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IR-4 Ornamental Horticulture Program Diuron Crop Safety

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Acknowledgements

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Abstract

Data in this report were generated to expand registered uses of diuron on ornamental species. Diuron rates in these experiments ranged from 0.5 to 16 lb ai/A. Direx 80DF and Karmex 80WP were tested on 26 plant genera or species between 1978 and 2002. Two bulb species exhibited no injury with soil applications after planting: *Lilium sp* and *Narcissus sp*. Two species exhibited mortality with over the top applications: *Quercus palustris* and *Washingtonia robusta*. The remaining species were tested either as directed sprays or under the greenhouse bench applications. More information is needed on these crops because only 1 or 2 trials were conducted.

Introduction

Karmex 80WP (diuron) was initial registered in October 16, 1961. Ornamental horticulture uses were added September 30, 1983, but these uses were limited. Applications were limited to Iris and Narcissus in Western Washington, Plumosa fern in Florida, and certain established tree species in specific western and north central states. A second formulation, Karmex 80DF was registered on June 29, 1987 with these same uses, but the label amended on April 19, 1993 removed the fern and bulb crop uses. This product was sub-registered and marketed under the name Direx 80DF.

IR-4 research activities on these products fit into two categories. Over the top applications or directed spray applications to add new crops to the label. Applications within greenhouse structures for under the bench weed control and any resulting phytotoxicity issues that may occur with crops.

This report summarizes 33 crop safety trials conducted between 1978 and 2001 involving Direx 80DF and Karmex 80WP.

Materials and Methods

The diuron rates tested ranged from 0.5 lb ai per acre to 16 lb ai per acre plus an untreated control. For application to bulbs, timings included immediately after planting and after emergence but before flowering. For application to tree and palm species, applications were primarily directed around the plants, but there were a handful of trials with over the top applications. Several experiments were conducted in the greenhouse under benches for weed management.

Phytotoxicity data was recorded at all rates using a 0-10 scale. 0 = no phytotoxicity, 10 = complete kill. Efficacy data as well as indications regarding marketability were given in some cases but not all.

Direx 80DF and Karmex 80WP were provided to researchers by DuPont or Griffin.

Results and Summary

Phytotoxicity

Based on the type and nature of injury seen with Direx 80DF and Karmex 80WP applications in the conducted research, tested plant species were placed into four categories: 1) no significant phytotoxicity or growth differences from the untreated check or any injury was transitory, 2) no or minimal transitory injury seen at the 1X rate, but the 2X and/or 4X rates did cause significant phytotoxicity, 3) significant injury sufficient to recommend growers not utilize this product, and 4) more data is needed to make informed recommendations. Applications with both products and for both use sites (field and greenhouse) are placed together in all tables below.

Direx 80DF and Karmex 80WP exhibited no or minimal negative impact on 2 plant genera with over the top applications (Table 1). Some minimal injury may be acceptable for growers if applications are made several weeks to months in advance of crop sale particularly for woody ornamental crops. However, in the research presented here, no plants exhibited significant injury at higher rates even though little injury was observed at 1X (Table 2). Two crops tested from exhibited damage sufficient to recommend growers not utilize either product as an over-the-top treatment (Table 3). For 17 genera/species, more information is needed either because only 1 or 2 trials were conducted or because consistent results were not achieved among the research sites (Table 4). Even so, 6 species were on benches with applications target for weeds under those benches.

Please see Table 5 for a list of individual trial summaries for both products.

Table 1. List of Direx 80DF and Karmex 80WP treated crops with no or minimal transitory injury.

*Iris sp.*¹

Lillium longiflorum

Table 2. List of Direx 80DF and Karmex 80WP treated crops with no or minimal transitory injury seen at the 1X rate, but the 2X or 4X rate did cause significant phytotoxicity

None

¹ Registered already

² Damage seen with over the top application.

Table 3. List of Direx 80DF and Karmex 80WP treated crops exhibiting significant injury.

*Quercus palustris*²

Washingtonia robusta

Table 4. List of Direx 80DF and Karmex 80WP treated crops where more information is needed.

Acer rubrum

Acer saccharinum

Chrysalidocarpus lutescens

*Chrysanthemum sp.*³

Crataegus phaenopyrum

Fraxinus pennsylvanica

Geditsia triacanthos

*Ilex sp.*³

Malus sp.

*Narcissus sp.*¹

Phoenix roebelinii

*Picea pungens glauca*³

Prunus sp.

*Rhododendron sp.*³

*Rosa sp.*³

*Tagetes sp.*³

Tulipa sp.

¹ Registered already

² Damage seen with over the top application.

³ No injury observed with under bench applications.

Table 5. List of crops studied in greenhouse applications of Direx 80DF and Karmex 80WP.

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 3/15/10 are listed below. Table entries with blank results have been received but not yet cataloged in the database.

| PR # | Product | Crop Common Name | Crop Latin Name | Cultivar | Production Site | Researcher | Year | Application | Results | Reg ? Y/N | File Name |
|-------|------------|------------------|-----------------------------------|---------------------|-----------------|-----------------|------|----------------|--|-----------|---------------|
| 11999 | Direx 80DF | Maple, Red | <i>Acer rubrum</i> | | Field In-Ground | Buriff | 1996 | Over the top | Significant injury at 2.5, 5.0 and 10 lb ai per acre including mortality on 2 year old seedlings. | N | 20001027a.pdf |
| 11999 | Direx 80DF | Maple, Red | <i>Acer rubrum</i> | | Field In-Ground | Buriff | 1997 | Directed spray | No injury at 2.5, 5.0, and 10 lb ai per acre on 2 year old seedlings. | N | 20001027b.pdf |
| 12000 | Direx 80DF | Maple, Sugar | <i>Acer saccharum</i> | | Field In-Ground | Buriff | 1997 | Over the top | No injury with 2.5, 5.0 and 10 lb ai per acre. | N | 20001027c.pdf |
| 23599 | Direx 80DF | Bog Rosemary | <i>Andromeda polifolia</i> | <i>A. polifolia</i> | Field Container | Ahrens/ Mervosh | 2002 | Over the top | No injury with 0.25, 0.5, and 1.0 lb ai per acre; great general efficacy with the exception of spurge. | N | 20031015d.pdf |
| 20875 | Karmex 80W | Bearberry | <i>Arctostaphylos</i> sp. | <i>A. uva-ursi</i> | Greenhouse | Ticknor | 1979 | Foliar | No injury from volatiles for under bench applications at 16 and 32 lb ai per acre. | N | 20001027d.pdf |
| 23631 | Direx 80DF | Butterfly Bush | <i>Buddleia davidii</i> | 'Black Night' | Field Container | Ahrens | 2003 | Over the top | No significant injury after one or two applications at 0.25, 0.5 and 1.0 lb ai per acre; minimal efficacy for weeds including liverwort after one application, but excellent after the second. | N | 20100803a.pdf |
| 19620 | Karmex 80W | Palm, Areca | <i>Chrysalidocarpus lutescens</i> | | Field Container | Broschat | 1999 | Over the top | No injury at 4 and 8 lb ai per acre. | N | 20001027f.pdf |

| PR # | Product | Crop Common Name | Crop Latin Name | Cultivar | Production Site | Researcher | Year | Application | Results | Reg ? Y/N | File Name |
|-------|------------|-------------------------|-------------------------|----------------------------|-----------------|-----------------|------|-----------------------------|--|-----------|---------------|
| 29963 | Karmex 80W | Pyrethum, Painted Daisy | Chrysanthemum coccineum | 'Always Pink' | Greenhouse | Ticknor | 1978 | Spray on polyethylene sheet | No injury observed with 32 lb ai per acre. | N | 19790115a.pdf |
| 12001 | Direx 80DF | Hawthorn | Crataegus sp. | C. phaeneopyrum | Field In-Ground | Buriff | 1997 | Directed spray | No injury at 2.5, 5.0 and 10 lb ai per acre. | N | 20001027e.pdf |
| 23633 | Direx 80DF | Winged Burning Bush | Euonymus alatus | E. alatus 'Compactus' | Field Container | Ahrens | 2002 | Over the top | No significant injury with 0.25, 0.5, and 1.0 lb ai per acre; great general efficacy with the exception of spurge. | N | 20031015a.pdf |
| 23633 | Direx 80DF | Winged Burning Bush | Euonymus alatus | E. alatus 'Compactus' | Field Container | Ahrens | 2003 | Over the top | No injury after one or two applications at 0.25, 0.5 and 1.0 lb ai per acre; minimal efficacy for weeds including liverwort after one application, but excellent after the second. | N | 20100803a.pdf |
| 12002 | Direx 80DF | Ash | Fraxinus sp. | F. pennsylvania lanceolata | Field In-Ground | Buriff | 1997 | Directed spray | No injury at 2.5, 5.0 and 10 lb ai per acre. | Y | 20001027g.pdf |
| 12003 | Direx 80DF | Honey Locust | Gleditsia sp. | G. triacanthos | Field In-Ground | Buriff | 1997 | Directed spray | No injury at 2.5, 5.0 and 10 lb ai per acre. | Y | 20001027h.pdf |
| 23629 | Direx 80DF | Hydrangea | Hydrangea sp. | H. macrophylla | Field Container | Ahrens/ Mervosh | 2002 | Over the top | Significant but transient injury at 0.5 and 1.0 lb ai per acre; great general efficacy with the exception of spurge. | N | 20031015e.pdf |
| 23629 | Direx 80DF | Hydrangea | Hydrangea sp. | H. paniculata 'Pee Gee' | Field Container | Ahrens/ Mervosh | 2002 | Over the top | No significant injury with 0.25, 0.5, and 1.0 lb ai per acre; great general efficacy with the exception of spurge. | N | 20031015e.pdf |
| 20876 | Karmex 80W | Holly | Ilex sp. | | Greenhouse | Ticknor | 1977 | Foliar | No injury with 32 lb ai per acre. | N | 20001027i.pdf |

| PR # | Product | Crop Common Name | Crop Latin Name | Cultivar | Production Site | Researcher | Year | Application | Results | Reg ? Y/N | File Name |
|-------|------------|------------------|--------------------|------------------------------|-----------------|-----------------|------|----------------|---|-----------|---------------|
| 23597 | Direx 80DF | Holly | Ilex sp. | I. x meserve 'Blue Princess' | Field Container | Ahrens | 2003 | Over the top | No injury after one application at 0.25, 0.5 and 1.0 lb ai per acre, but minor to significant after the second; minimal efficacy for weeds including liverwort after one application, but excellent after the second. | N | 20100803a.pdf |
| 2618 | Karmex 80W | Flag | Iris sp. | 'Blue Pearl' | Field In-Ground | Elmore | 1979 | Directed spray | Trial 3: No adverse effects (emergence, number of flowers or stem length) with 1 lb ai per acre. | Y | 19790115h.pdf |
| 2618 | Karmex 80W | Flag | Iris sp. | 'Wedgewood' | Field In-Ground | Elmore | 1979 | Directed spray | Trial 1: No adverse effects (emergence, number of flowers or stem length) with 1 lb ai per acre. | Y | 19790115f.pdf |
| 2618 | Karmex 80W | Flag | Iris sp. | 'Wedgewood' | Field In-Ground | Elmore | 1979 | Directed spray | Trial 2: No adverse effects (emergence, number of flowers or stem length) with 1 lb ai per acre after 2nd year application. | Y | 19790115g.pdf |
| 23594 | Direx 80DF | Juniper | Juniperus sp. | J. horizontalis 'Wiltoni' | Field Container | Ahrens/ Mervosh | 2002 | Over the top | No injury at 0.25, 0.5, and 1.0 lb ai per acre; great general efficacy with the exception of spurge. | N | 20031015b.pdf |
| 7820 | Karmex 80W | Lily, Easter | Lilium longiflorum | 'Nellie White' | Field In-Ground | William | 1981 | Directed spray | Trial 1: No reduction in vigor at 4 and 8 lb ai per acre, but slight reduction at 16 lb ai per acre with Fall preemergent applications. | N | 19790115j.pdf |

| PR # | Product | Crop Common Name | Crop Latin Name | Cultivar | Production Site | Researcher | Year | Application | Results | Reg ? Y/N | File Name |
|-------|------------|---------------------------------|--------------------|----------------|-----------------|------------|------|----------------|--|-----------|---------------|
| 7820 | Karmex 80W | Lily, Easter | Lilium longiflorum | 'Nellie White' | Field In-Ground | William | 1981 | Over the top | Trial 2: No reduction in bilb size at 4, 8 and 16 lb ai per acre with spring post emergent over the top applications. | N | 19790115j.pdf |
| 7820 | Karmex 80W | Lily, Easter | Lilium longiflorum | 'Nellie White' | Field In-Ground | William | 1981 | Directed spray | Trial 3: No significant reduction in bulb weight at 4, 8 and 16 lb ai per acre with soil applications in a growth chamber. | N | 19790115j.pdf |
| 12004 | Direx 80DF | Apple & Crabapple (Non-Bearing) | Malus sp. | 'Prairiefire' | Field In-Ground | Buriff | 1997 | Directed spray | No injury at 2.5, 5.0 and 10 lb ai per acre. | N | 20001027j.pdf |
| 23630 | Direx 80DF | Heavenly Bamboo | Nandina domestica | | Field Container | Ahrens | 2003 | Over the top | No injury after one application at 0.25, 0.5 and 1.0 lb ai per acre, and none to minor after the second; minimal efficacy for weeds including liverwort after one application, but excellent after the second. | N | 20100803a.pdf |
| 20877 | Karmex 80W | Daffodil | Narcissus sp. | 'King Alfred' | Field In-Ground | Elmore | 1979 | Directed spray | Trial 1: No adverse effects (emergence, number of flowers or stem length) with 1 lb ai per acre. | Y | 19790115d.pdf |
| 20877 | Karmex 80W | Daffodil | Narcissus sp. | 'King Alfred' | Field In-Ground | Elmore | 1979 | Directed spray | Trial 2: No adverse effects (emergence, number of flowers or stem length) with 1 lb ai per acre after 2nd year application. | Y | 19790115e.pdf |
| 19619 | Karmex 80W | Palm, Pygmy Date | Phoenix roebelinii | | Field Container | Broschat | 1999 | Over the top | No significant injury at 4 and 8 lb ai per acre. | N | 20001027k.pdf |

| PR # | Product | Crop Common Name | Crop Latin Name | Cultivar | Production Site | Researcher | Year | Application | Results | Reg ? Y/N | File Name |
|-------|------------|------------------------|------------------|-------------------------------|-----------------|-----------------|------|-----------------------------|--|-----------|---------------|
| 20879 | Karmex 80W | Spruce | Picea sp. | P. pungens v. glauca | Greenhouse | Ticknor | 1979 | Foliar | No injury from volatiles for under bench applications at 16 and 32 lb ai per acre. | N | 20001027l.pdf |
| 12005 | Direx 80DF | Cherry (Non-Bearing) | Prunus sp. | P. serrulata 'Royal Burgundy' | Field In-Ground | Buriff | 1997 | Directed spray | No injury at 2.5, 5.0, and 10 lb ai per acre. | N | 20001027m.pdf |
| 12007 | Direx 80DF | Oak | Quercus sp. | Q. palustris | Field In-Ground | Buriff | 1996 | Over the top | Plant death occurred with all rates (2.5, 5.0, 10 lb ai per acre). | N | 20001027n.pdf |
| 20881 | Karmex 80W | Rhododendron | Rhododendron sp. | | Greenhouse | Ticknor | 1978 | Foliar | No injury from volatiles with under the bench applications at 32 lb ai per acre. | N | 19790115b.pdf |
| 23598 | Direx 80DF | Azalea, & Rhododendron | Rhododendron sp. | R. catawbiense 'Grandiflorum' | Field Container | Ahrens | 2003 | Over the top | No to minor injury increasing with rate after one application at 0.25, 0.5 and 1.0 lb ai per acre, but minor to moderate after the second; minimal efficacy for weeds including liverwort after one application, but excellent after the second. | N | 20100803a.pdf |
| 20880 | Karmex 80W | Azalea | Rhododendron sp. | 'Red Wing' Azalea | Greenhouse | Ticknor | 1978 | Spray on polyethylene sheet | No injury observed with 32 lb ai per acre. | N | 19790115a.pdf |
| 23598 | Direx 80DF | Azalea, & Rhododendron | Rhododendron sp. | 'Stewartsonian' azalea | Field Container | Ahrens/ Mervosh | 2002 | Over the top | No to very slight injury increasing with rate (0.25, 0.5, and 1.0 lb ai per acre); great general efficacy with the exception of spurge. | N | 20031015c.pdf |
| 20882 | Karmex 80W | Rose | Rosa sp. | R. multiflora 'Burr' | Greenhouse | Ticknor | 1978 | Spray on polyethylene sheet | No injury observed with 32 lb ai per acre. | N | 19790115a.pdf |

| PR # | Product | Crop Common Name | Crop Latin Name | Cultivar | Production Site | Researcher | Year | Application | Results | Reg ? Y/N | File Name |
|-------|------------|-------------------|----------------------|-------------------|-----------------|------------|------|-----------------------------|---|-----------|---------------|
| 20883 | Karmex 80W | Marigold | Tagetes sp. | 'Pineapple Crush' | Greenhouse | Ticknor | 1978 | Spray on polyethylene sheet | No injury observed with 32 lb ai per acre. | N | 19790115a.pdf |
| 20884 | Karmex 80W | Tulip | Tulipa sp. | 'Texas Gold' | Field In-Ground | Elmore | 1978 | Directed spray | No significant injury with 1.0 lb ai per acre. | N | 19790115i.pdf |
| 19621 | Karmex 80W | Palm, Mexican Fan | Washingtonia robusta | | Field Container | Broschat | 1999 | Over the top | Significant injury at 4 and 8 lb ai per acre; bud failure occurred at 8 to 10 months after application. | N | 20001027o.pdf |

Label Suggestions

For Direx 80DF and Karmex 80WP, it is suggested that the current labels include the applications for bulbs between planting and emergence for daffodil, iris, and lily. Additional testing, or data from non-IR-4 experiments, will be required to add additional tree or shrub species to the label for directed applications only, although the breadth of plant materials exhibiting no adverse effects even in a single trial suggests diuron as a directed soil spray will have little impact. Weed control in greenhouses is a critical need for these growers. Application of Karmex 80WP under greenhouse benches appeared to have no impact on crops growing on those benches; but additional testing is needed because only one experiment was conducted.

Appendix 1: Protocols

None available at this time

Appendix 2: Contributing Researchers

| | |
|-------------------------|---|
| Dr. John Ahrens | Connecticut Agricultural Experiment Station Valley Laboratory 153 Cook Hill Road, P.O. Box 248 Windsor, CT |
| Dr. Timothy K. Broschat | University of Florida Fort Lauderdale Research and Education Center 3205 College Avenue Davie, FL 33314 |
| Dr. Clyde Elmore | Botany Department University of California Davis, CA 95616 |
| Dr. Charles Buriff | USDA-ARS 359 Main Rd Delaware OH 43015 |
| Dr. Robert L. Ticknor | N. Willamette Experiment Station Rt. 2. Box 600 Aurora, OR 97002 |
| Dr. Ray D. William | Dept. of Horticulture Oregon State University Corvallis, OR 97331 |

Appendix 3: Submitted Data

Researcher reports included in the printed copy of this report are those received by 7/27/2010. Reports on following pages are in alphanumeric order of author then PR number.