-T	amitrole-T	4	4.5				
+ dalapon[x]	+ dicamba[x]	4	4.5	24.8[w]	63[w]	26.3[v]	67[v]
Glyphosate + napropamide	glyphosate	2	2.2	30.6	78	27.1	69
				Staghorn sumac height (inches)	Staghorn sumac height (cm)		
Glyphosate + paraquat	amitrole-T	4	4.5				
+ pronamide + oxadiazon	+ dicamba[x]	4	4.5	53.1[v]	135[v]		
Glyphosate + pronamide	glyphosate	2	2.2	50.0	127		

[z] Planted April 26-27, 1978.

[y] Rate of dicamba is expressed in terms of acid equivalent.

[x] Tank mix.

[w] Means within columns are significantly different at the 5% level.

[v] Means are not significantly different at the 5% level.

Table 46. Weed control from 1975-76 herbicide applications. Kinnikinnick Experiment 1.

Herbicide	Rate (active ingredient)[z] Lb/A	Rate (active ingredient)[z] Kg/ha	Date applied 1975	Date applied 1976	Grass control (0-10)[y] 1976 2-3	Grass control (0-10)[y] 1976 3-1	Weed control (%)[x] 7-27-76 Grass[w]	Weed control (%)[x] 7-27-76 Broadleaf[v]
Amitrole-T + dalapon[t] + diuron + bromacil[u]	2 + 12 2 + 2	4.5 + 13.4 2.2 + 2.2	7-9 9-23		10.0a[s]	-	59c	24bc
Dalapon + diuron + bromacil[u]	12 2 + 2	13.4 2.2 + 2.2	7-9 9-23		9.3a	-	40cd	0c
Diuron + bromacil[u] + amitrole-T	2 + 2 4	2.2 + 2.2 4.5	9-23	 2-6	0b	3.3b	14d	5c
Diuron + bromacil[u] + amitrole-T[t]	2 + 2 4	2.2 + 2.2 4.5		2-6 2-6	-	4.7b	98a	7c
Pronamide 50WP + amitrole-T + simazine 80WP + napropamide 50WP[t]	2.2 4 + 4 4	2.2 4.5 + 4.5 4.5	11-12	 2-6 2-6	1.0b	9.6a	62bc	50abc
Pronamide 50WP + amitrole-T + simazine 80WP + napropamide 50WP[t]	2 4 + 4 4	2.2 4.5 + 4.5 4.5	11-12	 4-22 4-22	2.7b	9.6a	94a	98a
Pronamide 50WP + dichlobenil 4G	2 6	2.2 6.7	11-12	 3-12	2.0b	9.2a	92ab	78ab
Glyphosate + simazine 80WP	2.7 4	3.0 4.5	9-23 11-12		10.0a	10.0a	90ab	0c[r]

[z] Rate of dalapon is expressed in terms of acid equivalent.

[y] Based on rating of injury to grass on a 0 to 10 scale: 0 = no injury, 10 = dead.

[x] Based on area covered compared with check plots.

[w] Grasses were predominantly creeping red fescue, sweet vernalgrass and colonial bentgrass.

[v] Broadleaf weeds were predominantly spotted catsear, smooth hawksbeard, and buckhorn plantain.

(continued)

Table 46. Weed control from 1975-76 herbicide applications. Kinnikinnick Experiment 1. - Cont.

[u] Applied in the combined formulation.

[t] Tank mix.

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

[r] Virginia pepperweed was predominant in this treatment.

Table 47. Experiment 1. Injury to kinnikinnick from 1975-76 herbicide applications. Kinnikinnick Experiment 1.

Herbicide	Rate (active ingredient)[z] Lb/A	Rate (active ingredient)[z] Kg/ha	Date applied 1975	Date applied 1976	Injury rating (0-10)[y] 1976 2-3	Injury rating (0-10)[y] 1976 7-8
Amitrole-T	4	4.5	7-9		4.0b[v]	2.0 ab
+ diuron + bromacil[x]	2 + 2	2.2 + 2.2	9-23			
Amitrole-T + dalapon[w]	4 + 12	4.5 + 13.4	7-9		8.7c	1.3ab
+ diuron + bromacil[x]	2 + 2	2.2 + 2.2	9-23			
Diuron + bromacil[x]	2 + 2	2.2 + 2.2	9-23		0.3a	2.5bc
+ amitrole-T	4	4.5		2-6		
Diuron + bromacil[x]	2 + 2	2.2 + 2.2		2-6	-	4.7c
+ amitrole-T[w]	4	4.5		2-6		
Pronamide 50WP	2	2.2	11-12		2.0ab	3.7bcd
+ amitrole-T + simazine 80WP[w]	4 + 4	4.5 + 4.5		2-6		
+ napropamide 50WP[w]	4	4.5		2-6		
Pronamide 50WP	2	2.2	11-12		1.0a	8.0d
+ amitrole-T + simazine 80WP[w]	4 + 4	4.5 + 4.5		4-22		
+ napropamide 50WP[w]	4	4.5		4-22		
Pronamide 50WP	2	2.2	11-12		1.0a	0a
+ dichlobenil 4G	6	6.7		3-12		
Glyphosate	2.7	3.0	9-23		2.0ab	0a
+ simazine 80WP	4	4.5	11-12			

[z] Rate of dalapon is expressed in terms of acid equivalent.

[y] Rated on a 0 to 10 scale: 0 = no injury, 10 = dead.

[x] Applied in the combined formulation.

[w] Tank mix.

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

Table 48. Effect of herbicide treatments, 1975 to 1977, on change in kinnikinnick area. Kinnikinnick Experiment 1.

Herbicide	Rate (active ingredient)[z]		Dates applied			Change in area (%)[y]
	Lb/A	Kg/ha	1975	1976	1977	8-11-77
Check	-	-				-22d
Amitrole-T + dalapon	4 + 12	4.5 + 13.4	7-9			+50bc
+ diuron + bromacil[x]	2 + 2	2.2 + 2.2	9-23			
Diuron + bromacil[x]	2 + 2	2.2 + 2.2		2-6		+24cd
+ amitrole-T[w]	4	4.5		2-6		
+ dichlobenil 4G	6	6.7			2-25	
Pronamide 50WP	2	2.2	11-12	11-9	11-30	+122a
+ amitrole-T	4	4.5		2-6		
+ simazine 80WP + napropamide 50WP[w]	4 + 4	4.5 + 4.5		2-6	2-16	
Pronamide 80WP	2	2.2	11-12	11-9	11-30	+50bc
+ amitrole-T	4	4.5		4-22		
+ simazine 80WP + napropamide 50WP[w]	4 + 4	4.5 + 4.5		4-22	2-16	
Pronamide 80WP	2	2.2	11-12	11-9	11-30	+100ab
+ dichlobenil 4G	6	6.7		3-12	2-25	

[z] Rate of dalapon is expressed in terms of acid equivalent.

[y] Percent increase (+) or decrease (-) in plot area covered with kinnikinnick.

[x] Applied in combined formulation.

[w] Tank mix.

[v] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 49. Effects of herbicide applications, 1975 to 1978, on area covered by kinnikinnick. Kinnikinnick Experiment 1.

Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Dates applied 1975	Dates applied 1976	Dates applied 1977	Dates applied 1978	Change in area (%)[z] 9-13-78	Change in area (%)[z] 6-20-79
Check	-	-					-40bc[w]	-70b
Diuron + bromacil[y]	2 + 2	2.2 + 2.2		2-6		3-16	+54ab	+104a
+ amitrole-T	4	4.5		2-6				
+ dichlobenil 4G	6	6.7			2-25			
Diuron + bromacil[y]	3 + 3	3.4 + 3.4		2-6		3-16	+91a	+117a
+ amitrole-T	4	4.5		2-6				
+ dichlobenil 4G	6	6.7			2-25			
Pronamide WP	2	2.2	11-12	11-9	11-30		+133a	+130a
+ amitrole-T	4	4.5		2-6				
+ simazine 80WP + napropamide 50WP[x]	4 + 4	4.5 + 4.5		2-6	2-16	3-16		
+ fosamine	4	4.5			9-13	9-13		
Pronamide 50WP	2	2.2	11-12	11-9	11-30		+128a	+102a
+ dichlobenil 4G	6	6.7		3-12	2-25	3-10		
+ fosamine	4	4.5				9-13		
Pronamide 50WP	2	2.2	11-12	11-9	11-30		+100a	+176a
+ amitrole-T	4	4.5		4-22				
+ simazine 80WP + napropamide 50WP[x]	4 + 4	4.5 + 4.5		4-22	2-16	3-16		
Hexazinone	8	9.0	11-12				-73c	-
Tebuthiuron 80WP	3	3.4	11-12				-94c	-

[z] Percent increase (+) or decrease (-) in plot area covered with kinnikinnick.

[y] Applied in combined formulation.

[x] Tank mix.

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

Table 50. Control of Pacific blackberry with fosamine. Kinnikinnick Experiment 1.

Herbicide	Rate (active ingredient)		Dates applied		Change in area (%)[z]		
	Lb/A	Kg/ha	1977	1978	9-13-78	5-16-79	6-20-79
Fosamine[y]	4	4.5	9-13	9-13	-81	-100	-100
Fosamine[y]	4	4.5	-	9-13	+30	-97	-88
Check	-	-	-	-	+238	+150	+175

[z] Percent decrease (-) or increase (+) in area covered.

[y] Surfactant WK added at 0.25%.

Table 51. Effect of herbicides on kinnikinnick appearance and growth. Kinnikinnick Experiment 2.

Herbicide	Rate (active ingredient)[z] Lb/A	Rate (active ingredient)[z] Kg/ha	Injury 7-18-77 (0-10)[y]	Change in area (%)[x] 9-19-78	Change in area (%)[x] 6-20-79
Check	-	-	-	-24c	-24c
Diuron + bromacil[w] + simazine 80WP[v]	3 + 3 + 6	3.4 + 3.4 + 6.7	0.7a[s]	+47abc	+80abc
Diuron + bromacil[w] + simazine 80WP[v]	5 + 5 + 6	5.6 + 5.6 + 6.7	0.5a	+32abc	+43bc
Diuron 80WP + simazine 80WP[w]	5 + 6	5.6 + 6.7	1.0a	+33abc	+41bc
Diuron 80WP + simazine 80WP[w]	10 + 6	11.1 + 6.7	1.2a	+79a	+153ab
Diuron + bromacil + dichlobenil 4G	5 + 5 + 8	5.6 + 5.6 + 9.0	0.5a	-[r]	-[r]
Diuron + dichlobenil 4G	5 + 8	5.6 + 9.0	2.0ab	+23abc	+34bc
Bromacil 80WP + dichlobenil 4G	5 + 8	5.6 + 9.0	3.5b	0bc	+22bc
Dichlobenil 4G[u]	8	9.0	1.3a	+62ab	+89abc
Dichlobenil 4G	8	9.0	0.5a	+78ab	+64abc
Pronamide 50WP + dichlobenil 4G	4 + 8	4.5 + 9.0	1.1a	+102a	+150ab
Glyphosate[t] + diuron + bromacil + simazine 80WP	2 3 + 3 + 6	2.2 3.4 + 3.4 + 6.7	0.5a	+97a	+191a

[z] Rates were reduced in 1978 as follows:

	Lb/A 1977	Lb/A 1978	Kg/ha 1977	Kg/ha 1978
Diuron and bromacil	3, 5, 10	2, 3, 6	3.4, 5.6, 11.1	2.2, 3.4, 6.7
Simazine	6, 12	4, 8	6.7, 13.4	4.5, 9.0
Dichlobenil	8	6	9.0	6.7

[y] Rated on a 0 to 10 scale: 0 = no injury, 10 = dead.

(continued)

Table 51. Effect of herbicides on kinnikinnick appearance and growth. Kinnikinnick Experiment 2 - Cont.

[x] Percent increase (+) or decrease (-) in area covered by kinnikinnick.

[w] Applied in combined formulation.

[v] Tank mix.

[u] Applied November 9, 1976 and November 29, 1977. All other residual herbicides applied February 18, 1977 and March 16, 1978.

[t] Applied September 30, 1976.

[s] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

[r] Data omitted because of excessive variation among replications.

Appendix A

Weed Species
(Including woody plants)
Listed alphabetically by common name

Common name	Scientific name
alfalfa	Medicago sativa L.
barley, foxtail	Hordeum jubatum L.
barnyardgrass	Echinochloa crus-galli (L.) Beauv.
bentgrass, colonial	Agrostis tenuis Sibth.
bindweed, field [morning glory]	Convolvulus arvensis L.
bittercress	Cardamine oligosperma Nutt.
blackberry, Pacific [Douglas berry, dewberry]	Rubus ursinus Cham. & Schlecht.
blackberry, evergreen	Rubus lacinatus Willd.
blackberry, Himalayan	Rubus procerus Muell.
bluegrass, Kentucky	Poa pratensis L.
brome, downy [cheatgrass]	Bromus tectorum L.
broom, Scotch	Cytisus scoparius (L.) Link.
buckwheat, wild	Polygonum convolvulus L.
burnweed, Australian	Erechtites prenanthoides (A. Rich) DC.
catsear, spotted [false dandelion]	Hypochaeris radicata L.
chickweed, common	Stellaria media (L.) Cyrillo
chickweed, mouseear	Cerastium vulgatum L.
clover, red	Trifolium pratense L.
clover, white	Trifolium repens L.
dandelion, common	Taraxacum officinale Weber
fescue, creeping red	Festuca rubra L.
fescue, hard	Festuca ovina L.
fescue, rattail	Festuca myuros L.
fescue, tall	Festuca arundinacea Schreb.
filaree, redstem	Erodium cicutarium (L.) L'Hér.
groundsel, common	Senecio vulgaris L.
hawksbeard, smooth [fall dandelion]	Crepis capillaris (L.) Wallr.
horsetail, field	Equisetum arvense L.
knotweed, prostrate	Polygonum aviculare L.
lambsquarters, common	Chenopodium album L.
lettuce, prickly [China lettuce]	Lactuca serriola L.
mallow, common	Malva neglecta Wallr.

(continued)

Appendix A

Weed species listed by common name. - continued

Common name	Scientific name
medic, black [Japanese clover]	*Medicago lupulina* L.
mustard, tumble	*Sisymbrium altissimum* L.
orchardgrass	*Dactylis glomerata* L.
pepperweed, Virginia	*Lepidium virginicum* L.
pigweed, redroot	*Amaranthus retroflexus* L.
plantain, buckhorn	*Plantago lanceolata* L.
puncturevine	*Tribulus terrestris* L.
quackgrass	*Agropyron repens* (L.) Beauvois
ryegrass, perennial	*Lolium perenne* L.
salmonberry	*Rubus spectabilis* Pursh.
salsify	*Tragopogon* spp.
skeletonweed, rush	*Chondrilla juncea* L.
sowthistle, annual	*Sonchus oleraceus* L.
sweetclover, white	*Melilotus alba* Desr.
thistle, bull	*Cirsium vulgare* (Savi) Tenore
thistle, Russian	*Salsola kali* L. var. *tenuifolia* Tausch
toadflax, Dalmatian	*Linaria dalmatica* (L.) Mill.
trefoil, birdsfoot	*Lotus corniculatus* L.
velvetgrass	*Holcus lanatus* L.
vernalgrass, sweet	*Anthoxanthum odoratum* L.
vetch, common	*Vicia sativa* L.
vetch, tiny	*Vicia hirsuta* (L.) S. F. Gray
wheatgrass, crested	*Agropyron cristatum* (L.) Gaertn.

Appendix A

Weed Species

(Including woody plants)

Listed alphabetically by scientific name

Scientific name	Common name
Agropyron cristatum (L.) Gaertn.	crested wheatgrass
Agropyron repens (L.) Beauvois	quackgrass
Agrostis tenuis Sibth.	colonial bentgrass
Amaranthus retroflexus L.	redroot pigweed
Anthoxanthum odoratum L.	sweet vernalgrass
Bromus tectorum L.	downy brome [cheatgrass]
Cardamine oligosperma Nutt.	bittercress
Cerastium vulgatum L.	mouseear chickweed
Chenopodium album L.	common lambsquarters
Chondrilla juncea L.	rush skeletonweed
Cirsium vulgare (Savi) Tenore	bull thistle
Convolvulus arvensis L.	field bindweed [morning glory]
Crepis capillaris (L.) Wallr.	smooth hawksbeard [fall dandelion]
Cytisus scoparius (L.) Link	Scotch broom
Dactylis glomerata L.	orchardgrass
Echinochloa crus-galli (L.) Beauv.	barnyardgrass
Equisetum arvense L.	field horsetail
Erechtites prenanthoides (A. Rich) DC.	Australian burnweed
Erodium cicutarium (L.) L'Hér.	redstem filaree
Festuca arundinacea Schreb.	tall fescue
Festuca myuros L.	rattail fescue
Festuca ovina L.	hard fescue
Festuca rubra L.	creeping red fescue
Holcus lanatus L.	velvetgrass
Hordeum jubatum L.	foxtail barley
Hypochaeris radicata L.	spotted catsear [false dandelion]
Lactuca serriola L.	prickly lettuce [China lettuce]
Lepidium virginicum L.	Virginia pepperweed
Linaria dalmatica (L.) Mill.	Dalmatian toadflax
Lolium perenne L.	perennial ryegrass
Lotus corniculatus L.	birdsfoot trefoil

(continued)

Appendix A

Weed species listed by scientific name. - continued

Scientific name	Common name
Malva neglecta Wallr.	common mallow
Medicago lupulina L.	black medic [Japanese clover]
Medicago sativa L.	alfalfa
Melilotus alba Desr.	white sweet clover
Plantago lanceolata L.	buckhorn plantain
Poa pratensis L.	Kentucky bluegrass
Polygonum aviculare L.	prostrate knotweed
Polygonum convolvulus L.	wild buckwheat
Rubus spectabilis Pursh.	salmonberry
Rubus ursinus Cham. & Schlecht.	Pacific blackberry [Douglas berry, dewberry]
Rubus lacinatus Willd.	evergreen blackberry
Rubus procerus Muell.	Himalayan blackberry
Salsola kali L. var. tenuifolia Tausch	Russian thistle
Senecio vulgaris L.	common groundsel
Sisymbrium altissimum L.	tumble mustard
Sonchus oleraceus L.	annual sowthistle
Stellaria media (L.) Cyrillo	common chickweed
Taraxacum officinale Weber	common dandelion
Tragopogon spp.	salsify
Tribulus terrestris L.	puncturevine
Trifolium pratense L.	red clover
Trifolium repens L.	white clover
Vicia hirsuta (L.) S. F. Gray	tiny vetch
Vicia sativa L.	common vetch

Authority for common and scientific names of weeds in these lists is the 1971 Report of the Terminology Committee of Weed Science Society of America, Subcommittee on Standardization of Common and Botanical Names of Weeds. Weed Science 19:435-476.

For species not listed in that report, the authority is Hitchcock, C. Leo, Arthur Cronquist, Marion Ownbey, and J. W. Thompson. 1969. Vascular Plants of the Pacific Northwest. Univ. of Wash. Press.

Appendix B

Landscape plants used in the project

Location	Common name	Scientific name
SeaTac Rest Area	California privet	Ligustrum ovalifolium Hassk.
	Staghorn sumac	Rhus typhina L.
	Snowberry	Symphoricarpus albus (L.) S. F. Blake
	Oregon grape	Mahonia Aquifolium (Pursh) Nutt.
	Evergreen huckleberry	Vaccinium ovatum Pursh.
	Salal	Gaultheria Shallon Pursh.
Tukwila	'Lalandei' firethorn	Pyracantha coccinea 'Lalandei' M. J. Roem
	Shrubby cinquefoil	Potentilla fruticosa L.
	Forsythia	Forsythia suspensa (Thunb.) Vahl
	Japanese photinia	Photinia glabra (Thunb.) Maxim.
	Salal	Gaultheria Shallon Pursh.
	Snowberry	Symphoricarpus albus (L.) S. F. Blake
Walla Walla	Rugosa rose	Rosa rugosa Thunb.
	Shrubby cinquefoil	Potentilla fruticosa L.
	Red-osier dogwood	Cornus sericea L.
	St. Johns-Wort	Hypericum calycinum L.
	Mugho pine	Pinus mugo var. mugo Turra
Spokane-Irrigated	Paxistima (Cliff-green)	Paxistima Canbyi Raf.
	'Moonlight' broom	Cytisus X praecox Bean
	'Baltic' ivy	Hedera Helix 'Baltica' L.
	Japanese barberry	Berberis Thunbergii DC
	Boston ivy	Parthenocissus tricuspidata (Siebold & Zucc.) Planch.
	'Tamariscifolia' juniper	Juniperus sabina 'Tamariscifolia' L.
Spokane-Non-Irrigated	Ponderosa pine	Pinus ponderosa Dougl. ex. P. Laws & C. Laws
	Scots (Scotch) pine	Pinus sylvestris L.
	Red-osier dogwood	Cornus sericea L. (C. stolonifera Michx.)
	Caragana (Siberian pea tree)	Caragana arborescens Lam.
	Skunkbush sumac	Rhus trilobata Nutt.
	Sand cherry	Prunus pumila L.

(Continued)

Appendix B - Continued

Location	Common name	Scientific name
Yakima	Forsythia	Forsythia suspense (Thunb.) Vahl
	'Bar Harbor' juniper	Juniperus horizontalis 'Bar Harbor' Moench.
	Snowberry	Symphoricarpus albus (L.) S. F. Blake
	Spirea	Spirea Thunbergii Siebold x Blume
	Staghorn sumac	Rhus typhina L.
	Boston ivy	Parthenocissus tricuspidata (Siebold & Zucc.) Planch.
State Road 8, west of Olympia	Kinnikinnick (Common bearberry)	Arctostaphylos Uva-ursi [L.] Spreng.
State Road 101, southwest of South Bend	Salal	Gaultheria shallon Pursh.

Authority for names on this list is Hortus Third. Liberty Hyde Bailey and Ethel Zoe Bailey. Revised and expanded by Liberty Hyde Bailey Hortorium. 1976.

Appendix C

Tolerance of ornamental plants to herbicides.

Plant	Herbicide	Rate (active ingredient) Lb/A	Kg/ha	Injury	Reference
Barberry (B. verruculosa)	Simazine	6	6.7	None	3
	Dichlobenil	4.8	5.25	None	114
Barberry	Simazine	2 to 18	2.2 to 20.2	None	3,37
	Dichlobenil	4	4.5	None	37
Barberry, Japanese	Dichlobenil	2.7, 5.4	3,6 Spring	None	62
	Dichlobenil	2.7, 5.4	3,6 Fall	Injury	62
	Pronamide	2.2	2.5	None	2
Broom (C. elongatus)	Dichlobenil	4.8	5.25	Injury	114
Caragana	Simazine	2 to 9	2.2 to 10.1	None	50,93
Dogwood (C. florida)	Napropamide	2 to 16	2.2 to 17.9	None	27
	Alachlor	2 to 16	2.2 to 17.9	None	27
Dogwood, red-osier	Simazine	1, 6, 10	1.1, 6.7, 11.2	None	102,112
	Pronamide	1.5	1.7	None	102
	Alachlor	2	2.2	None	27
	Alachlor	4 to 16	4.5 to 17.9	Slight	27
	Alachlor	2 to 16	2.2 to 17.9	None	27[z]
	Oxadiazon	2 to 8	2.2 to 9.0	Slight	27
	Oxadiazon	16	17.9	Severe	27
Firethorn, 'Lalandei'	Alachlor	1 to 8	1.1 to 9.0	Slight	54
	Oryzalin	1 to 8	1.1 to 9.0	None	54
	Oxadiazon	1 to 8	1.1 to 9.0	None	54
	Napropamide	1 to 8	1.1 to 9.0	None	54
	Simazine	1 to 2	1.1 to 2.2	Slight	54
	Simazine	4 to 8	4.5 to 9.0	Moderate	54
	Alachlor	5 to 8	5.6 to 9.0	None	26

[z] Different location than preceding two lines.

(continued)

Appendix C

Tolerance of ornamental plants to herbicides - continued.

	Alachlor	4 to 8	4.5 to 9.0		
	+ simazine	1 to 1.6	1.1 to 1.8	None	26
	Napropamide	4	4.5		
	+ simazine	1	1.1	None	26
	Oryzalin	2			
	+ simazine	1	1.1	None	26
	Oxadiazon	2	2.2		
	+ simazine	1	1.1	None	26
	Pronamide	4	4.5	None	26
Firethorn (*P. coccinea*)	Dichlobenil	10	11.2	None	66
	Simazine	4	4.5	None	66
Forsythia	Dichlobenil	4, 6		None	4,37
	Dichlobenil	4, 6		Slight	5
	Simazine	2		Slight	5,37
	Simazine	1		Injury	102
	Simazine	3		Slight	4
	Simazine	4.5		Injury	4
	Simazine	2 to 4		None	27
	Alachlor	2 to 16		None	25,26,27,47,96
	Alachlor	4 to 8			
	+ simazine	1 to 2		None	23,26,47,96
	Alachlor	4 to 8			
	+ simazine	1.5		Injury	11
	Napropamide	2 to 16	2.2 to 18	None	23,25,27
	Napropamide	8	9		
	+ simazine	2	2.2	None	23
	Oryzalin	2 to 4	2.2 to 4.5	None	11
	Oryzalin	2 to 4	2.2 to 4.5		
	+ simazine	1.5	1.7	Injury	11
	Oxadiazon	2 to 16	2.2 to 18	None	11,27
	Pronamide	1.5 to 4	1.7 to 4.5	None	23,26,102
Ivy, English	Dichlobenil	3 to 6	3.4 to 6.7	None	37,75
	Simazine	2 to 6	2.2 to 18	None	20,37,75
	Alachlor	2 to 16	2.2 to 18	None	27
	Napropamide	2 to 16	2.2 to 18	None	27
	Oxadiazon	2 to 16	2.2 to 18	None	27

(continued)

Appendix C

Tolerance of ornamental plants to herbicides - continued.

Juniper	Dichlobenil	5, 10	5.6, 11.2	None	12
	Simazine	1.6 to 18	1.8 to 20.2	None	3,12
Juniper, Andorra	Simazine	2 to 4	2.2 to 4.5	None	29,93
	Alachlor	5, 6	5.6, 6.7		
	+ simazine	1.5	1.7		9,23
	Oryzalin	2 to 4	2.2 to 4.5		9
	Oryzalin	2	2.2		
	+ simazine	1.5	1.7		9
	Napropamide	4 to 8	4.5 to 9		23
	Napropamide	4, 8	4.5, 9		
	+ simazine	1, 2	1.1, 2.2		19,23
	Oxadiazon	2, 4	2.2, 4.5		9
	Pronamide	1.5	1.7	None	23
Juniper, Compact Andorra	Simazine	3, 7.5	3.4, 8.4	None	103
	Simazine	15	16.8	Slight	103
	Simazine	30, 60	34, 66	Injury	103
	Oryzalin	2, 4	2.2, 4.5	None	11
	Oxadiazon	3, 4	3.4, 4.5	None	11
Juniper 'Wiltoni'	Simazine	1 to 4	1.1 to 4.5	None	52
	Alachlor	2 to 8	2.2 to 9.0	None	52, 96
	Alachlor	4, 8	4.5, 9.0		
	+ simazine	1 to 2	1.1 to 2.2	None	11,96
	Napropamide	2 to 8	2.2 to 9.0	None	52
Juniper (_J. sabina_)	Simazine	1 to 6	1.1 to 6.7	None	3,52
	Alachlor	2 to 8	2.2 to 9.0	None	52
	Napropamide	2 to 4	2.2 to 4.5	None	52
Kinnikinnick	Simazine	1	1.1	None	52
	Simazine	2 to 4	2.2 to 4.5	Injury	52
	Alachlor	2 to 8	2.2 to 9.0	None	52
	Napropamide	2 to 8	2.2 to 9.0	None	52
Oregon grape	Simazine	4 to 8	4.5 to 9.0	None	87
	Dichlobenil (Spring)	2.7, 5.4	3, 6	None	62
	Dichlobenil (Fall)	2.7, 5.4	3, 6	Injury	62

(continued)

Appendix C

Tolerance of ornamental plants to herbicides - continued

Pine	Simazine	6 to 18	6.7 to 20.1	None	3
Pine, Ponderosa	Simazine	2	2.2	None	112
Pine, Scots	Simazine	2 to 8	2.2 to 9.0	None	49,112
	Pronamide	2.2	2.4	None	2
Pine, White	Alachlor	6	6.7	None	25
	Alachlor	4 to 8	4.5 to 9.0		
	+ simazine	1.5	1.7	None	9,11,23
	Oryzalin	2 to 4	2.2 to 4.5	None	9,11
	Napropamide	4 to 8	4.5 to 9.0	None	23,25
	Napropamide	8	9.0		
	+ simazine	2	2.2	None	23
	Oxadiazon	2 to 4	2.2 to 4.5	None	11
	Pronamide	1.5	1.7	None	23
Pine (*P. thunbergii*)	Alachlor	5 to 8	5.6 to 9.0	None	26
	Alachlor	8	9.0		
	+ simazine	1.6	1.8	None	26
	Pronamide	4	4.5	None	26
Potentilla	Simazine	1	1.1	Injury	102
	Dichlobenil (Spring)	3, 6	3.4, 6.7	None	62
	Dichlobenil (Fall	3, 6	3.4, 6.7	Injury	62
	Pronamide	1.5	1.7	None	102
Privet, California	Simazine	6, 10	6.7, 11.2	None	112
	Simazine	4	4.5	None	20
	Simazine	8	9.0	None	20
	Alachlor	2 to 16	2.2 to 18	None	26,27
	Alachlor	1 to 1.6	1.1 to 1.8		
	+ simazine	4 to 8	4.5 to 9.0	None	9,21,23,26
	Oryzalin	2 to 4	2.2 to 4.5	None	9
	Oryzalin	2	2.2		
	+ simazine	1.5	1.7	None	9
	Napropamide	2 to 8	2.2 to 9.0	None	23,27
	Napropamide	8	9		
	+ simazine	2	2.2	None	23
	Pronamide	4	4.5	None	26
	Oxadiazon	2 to 16	2.2 to 18	None	9,27

(continued)

Appendix C

Tolerance of ornamental plants to herbicides - continued

Privet, Wax leaf	Simazine	1.6 to 4.8	1.8 to 5.4	Injury	12
	Dichlobenil	5 to 10	5.6 to 11.2	Injury	12
Privet (_L. japonicum_)	Dichlobenil (3 applic.)	4, 8	4.5, 9.0	Slight	34
Snowberry	Simazine	2	2.2	Slight	5
	Simazine	6, 10	6.7, 11.2	None	112
	Dichlobenil	4, 6	4.5, 6.7	Slight	5
Spirea (_S. bumalda_)	Dichlobenil (Spring)	3, 6	3.4, 6.7	None	62
	Dichlobenil (Fall)	3, 6	3.4, 6.7	Injury	62
Spirea (_S. nipponica_)	Simazine	1	1.1	Severe	102
	Alachlor	2.5	2.8	Injury	102
	Napropamide	1.5	1.7	None	102
Spirea, Douglas	Simazine	6	6.7	Slight	112
	Simazine	10	11.2	Severe	112
Spirea, Van Houtei	Simazine	4.5	5.0	Injury	4
	Dichlobenil	4, 6	4.5, 6.7	None	4

Appendix D

Precipitation at SeaTac Airport 1975-1977, and irrigation at Tukwila.

1975	(inches)	(cm)	1976	(inches)	(cm)	1977	(inches)	(cm)
July 1	T	T	January	5.55	14.10	January	1.77	4.50
2	.02	.05	February	4.74	12.04	February	1.58	4.01
11-17	.14	.36	March	2.71	6.88	March	3.80	9.65
28	.01	.03	April	1.67	4.24	April 8-9	.10	.25
29	.01	.03	May	1.61	4.09	11-13	.14	.36
August 7-8	.13	.33	June 1-3	T	T	15-16	.11	.28
16-18	1.81	4.60	4-10	T	T	21-27	.20	.51
22-30	2.65	6.73	11-12	.23	.58	May	3.70	9.40
September	T	T	13-16	.40	1.02	June	.54	1.37
October	7.75	19.69	17-30	T	T	July	.42	1.07
November 1-11	1.48	3.76	July	1.17	2.97	August	3.59	9.12
13-17	2.11	5.36	August 1-25	2.69	6.83	September	2.55	6.48
21-30	1.48	3.76	27	.02	.05	October	2.60	6.60
December	7.66	19.46	September 1-4	T	T	November	5.27	13.39
			5-6	.55	1.40	December	6.47	16.43
			11-22	.69	1.76			
			23-30	.01	.03			
			October 2	.16	.41			
			5-11	.07	.18			
			24-31	1.83	4.65			
			November	.74	1.88			
			December	1.86	4.72			

Irrigation, 1976, 1977, 1978: June 1 to September 30, 0.14 to 0.18 inch (0.36 to 0.46 cm) 3 times per week.

Appendix E

Precipitation and irrigation at Walla Walla.

Precipitation 1976				Precipitation 1977				Precipitation 1978			
		(inches)	(cm)			(inches)	(cm)			(inches)	(cm)
May	1-22	.49	1.2	Jan.		.55	1.40	Jan.		2.42	6.15
	23	.05	.13	Feb.		.64	1.63	Feb.		1.42	3.61
	27	.25	.64	Mar.		.98	2.49	Mar.	1-23	.98	2.49
	30-31	.38	.97	April		.20	.51		31	.09	.23
June	1-15	.32	.81	May	1-3	.62	1.57	April	1	.69	1.75
	16-21	.29	.74		7-19	.15	.38		2-7	.24	.61
July	7-12	.30	.76		23-27	.54	1.37		13-22	1.27	3.23
Aug.	1	.19	.48	June		.35	.89		26-27	1.06	2.69
	2	.08	.20	July		.34	.86	May		.68	1.73
	5-8	.48	1.22	Aug.		2.94	7.47	June		.61	1.55
	13-15	.45	1.14	Sept.	3	.01	.03	July		.81	2.06
	20-25	.32	.81		19-29	1.17	2.97	Aug.		2.29	5.82
Sept.	6-21	.11	.28	Oct.		.49	1.24	Sept.		.99	2.51
Oct.	1	.01	.03	Nov.		2.03	5.16	Oct.		.03	.08
	2	.24	.61	Dec.		3.83	9.73	Nov.		2.38	6.05
	24-25	.46	1.17					Dec.		2.29	5.82
	31	.90	2.29								
Nov.		.31	.79								
Dec.		.75	1.91								

Irrigation 1977 and 1978: May 1 to October 1, 0.4 inches (1.0 cm) every other day.

Appendix F

Precipitation and irrigation at Spokane.

Precipitation 1976				Precipitation 1977				Precipitation 1978			
		(inches)	(cm)			(inches)	(cm)			(inches)	(cm)
May	2-21	.70	1.78	Jan.		.52	1.32	Jan.		2.36	5.99
	23	.04	.10	Feb.		.65	1.65	Feb.		1.70	4.32
	25	.02	.05	Mar.		1.34	3.40	Mar.		.85	2.16
	28	.18	.46	April		.12	.30	Apr.	2-5	1.10	2.79
	31	.38	.97	May	1-4	.58	1.47		16	.28	.71
June	1-2	.04	.10		10-12	.30	.76		20-23	.71	1.80
	8-9	.35	.89		17-23	1.16	2.95		27-28	.74	1.88
	16-17	.17	.43		26-27	.07	1.78	May		3.17	8.05
	21-22	.37	.94		30	.04	1.27	June		1.35	3.43
July	1-8	.62	1.57	June	2-4	.34	.86	July		1.78	4.52
	20	.04	.10		8	.85	2.16	Aug.		2.41	6.12
	30	.02	.05		12	.08	2.03	Sept.		1.64	4.17
Aug.	1-4	.31	.79	July		.24	.61	Oct.		.12	.30
	7-9	.18	.46	Aug.		.53	1.35	Nov.		1.61	4.09
	16-26	1.77	4.49	Sept.		1.30	3.30	Dec.		1.82	4.62
Sept.	6	.01	.03	Oct.		.49	1.24				
Oct.	9	.01	.03	Nov.		2.46	6.25				
	25-28	.30	.76	Dec.		4.63	11.76				
Nov.		.68	1.73								
Dec.		3.86	9.80								

Irrigation 1977 and 1978: April 15 to October 1, 0.16 inches (0.4 cm) every day.

Appendix G

Precipitation and irrigation at Yakima.

Precipitation 1976				Precipitation 1977				Precipitation 1978			
		(inches)	(cm)			(inches)	(cm)			(inches)	(cm)
May	2-10	.04	.10	Jan.		.13	.33	Jan.		2.30	5.84
	23	.01	.03	Feb.		.69	1.75	Feb.		1.30	3.30
	27-29	.04	.10	Mar.		.23	.58	Mar.		.52	1.32
June	8	.53	1.35	Apr.		.01	.03	Apr.		.91	2.31
	15-16	.06	.15	May		.68	1.73	May	4-15	.28	.71
	30	.10	.25	June	1-4	.46	1.17	June		.32	.81
July		.26	.66	July		T	T	July		.29	.74
Aug.		.50	1.27	Aug.		1.16	2.95	Aug.		.38	.97
Sept.	5-22	.13	.33	Sept.	3	.02	.05	Sept.		.64	1.63
Oct.	1-5	.03	.08		18-21	.14	.36	Oct.		0	0
	24	.04	.10		23	.24	.61	Nov.		.94	2.39
Nov.		T	T		25-28	.49	1.24	Dec.		.14	3.56
Dec.		.07	.18	Oct.	6	.05	.13				
					28-29	.12	.30				
				Nov.		.70	1.78				
				Dec.		2.80	7.11				

Irrigation 1978: April 1 to October 1, 0.05 inches (0.13 cm) every day.

Appendix H

Control of broadleaf weeds by postplant herbicide applications. Spokane, Non-irrigated.

Herbicide[z]	Rate (active ingredient)		Weed control (%)[y]			
			7-20-78		10-18-78	
	Lb/A	Kg/ha	Wild buckwheat	Field bindweed	Field bindweed	Redstem filaree
Check	-	-	(15)[w]	(4)	(8)	(2)
Oxadiazon 2G + napropamide 50WP	4 + 4	4.5 + 4.5	68	87	80	98
Oxadiazon 2G + oryzalin 75WP	4 + 4	4.5 + 4.5	97	95	93	99
Simazine 80WP + napropamide 50WP[x]	4 + 4	4.5 + 4.5	74	26	56	56
Simazine 80WP + oryzalin 75WP[x]	4 + 4	4.5 + 4.5	78	74	40	90
Simazine 80WP + oxyfluorfen 2EC[x]	4 + 2	4.5 + 2.2	100	90	48	95
Dichlobenil 4G + oryzalin 75WP	4 + 4	4.5 + 4.5	97	50	68	84

[z] Applied April 13-14, 1978.

[y] Based on plot area covered compared with untreated check plots.

[x] Tank mix.

[w] Numbers in parenthesis are percent of check plot area covered.

Appendix I

Control of downy brome. Yakima.

Herbicide	Rate (active ingredient) Lb/A	Kg/ha	Dates applied 1978	Control 3-27-79[z] (%)
Check	-			(24)[y]
Oxadiazon 2G	4	4.5	5-25	
+ napropamide 50WP	4	4.5	5-25, 9-21	88
Simazine 80W	4	4.5	5-25	
+ napropamide 50WP	4	4.5	5-25, 9-21	79
Dichlobenil 4G	4	4.5	5-25	
+ napropamide 50WP	4	4.5	5-25, 9-21	96
Oxadiazon 2G	4	4.5	5-25	
+ oryzalin 75WP	4	4.5	5-25, 9-21	58
Simazine 80WP	4	4.5	5-25	
+ oryzalin 75WP	4	4.5	5-25, 9-21	46
Dichlobenil 4G	4	4.5	5-25	
+ oryzalin 75WP	4	4.5	5-25, 9-21	71

[z] Based on plot area covered compared with check plots. Data are from subplots in the main plots treated preplant with glyphosate only, with no preplant residual herbicide. No downy brome occurred in other main plots except 2 to 10% in untreated check subplots.

[y] Area covered in check plots.

Appendix J

Control of downy brome by pronamide. Yakima - Secondary plots.

Plot surface when sprayed	Herbicide applied 9-21-78	Rate (active ingredient)		Plot area covered 3-27-79 (%)
		Lb/A	Kg/ha	
Bark mulch	pronamide WP	2	2.2	1a[z]
	none	-	-	15b
No mulch	pronamide WP	2	2.2	0a
	none	-	-	2ab

[z] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Appendix K

Survival of evergreen huckleberry and salal.[z] SeaTac Rest Area.

Herbicide[y]	Rate (active ingredient) Lb/A	Kg/ha)	Survival 5-21-77 (%) Evergreen huckleberry	Salal
Check	-	-	93	80
Dichlobenil	4	4.5	90	97
Simazine	8	9.0	90	97
Simazine + napropamide	8 + 6	9.0 + 6.7	90	70
Oxadiazon	3	3.4	90	97
Oxadiazon	6	6.7	87	90
Oxadiazon + napropamide	3 + 6	3.4 + 6.7	87	90

[z] Planted October 16 to 24, 1975.

[y] Herbicides applied November 12 to 18, 1975 and September 23 to October 1, 1976, all in granular formulations.

Appendix L

Survival of landscape plants in treated and untreated plots. Spokane, Non-irrigated.

	Survival (%) 6-19-79[z]				
	Untreated preplant check	Untreated postplant check[y]	All combinations of preplant and postplant treatments[x]		
			Low	High	Mean[w]
Ponderosa pine	87	100	87	100	97
Scots pine	87	90	73	100	89
Sand cherry	80	100	100	100	100
Skunkbush sumac	53	90	80	100	91
Caragana	100	97	93	100	99
Red-osier dogwood	60	100	93	100	99

[z] Percent survival of 5 plants per plot, 3 replications, planted March 13-14, 1978.

[y] Untreated postplant, in 2 preplant treatments for each plant species (means for 30 plants).

[x] Figures in the first 2 columns are for 15 plants.

[w] Means for 180 plants in 12 treatment combinations (2 preplant x 6 postplant).

Appendix M

Weed control and injury to kinnikinnick from hexazinone, tebuthiuron and glyphosate with simazine. Kinnikinnick Experiment 1.

Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Dates applied 1975	Dates applied 1976	Dates applied 1977	Grass control (%)[z] 7-26-76	Grass control (%)[z] 4-24-77	Injury rating (0-10)[y] 7-8-76	Injury rating (0-10)[y] 1977 2-25	Injury rating (0-10)[y] 1977 4-24
Hexazinone	8	9.0	11-12		2-16	21bc[x]	99a	0a	1.0a	7.7bc
Tebuthiuron 80WP	3	3.4	11-12		2-16	14bc	73b	1.0ab	4.7bc	8.7c
Tebuthiuron 20G	6	6.7	11-12			24b	-	4.5d	9.0d	-
Tebuthiuron 80WP	6	6.7	11-12		2-16	7c	98a	1.0ab	6.0c	8.5c
Glyphosate + tebuthiuron 80WP + simazine 80WP	2.7 3 4	3.0 3.4 4.5	9-23 11-12	10-4 10-4	 2-16	94a	100a	3.5c	6.0c	6.5b
Glyphosate + simazine 80WP	2.7 4	3.0 4.5	9-23 11-12	 10-4	 2-16	90a	100a	0a	2.0ab	3.0a

[z] Based on area covered compared with check plots.

[y] Rated on a 0-10 scale: 0 = no injury, 10 = dead.

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

Appendix N

Control of grasses from 1977 and 1978 herbicide applications. Kinnikinnick Experiment 1.

Herbicides applied 1975-76	1977-1978 applications: Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Dates of application 1977	Dates of application 1978	Plot area covered (%) 8-11-77 All grasses[z]	9-13-78 Sweet vernalgrass	9-13-78 Bentgrass and fescue
Amitrole-T or dalapon	Pronamide 50WP	2	2.2	11-30		66 b[x]	6.5a	2
+ diuron + bromacil	+ dichlobenil 4G	6	6.7		3-10			
	Pronamide 50WP	2	2.2	11-30		73 bc	0 a	2
	+ simazine 80WP[y]	4	4.5	11-30	3-16			
Pronamide 50WP	Pronamide 50WP	2	2.2	11-30		0.4a	0 a	0
+ dichlobenil 4G	+ dichlobenil 4G	6	6.7	2-25	3-10			
Pronamide 50WP	Pronamide 50WP	2	2.2	11-30		0.2a	0 a	1
+ amitrole-T	+ simazine 80WP	4	4.5	2-16	3-10			
+ napropamide 50WP	+ napropamide 50WP[y]	4	4.5	2-16	3-10			
Tebuthiuron 80WP	Tebuthiuron 80WP	3	3.4	2-16		4 a	34 b	1
	+ dichlobenil 4G	6	6.7		3-10			
	Simazine 80WP	4	4.5	9-15	3-10	87 c	0 a	4
	Tebuthiuron 80WP	6	6.7	2-16		0.1a	0 a	0
	+ simazine 80WP	4	4.5	9-15	3-10			

[z] Includes creeping red fescue (40% of the area covered by grasses was covered by this species), sweet vernalgrass (32%), and colonial bentgrass (28%).

[y] Tank mix.

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

Appendix O

Effect of herbicides on appearance of kinnikinnick and plot area covered. Kinnikinnick Experiment 1.

Herbicide	Rate (active ingredient) Lb/A	Kg/ha	Dates applied 1975	1976	Change in area[z] 2-25-77 (%)	Injury rating[y] 2-25-77 (0-10)
Check	-	-	-	-	-9	0 a[v]
Diuron + bromacil[x]	2 + 2	2.2 + 2.2		2-6	+3	0 a
+ amitrole-T[w]	4	4.5		2-6		
Diuron + bromacil[x]	3 + 3	3.4 + 3.4		2-6	+16	1.7a
+ amitrole-T[w]	4	4.5		2-6		
Pronamide	2	2.2	11-12	11-9	+18	1.0a
+ amitrole-T + simazine 80WP	4 + 4	4.5 + 4.5		2-6		
+ napropamide 50WP[w]	4	4.5		2-6		
Pronamide 50WP	2	2.2	11-12	11-9	+52	0.3a
+ dichlobenil 4G	6	6.7		3-12		
Pronamide 50WP	2	2.2	11-12	11-9	-7	5.0b
+ amitrole-T + simazine 80WP	4 + 4	4.5 + 4.5		4-22		
+ napropamide 50WP[w]	4	4.5		4-22		

[z] Percent increase (+) or decrease (-) in plot area covered by kinnikinnick.

[y] Rated on a 0 to 10 scale: 0 = no injury, 10 = dead.

[x] Applied in combined formulation.

[w] Tank mix.

[v] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Appendix P

Scotch broom control. Kinnikinnick Experiment 2.

Herbicide	Rate[z] (active ingredient) Lb/A	Rate[z] (active ingredient) Kg/ha	Dates applied	Scotch broom control[y] 9-19-78 (%)
Diuron + bromacil[x] + simazine 80WP[w]	3 + 3 + 6	3.4 + 3.4 + 6.7	2-18-77, 3-16-78	83a[v]
Diuron + bromacil[x] + simazine 80WP[w]	5 + 5 + 6	5.6 + 5.6 + 6.7	2-18-77, 3-16-78	68ab
Diuron + simazine 80WP[w]	5 + 6	5.6 + 6.7	2-18-77, 3-16-78	68ab
Diuron + simazine 80WP[w]	10 + 6	11.2 + 6.7	2-18-77, 3-16-78	98a
Diuron + bromacil[x] + dichlobenil 4G	5 + 5 + 8	5.6 + 5.6 + 9.0	2-18-77, 3-16-78	89a
Diuron 80WP + dichlobenil 4G	5 + 8	5.6 + 9.0	2-18-77, 3-16-78	46abcd
Bromacil 80WP + dichlobenil 4G	5 + 8	5.6 + 9.0	2-18-77, 3-16-78	81abc
Dichlobenil 4G	8	9.0	11-9-76, 11-29-77	-13bcd
Dichlobenil 4G	8	9.0	2-17-77, 3-16-78	-19bcd
Pronamide 80WP + dichlobenil 4G	2 + 8	2.2 + 9.0	11-9-76, 11-29-77	16abcd
Pronamide 80WP + dichlobenil 4G	4 + 8	4.5 + 9.0	11-9-76, 11-29-77	-33d
Simazine 80WP	12	13.4	2-18-77, 3-16-78	19abcd
Glyphosate	2	2.2	9-30-76 -	63abc
+ diuron + bromacil[x] + simazine 80WP[w]	3 + 3 + 6	3.4 + 3.4 + 6.7	2-18-77, 3-16-78	

[z] Rates were reduced in 1978 as follows:

	Lb/A 1977	Lb/A 1978	Kg/ha 1977	Kg/ha 1978
Diuron and bromacil	3, 5, 10	2, 3, 6	3.4, 5.6, 11.2	2.2, 3.4, 6.7
Simazine	6, 12	4, 8	6.7, 13.4	4.5, 9.0
Dichlobenil	8	6	9.0	6.7

[y] Control based on plot area covered compared with area before treatment. Negative values indicate an increase in area covered.

[x] Applied in combined formulation.

[w] Tank mix.

[v] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Appendix Q

Weed control and injury to salal in April and July 1976 from 1975-76 herbicide applications. Salal Experiment 1.

Herbicide	Rate (active ingredient)[z] Lb/A	Rate (active ingredient)[z] Kg/ha	Date applied	Weed control (%) Grass 4-2[y]	Weed control (%) Grass 7-8[x]	Weed control (%) Spotted catsear 7-8[w]	Injury to salal (0-10)[v] 4-2
Check	-	-			(95)[s]	(20)	0.3a
Amitrole-T + diuron + bromacil[u]	4 2 + 2	4.5 2.2 + 2.2	7-9-75 9-30-75	0b[r]	4d	99a	2.7bc
Amitrole-T + dalapon + diuron + bromacil[u]	4 + 12 2 + 2	4.5 + 13.4 2.2 + 2.2	7-9-75 9-30-75	82a	19c	69ab	3.7c
Amitrole-T + diuron + bromacil[ut]	4 2 + 2	4.5 2.2 + 2.2	2-5-76 2-5-76	96a	95ab	57bc	2.3abc
Amitrole-T + diuron + bromacil[ut]	4 3 + 3	4.5 3.4 + 3.4	2-5-76 2-5-76	100a	99a	81ab	2.7bc
Pronamide 50WP + amitrole-T + dichlobenil 4G	2 4 6	2.2 4.5 6.7	11-13-75 2-5-76 2-5-76	100a	86b	97a	2.0abc
Amitrole-T + simazine 80WP[t] + alachlor 4EC	4 + 4 4	4.5 + 4.5 4.5	2-5-76 4-2-76	100a	88ab	93ab	1.0ab

[z] Rate of dalapon is expressed in terms of acid equivalent.

[y] Based on estimate of injury to grass.

[x] Based on area covered, compared with check plots.

[w] Based on area covered, compared with check plots, in Replication 2 and 3 only. Checks and adjacent plots of Replication 1 were very dry and had few broadleaf weeds.

[v] Rated on a 0 to 10 scale: 0 = no injury, 10 = dead.

[u] Applied as combined formulation.

[t] Tank mix.

[s] Numbers in parenthesis are percent of check plot area covered.

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

Appendix R

Weed control in September 1976 from 1975-76 herbicide applications. Salal Experiment 1.

Herbicide	Rate (active ingredient)[z] Lb/A	Rate (active ingredient)[z] Kg/ha	Date applied	Plot area covered 9-9-76 (%) Colonial bentgrass	Creeping red fescue	Sweet vernalgrass	Australian burnweed	Spotted catsear
Check	-	-		0a[w]	88e	8 ab	0.3a	2 a
Amitrole-T + diuron + bromacil[y]	4 2 + 2	4.5 2.2 + 2.2	7-9-75 9-30-75	23c	60d	15 b	0 a	0.7a
Amitrole-T + dalapon[x] + diuron + bromacil[y]	4 + 12 2 + 2	4.5 + 13.4 2.2 + 2.2	7-9-75 9-30-75	15b	40c	12 ab	0 a	33 b
Amitrole-T + diuron + bromacil[yx]	4 2 + 2	4.5 2.2 + 2.2	2-5-76 2-5-76	0a	10ab	1 a	28 b	12 ab
Amitrole-T + diuron + bromacil[yx]	4 3 + 3	4.5 3.4 + 3.4	2-5-76 2-5-76	0a	2a	0.1a	20 b	3 a
Pronamide 50WP + amitrole-T + dichlobenil 4G	2 4 + 6	2.2 4.5 + 6.7	11-13-75 2-5-76	0a	7a	47 c	0 a	2 a
Pronamide 50WP + amitrole-T + simazine 80WP[x] + alachlor EC	2 4 + 4 4	2.2 4.5 + 4.5 4.5	11-13-75 2-5-76 4-2-76	5a	25bc	4 ab	0.7a	32 b
Amitrole-T + simazine 80WP[x] + alachlor 4EC	4 + 4 4	4.5 + 4.5 4.5	2-5-76 4-2-76	2a	28c	1 a	0.4a	21 ab

[z] Rate of dalapon is expressed in terms of acid equivalent.

[y] Applied in combined formulation.

[x] Tank mix.

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

Appendix S

Effects of herbicide treatments on injury and area covered by salal. Salal Experiment 1.

Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Months applied	Injury (0-10)[z] 7-7-77	Change in area (%)[y] 9-8-78
Group 1					
Pronamide 50WP	2	2.2	11/75, 76, 77		
+ amitrole-T	4	4.5	2/76		
+ simazine 80WP	4	4.5	2/76, 3/77		
+ alachlor 4EC	4	4.5	4/76, 3/77	1.7a[w]	+122a
Pronamide 50WP	2	2.2	11/75, 76, 77		
+ amitrole-T	4	4.5	2/76		
+ dichlobenil 4G	6	6.7	2/76, 3/77	2.7a	-26b
Amitrole-T	4	4.5	2/76		
+ simazine 80WP	4	4.5	2/76, 3/77		
+ alachlor 4EC	4	4.5	4/76, 3/77	4.0ab	+17ab
Group 2					
Pronamide 50WP	2	2.2	11/75, 76, 77		
+ amitrole-T	4	4.5	2/76		
+ simazine 80WP	4	4.5	2/76, 3/77		
+ alachlor 4EC	4	4.5	4/76, 3/77		
+ bromacil + diuron[x]	3 + 3	3.4 + 3.4	3/77	7.0bc	-27b
Pronamice 50WP	2	2.2	11/75, 76, 77		
+ amitrole-T	4	4.5	2/76		
+ dichlobenil 4G	6	6.7	2/76, 3/77		
+ bromacil + diuron[x]	2 + 2	2.2 + 2.2	3/77	6.3bc	-69b
Amitrole-T	4	4.5	2/76		
+ simazine 80WP	4	4.5	4/76, 3/77		
+ alachlor 4EC	4	4.5	2/76, 3/77		
+ bromacil + diuron[x]	3 + 3	3.4 + 3.4	3/77	8.0c	-67b
Group 3					
Amitrole-T	4	4.5	2/76		
+ bromacil + diuron[x]	2 + 2	2.2 + 2.2	2/76, 3/77	5.3bc[w]	-6b
Amitrole-T	4	4.5	2/76		
+ bromacil + diuron[x]	3 + 3	3.4 + 3.4	2/76, 3/77	8.0c	-55b
Amitrole-T	4	4.5	2/76		
+ bromacil + diuron[x]	3 + 3	3.4 + 3.4	2/76, 3/77		
+ simazine 80WP	4	4.5	3/77	7.3c	-75b
Means					
Group 1				2.8A	+37A
Group 2				7.1B	-54B
Group 3				6.8B	-45B

(continued)

Appendix S - cont.

Effects of herbicide treatments on injury and area covered by salal. Salal Experiment 1.

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[z] Injury on old foliage rated on a 0 to 10 scale: 0 = no injury, 10 = dead. Injury on new foliage was rated less than 3 in all treatments.

[y] Percent increase (+) or decrease (-) in area covered by salal.

[x] Applied in combined formulation.

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

Appendix T

Effects of herbicide treatments on area covered with grass and salal. Salal Experiment 2.

Herbicide	Rate (active ingredient) Lb/A	Rate (active ingredient) Kg/ha	Months applied	Area covered (%) Sweet vernalgrass 9-7-77	Area covered (%) Sweet vernalgrass 10-10-78	Change in area (%)[z] Salal 10-10-78
Diuron 80WP + simazine 80WP[x] + bromacil 80WP[yx]	3 + 6 3	3.4 + 6.7 3.4	3/77, 3/78 3/77	0a[u]	0a	-19b
Diuron 80WP + simazine 80WP[x] + bromacil 80WP[yx]	5 + 6 5	5.6 + 6.7 5.6	3/77, 3/78 3/77	0a	0a	-52c
Diuron 80WP + simazine 80WP[x]	10 + 6	11.1 + 6.7	3/77, 3/78	0a	0a	+2ab
Diuron 80WP + dichlobenil 4G + bromacil 80WP[yx]	5 + 8[v] 5	5.6 + 9.0 5.6	3/77, 3/78 3/77	0a	2a	-89d
Diuron 80WP + dichlobenil 4G	5[v] + 8[v]	5.6 + 9.0	3/77, 3/78	3a	6a	-22bc
Bromacil 80WP + dichlobenil 4G + diuron 80WP	5 8[v] 3	5.6 9.0 3.4	3/77 3/77, 3/78 3/78	0a	36b	-84d
Dichlobenil 4G + fosamine[w] + diuron 80WP	8 4 5	9.0 4.5 5.6	11/76 9/77 11/77	58b	4a	+6ab
Dichlobenil 4G + diuron 80WP	8 5	9.0 5.6	3/77 3/78	75b	10a	-2ab
Pronamide 50WP + dichlobenil 4G + diuron 80WP[x]	2 8 5	2.2 9.0 5.6	11/76, 11/77 11/76 11/77	4a	2a	+6ab
Pronamide 50WP + dichlobenil 4G + diuron 80WP[x]	4 8 5	4.5 9.0 5.6	11/76, 11/77 11/76 11/77	2a	0a	+10ab
Simazine 80WP	12[v]	13.4	3/77, 3/78	0a	0a	+31a

(Continued)

Appendix T - cont.

Effects of herbicide treatments on area covered with grass and salal. Salal Experiment 2. - continued

[z] Percent increase (+) or decrease (-) in area covered by salal.

[y] Applied in combined formulation.

[x] Tank mix.

[w] Surfactant WK added at 0.25%.

[v] These rates were reduced in 1978 as follows:

	Lb/A		Kg/ha	
	1977	1978	1977	1978
Dichlobenil	8	6	9.0	6.7
Diuron	5	3	5.6	3.4
Simazine	12	8	13.4	9.0

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

Appendix U

Effects of herbicide treatments on blackberries and salmonberry. Salal Experiment 2.

Herbicide	Rate (active ingredient) Lb/A	Kg/ha	Dates applied 1976	1977	1978	Change in plot area covered 9-77 to 10-10-78 (%)[z]
Check	-	-	-	-	-	+3ab[u]
Diuron 80WP + simazine 80WP[x]	3 + 6	3.4 + 6.7		3-10	3-22	+90b
+ bromacil 80WP[yx]	3	3.4		3-10		
Diuron 80WP + dichlobenil 4G	5 + 8	5.6[v] + 9.0[v]		3-10	3-22	+77b
Bromacil 80WP	5	5.6[v]		3-10		+13ab
+ dichlobenil 4G	8	9.0[v]		3-10	3-22	
+ diuron 80WP	3	3.4			3-22	
Dichlobenil 4G	8	9.0	11-1			-93a
+ fosamine[w]	4	4.5		9-17		
+ diuron 80WP	5	5.6		11-17		
Dichlobenil 4G	8	9.0		3-10		+107bc
+ diuron 80WP	5	5.6			3-22	
Pronamide 50WP	2	2.2	11-1	11-17		+93bc
+ dichlobenil 4G	8	9.0	11-1			
+ diuron 80WP	5	5.6		11-17		
Princep 80WP	12	13.4[v]		3-10	3-22	+138bc

[z] Percent increase (+) or decrease (-) in area covered by the four species: Pacific blackberry (this species covered 48% of the total area covered by the four species), evergreen blackberry (15%), Himalayan blackberry (11%), and salmonberry (26%).

[y] Applied in combined formulation.

[x] Tank mix.

[w] Surfactant WK added at 0.25%.

[v] These rates were reduced in 1978 as follows:

	1977 Lb/A	Kg/ha	1978 Lb/A	Kg/ha
Dichlobenil	8	9.0	6	6.7
Diuron	5	5.6	3	3.4
Simazine	12	13.4	8	9.0

[u] Means followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Appendix V

Herbicides Used in the Project

Common name	Trade name and formulation[1]	Manufacturer of product used
alachlor	Lasso 4EC	Monsanto Chemical Co.
amitrole-T	Amitrole-T 2SL	Amchem Products
atrazine	Aatrex 80WP	Ciba-Geigy Co.
bromacil	Hyvar X 80WP	DuPont
dalapon	Dowpon 74SP	Dow Chemical Co.
dicamba	Banvel 4SL	Velsicol Chemical Corp.
dichlobenil	Casoron 4G & 50WP	Thompson-Hayward
diuron	Karmex 80WP	DuPont
diuron + bromacil	Krovar 80WP	DuPont
glyphosate	Roundup 4SL	Monsanto Chemical Co.
hexazinone	Velpar 90SP	DuPont
napropamide	Devrinol 2G & 50WP	Stauffer Chemical Co.
oryzalin	Surflan 75WP	Elanco Products Co.
oxadiazon	Ronstar 2G, 3F, 75WP	Rhone-Poulenc Inc.
oxyfluorfen	Goal 2EC	Rohm & Haas Co.
paraquat	Paraquat CL 2SL	Chevron Chemical Co.
pronamide	Kerb 50WP	Rohm & Haas Co.
silvex	Weedone 2,4,5-TP 4SL	Amchem Products
simazine	Princep 4G & 80WP	Ciba-Geigy
tebuthiuron	Spike 20G & 80WP	Elanco Products Co.
trifluralin	Treflan 4EC	Elanco Products Co.
2,4-D amine	Weedar 64 4SL	Amchem Products
fosamine	Krenite 4SL	DuPont

[1] Formulation code

EC - Emulsifiable concentrate
SL - Soluble liquid
F - Flowable suspension
SP - Soluble powder
WP - Wettable powder
G - Granule

Appendix W

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