

PESTICIDE USE ON UTAH'S SMALL GRAIN CROPS

Howard Deer
Extension Pesticide Coordinator
Animal, Dairy, and Veterinary Sciences Department

and

Alan H. Roe
Insect Diagnostician
Biology Department

Funding provided by a grant from the
National Agricultural Pesticide Impact Assessment Program
(NAPIAP)

Extension Pesticide Programs
Cooperative Extension Service
Utah State University
Logan, Utah

October 1997

TABLE OF CONTENTS

- [LIST OF TABLES](#)
- [LIST OF ABBREVIATIONS](#)
- [INTRODUCTION](#)
 - Survey Background
 - Data Requested By The Survey

- [METHODS](#)
 - Data Compilation
 - Assumptions Used For Data Entry
 - Data Analyses

- [RESULTS](#)
 - Bound Estimates For Percentages
 - Responses And Reported Acreages
 - Cropping Patterns and Crop Acreage
 - Pesticide Use On Small Grains
 - Treatment Methods
 - Pesticide Use Patterns In Barley
 - Pesticide Use Patterns In Oats
 - Pesticide Use Patterns In Wheat
 - Major Target Pests In Barley
 - Major Target Pests In Oats
 - Major Target Pests In Wheat
 - Comparison Of County Acreages
 - Pesticide Use Comparisons By County
 - County Comparisons For Barley
 - County Comparisons For Oats
 - County Comparisons For Wheat
 - Extrapolated State Totals

- [SUMMARY AND CONCLUSIONS](#)
 - Survey Design And Responses
 - Cropping Patterns And Crop Acreage
 - Treatment Methods
 - Pesticide Use Patterns
 - Major Pesticides
 - Major Target Pests
 - County Comparisons
 - Usefulness Of The Data

- [ACKNOWLEDGMENTS](#)
- [REFERENCES CITED](#)
- [SUMMARY TABLES](#)
- [APPENDICES](#)

- A Pesticide Use Survey Questionnaire
- B Pesticide Trade Name To Generic Name Index
- C Pesticide Generic Name To Trade Name Index

LIST OF TABLES

1. Grower responses, total reported acreage, and treated acreage for Utah small grain crops.
2. Cropping patterns and pesticide use among Utah growers reporting small grain acreage.
3. Acreage and pesticide use among Utah growers reporting barley acreage.
4. Acreage and pesticide use among Utah growers reporting oats acreage.
5. Acreage and pesticide use among Utah growers reporting wheat acreage.
6. Acreage and pesticide use among Utah growers reporting small grain acreage (barley, oats, and wheat combined).
7. Pesticide types and application methods for treatments made to barley.
8. Pesticide types and application methods for treatments made to oats.
9. Pesticide types and application methods for treatments made to wheat.
10. Use patterns for pesticides applied to Utah barley.
11. Use patterns for pesticides applied to Utah oats.
12. Use patterns for pesticides applied to Utah wheat.
13. Target pests for pesticide applications to Utah barley.
14. Percent of Utah barley crop treated with fungicides for specific plant diseases.

15. Total reported amounts (pounds) of fungicides applied to Utah barley for specific plant diseases.
16. Percent of Utah barley crop treated with insecticides for specific insects.
17. Total reported amounts (pounds) of insecticides applied to Utah barley for specific insects.
18. Percent of Utah barley crop treated with repellents or poisons for specific vertebrates.
19. Total reported amounts (pounds) of repellents or poisons applied to Utah barley for specific vertebrates.
20. Percent of Utah barley crop treated with herbicides for specific weeds.
21. Total reported amounts (pounds) of herbicides applied to Utah barley for specific weeds.
22. Target pests for pesticide applications to Utah oats.
23. Percent of Utah oats crop treated with insecticides for specific insects.
24. Total reported amounts (pounds) of insecticides applied to Utah oats for specific insects.
25. Percent of Utah oats crop treated with repellents or poisons for specific vertebrates.
26. Total reported amounts (pounds) of repellents or poisons applied to Utah oats for specific vertebrates.
27. Percent of Utah oats crop treated with herbicides for specific weeds.
28. Total reported amounts (pounds) of herbicides applied to Utah oats for specific weeds.
29. Target pests for pesticide applications to Utah wheat.
30. Percent of Utah wheat crop treated with fungicides for specific plant diseases.

31. Total reported amounts (pounds) of fungicides applied to Utah wheat for specific plant diseases.
32. Percent of Utah wheat crop treated with insecticides for specific insects.
33. Total reported amounts (pounds) of insecticides applied to Utah wheat for specific insects.
34. Percent of Utah wheat crop treated with repellents or poisons for specific vertebrates.
35. Total reported amounts (pounds) of repellents or poisons applied to Utah wheat for specific vertebrates.
36. Percent of Utah oats crop treated with herbicides for specific weeds.
37. Total reported amounts (pounds) of herbicides applied to Utah wheat for specific weeds.
38. Comparison by county of reported survey acreages and official state acreages for Utah small grain crops.
39. Relative percent of pesticides applied to barley in Utah counties.
40. Relative percent of pesticides applied to oats in Utah counties.
41. Relative percent of pesticides applied to wheat in Utah counties.
42. Extrapolated amounts (pounds of active ingredient) of pesticides applied state-wide to Utah small grain crops.

LIST OF ABBREVIATIONS

-Pesticide Types-

F Fungicide
H Herbicide

I Insecticide
P Vertebrate Poison
R Vertebrate Repellent

-Pesticide Formulations-

B Bait
D Dust
DF Dry Flowable (Water Dispersible Granule)
EC Emulsifiable Concentrate
F Flowable
SC Soluble Concentrate

-Treatment Methods-

A Aircraft Application
G Ground Equipment Application
S Seed Treatment

INTRODUCTION

Survey Background

A survey of Utah small grain growers was conducted in the fall of 1996 by personnel of Utah State University Extension Entomology. The majority of the survey was related to integrated pest management practices but included a section devoted to pesticide use on small grains.

The pesticide use data of this survey were collected as part of the National Agricultural Pesticide Impact Assessment Program (NAPIAP). Only aspects of pesticide use are summarized here.

Data Requested By The Survey

In responding to the pesticide use portion of the survey, growers were asked to describe up to three of their most common pesticide use patterns on small grains. A reproduction of one of the pages from the pesticide use survey is

shown in Appendix A. For each use pattern, the following information was requested:

- 1) Pesticide applied - brand name and formulation
- 2) Target pest(s) - from a list including insects, mites, diseases, weeds, and vertebrates
- 3) Crop(s) treated - any small grain crops treated for the specified target pest(s) using the specified pesticide.
- 4) Application frequency - times per season or years between applications
- 5) Amount of crop treated - acreage or percentage of total crop acreage
- 6) Application rate - low, middle, or high label rate
- 7) Application method - ground equipment, aircraft, chemigation, or seed treatment
- 8) County - the county where the grower produces small grains
- 9) Crop acreage(s) - the acreage of any small grain crops produced

METHODS

Data Compilation

Data from usable pesticide survey responses was entered in a computer database and checked for entry errors. A database record was stored for each unique combination of grower, crop, pesticide, and target pest(s). All character data (such as brand names) were standardized for consistent usage and spelling. Specific methods used to enter and standardize data and to perform calculations are described below:

- 1) The county was entered using the full county name.
- 2) A reference number was assigned for each grower within a county and was recorded on the original survey form.
- 3) Total acreage of the crop produced was stored as an integer value.
- 4) Crops included in the database were barley, oats, and wheat.
- 5) Target pest names consisted of those shown below. Many growers indicated combinations of target pests for a given pesticide treatment. For the purposes of data storage, a combination of target pests was treated as a unique combination. Combinations of target pests were most common among weeds.

Diseases	Insects	Vertebrates	Weeds
Loose Smut	Armyworms	Birds	Bindweed
Seed Decay	Black Grass Bug	Deer	Broadleaf Annuals

Cereal Leaf Beetle	Rodents	Burr Buttercup
Cutworms		Canada Thistle
Grain Aphids		Foxtail
Grasshoppers		Jointed Goatgrass
Mormon Cricket		Kochia
Russian Wheat Aphid		Orchardgrass
Wireworms		Quackgrass
		Wild Oats

6) Pesticide generic names were used for all pesticide descriptions in the database. For example, the name "disulfoton" was used instead of Di-Syston". Pesticides applied as combinations were entered as two or more records, with each record being unique with respect to the generic name.

7) The type of pesticide was stored as a single-letter abbreviation. Types included fungicide (F), herbicide (H), insecticide (I), vertebrate poison (P), and vertebrate repellent (R).

8) Formulation of the pesticide was stored as a one or two-letter code. Formulations included bait (B), dust (D), dry flowable (DF), emulsifiable concentrate (EC), liquid flowable (F), and soluble concentrate (SC). For some herbicides such as 2,4-D, a designation of "EC,SC" was used because of the variety of available formulations.

9) A key word was stored to indicate pesticide combinations. These included combination formulations (containing more than one active ingredient) and combinations that were applied as tank mixtures. For example, if 2,4-D and dicamba was applied as a combination formulation of Landmaster BW, the key word "plus" was recorded, as in "2,4-D plus dicamba". If pesticides were applied as a tank mixture, for example Banvel and Roundup, the key word "with" was recorded, as in "dicamba with glyphosate".

10) Application frequencies were entered in the database as two-decimal values, with a value of 1.00 representing a single application per year. Similarly, a value of 2.00 represented two applications per year, and a value of 0.33 represented an application every third year.

11) The amount of crop treated was entered as percentage of the total acreage of the crop produced by a grower. This value represented the amount of crop acreage treated at one time, regardless of the application frequency.

12) Application rates (in pounds of active ingredient per acre) were calculated from current pesticide labels [1]. Most rates were further verified by comparison with available references containing pesticide recommendations for small grains [2,3,4].

13) Application methods included in the database were ground equipment, aircraft, and seed treatment. Miscellaneous methods that were specifically mentioned (for example, hand probes used for vertebrate poison placement) were included in the ground equipment category.

14) The amount of acreage treated per year was calculated as follows: (total crop acreage) x (decimal percent of crop treated)

15) The amount of pesticide applied per year was calculated as follows: (acreage treated per year) x (application rate) x (application frequency)

Assumptions Used For Data Entry

Responses received from the Utah small grain survey included varying degrees of detail regarding pesticide use patterns. Nearly all responses that indicated pesticide use contained some usable information. In order that as many possible responses could still be included, certain assumptions were made when details were not provided. These include assumptions regarding formulations, rates, percent of acreage treated, number of applications per year, application methods, and in a few cases, target pests and pesticide generic names.

Some missing information could be deduced from information given in other portions of the survey. A small percentage of the responses included too little information to be included in the pesticide use summaries, even if assumptions were made. Unless specific information was indicated or could be deduced from elsewhere in the responses, the following assumptions were made:

- 1) Formulations were assumed to be liquid (EC or SC).
- 2) Rates were assumed to mid-label rates.
- 3) Percent of acreage treated was assumed to be all acreage of the given crop reported by that grower.
- 3) Number of applications per year was assumed to be one.
- 4) Method of application was assumed to be by ground equipment.
- 5) In a few cases, target pests were deduced or assumed from the type of pesticide applied (for example, Russian wheat aphid was assumed to be the target pest if the pesticide applied was disulfoton).
- 6) In a few cases, the pesticide generic name was deduced from the use pattern (for example, strychnine was assumed to be the pesticide if the target pest was rodents).

Data Analyses

Summaries of the small grain survey were produced with data categorized according to crops, acreages, treatment methods, pesticides, target pests, counties, and state-wide totals. For most analyses, data for each crop (barley, oats, and wheat) were summarized separately. Because of the nature of the data, summary values from these various categories are not necessarily equal between categories nor additive within categories. For example, the total number of reports of specific pesticide uses is not equal to the total number of reports of treatments for specific target pests. These numbers are not equal because of combinations of pesticides were sometimes applied for a given target pest, multiple target pests were often the object of a single pesticide application, or both. For the same reasons, sums of the total acreage treated may exceed the total acreage of the crop, and sums for the percent of acreage treated may exceed 100 percent in some cases.

Percentage values for the number of reports and the acreage treated are used in many analyses. For report percentages, the total number of reports in the given category was used as the divisor, with the report totals varying according to the category (as mentioned above). For acreage percentages, the total reported acreage for the crop was used as the divisor.

Quantities of pesticide were calculated for application rates and for the total amounts of pesticide applied. All rates were calculated as pounds of active ingredient per acre. All total amounts were calculated as pounds of active ingredient.

Some data from the survey were compared using statistical analyses. Analytical methods included estimation of error bounds on proportions (percentage values), Z-tests of two proportions, and calculation of coefficients of linear correlation.

Much of the data here is compared using percentages, which are equivalent to decimal proportions used in statistical analyses. For each crop and all small grain crops combined, calculations of bound estimates were made for these percentages. Bound estimates were used in some analyses to compare percentage values for significant differences and also to evaluate the adequacy of the survey in terms of sample size.

Bounds on percentage values were calculated using a derivation of the formula for the sample size required to estimate a proportion. A proportion of 0.5 (50%) was used, which is the most conservative estimator [5]. These bound estimates are equivalent to one-half of the width of a confidence interval (P=.95).

Specific bounds could have been calculated for each of the comparisons, but it was deemed sufficient to use these generalized conservative estimators.

RESULTS

Bound Estimates For Percentages

Sample sizes used to calculate bound estimates were based on the number of survey responses for each crop and for all small grain crops combined. Estimates of the total sample population were based on 1997 Utah Agricultural Statistics [6] and 1992 USDA Agricultural Census [7] figures for the total state acreage for each crop and the number of farms producing each crop.

In the small grain survey, 140 growers reported barley acreage, 31 reported oats acreage, and 103 reported wheat acreage. Using extrapolations from the 1992 USDA Agricultural Census [7] and a figure of 13,400 total farms in Utah in 1996 [6], there were about 2380 barley growers, 690 oats growers, and 1295 wheat growers in Utah in 1996.

Based on the above values, bound estimates of 8.2% for barley, 17.6% for oats, and 9.4% for wheat were calculated for the individual crops. For all crops combined, a bound estimate of 5.9% was calculated.

Responses and Crop Acreages

Growers producing any barley, oats, or wheat were requested to answer all survey questions. Of approximately 1700 surveys that were mailed, 265 (15.6%) were returned with at least some information. Of the 265 responses returned, 188 (70.9%) were from growers reporting acreage of at least one small grain crop.

All responses from growers indicating acreages of barley, oats, or wheat and their county of origin were included for analysis, at least to some degree. The number of responses, total reported acreage, and treated acreage for small grain growers responding to the survey are summarized in Table 1.

Responses were received from 188 growers reporting acreage of at least one small grain crop. Counting crop acreages of barley, oats, and wheat for each grower, there were a total of 274 responses. Of these, 140 growers reported

barley acreage (51.1%), 103 reported wheat acreage (37.6%), and 31 reported oats acreage (11.3%). A total of 55,753 acres of small grains were reported. Wheat comprised most of the total reported acreage (40,712 acres or 73.0%), followed by barley (14,050 acres or 25.2%) and oats (991 acres or 1.8%).

Acreages reported by individual growers ranged from 4 to 1000 acres for barley, 2 to 162 acres for oats, and 2 to 5200 acres for wheat. The average acreage reported by Utah small grain growers was 100 acres of barley, 32 acres of oats, and 395 acres of wheat. By comparison, average acreages calculated from Utah and USDA Agricultural Statistics [6,7] result in 46 acres of barley, 65 acres of oats, and 158 acres of wheat.

Reported acreages from the small grain pesticide survey were compared to 1996 state acreage totals as reported by the Utah Department of Agriculture [6]. According to these statistics there were totals of 110,000 acres of barley, 45,000 acres of oats, and 205,000 acres of wheat planted in Utah in 1996. Total acreages reported from the small grain survey represent 12.8%, 2.2%, and 19.9% of these acreage figures, respectively. Overall, reported acreages from the survey amount to 15.5% of the total small grain crop acreage.

Responses from growers reporting barley acreage were received from 11 counties. These counties include 74.5% of the total state barley acreage. Similarly, responses were received from 10 counties which include 73.5% of the total state wheat acreage. However, the 9 counties reporting oats acreage included only 25.3% of the total state oats acreage.

Cropping Patterns

Cropping patterns of Utah small grain growers are summarized in Table 2. Most small grain growers produced a single small grain crop (113 growers or 60.1%). A total of 64 growers (34.0%) produced two different grain crops, and only 11 (5.6%) produced all three small grain crops.

Pesticides were applied by 70 of 113 growers that produced a single crop (61.9%), and by 49 of 75 growers that produced more than one crop (65.3%). These percentages are not significantly different when compared by a Z-test of two proportions ($Z=1.05$).

Pesticide use by Utah small grain growers is compared for five acreage ranges in Tables 3 through 6. Data from Table 6 was used to perform a correlation

analysis of crop acreage versus the percent of growers applying pesticides. These factors showed a significant positive correlation ($R=.799$, $df=4$, $P>.90$).

Pesticide Use On Small Grains

Some growers reported pesticide usage but did not provide enough details of their pesticide use patterns to be included in the pesticide summaries. For this reason, only 128 of the 140 reports for barley and 93 of the 103 reports for wheat were included. All reports for oats were sufficiently detailed to be included. Acreage included in the pesticide summaries was reduced to 13,131 acres of barley and 38,606 acres of wheat, but included all 991 acres of oats. These 252 reports generated a total of 357 treatment records that were stored in the database.

Among growers reporting small grain acreage, 94 of 140 (67.1%) applied pesticides to barley, 16 of 31 (51.6%) applied pesticides to oats, and 70 of 103 (68.0%) applied pesticides to wheat. Using bound estimates to compare these percentages showed no significant differences among crops.

Based on the reported pesticide use patterns, pesticides were applied to total of 11,531 acres of barley, 499 acres of oats, and 27,309 acres of wheat. These figures represent 87.8% of the barley acreage, 50.3% of the oats acreage, and 70.7 percent of the wheat acreage included in the summaries. Using bound estimates for each crop, only the percentage of barley and oats treated were significantly different, although barley and wheat very nearly showed a significant difference (which would be significant at a lower probability, e.g. $P=.90$).

Treatment Methods

Treatment methods used by Utah small grain growers are summarized in Table 7 through 9. Treatment methods reported included application by ground equipment, by aircraft, and seed treatment. No chemigation uses were reported even though this method was included as a possible response in the survey questionnaire. For all small grain crops, a total of 39,339 treated acres were reported among the 357 treatment records.

Treatment by ground equipment was used in 83.0% of treatments and accounted for 79.7% of all treated acreage, or 31,344 acres. Treatment by

ground equipment was the major method of application for herbicides, insecticides, and vertebrate poisons in all three crops.

Treatment by aircraft was used in 9.2% of treatments and accounted for 12.4% of all treated acreage, or 4,894 acres. Aircraft applications were reported for some herbicide and insecticide applications to barley and wheat, and for some herbicide applications to oats. Aircraft applications were used most often in wheat, predominantly for the application of herbicides.

A few growers indicated an optional use of ground equipment or aircraft for their applications. This category was reported in 3.6% of the treatment records and accounted for 6.0% of the treated acreage, or 2,346 acres.

Seed treatments were used in 4.3% of treatments and accounted for 1.9% of the treated acreage, or 754 acres. Seed treatment was the major method of application for fungicides and vertebrate repellents in all three crops, and was also used for some insecticide treatments in barley. Seed treatment was used most often in barley. No uses of seed treatment were reported from oats.

Pesticide Use Patterns In Barley

Use patterns for pesticides applied to Utah barley are summarized in Table 10. Among barley growers using pesticides, herbicide use was reported most often (72.8%), followed by insecticides (21.2%), vertebrate repellents (2.6%), vertebrate poisons (1.6%), and fungicides (1.5%). Herbicides were applied to largest percentage of barley acreage (70.5%), followed by insecticides (26.7%), fungicides and vertebrate repellents (1.0% each), and vertebrate poisons (0.4%). Calculated totals of pesticides applied to barley were 19.5 pounds of fungicides, 3534.8 pounds of herbicides, 1853.1 pounds of insecticides, 0.2 pounds of vertebrate poisons, and 6.7 pounds of vertebrate repellents.

Fungicides were applied to barley only as seed treatments and were used by very few growers. Among fungicides, carboxin plus maneb (a formulation combination) and thiram were each applied by 0.5% of barley growers using pesticides. Carboxin plus maneb was applied to 0.4% of the barley acreage. Maneb was applied to barley in the largest quantity (10.6 pounds). Carboxin plus maneb was applied at the rate of 0.104 pounds plus 0.182 pounds a.i. per acre. All fungicides were applied an average of once a year.

Among herbicides, 2,4-D was applied by the largest percentage of barley growers using pesticides (37.5%), to the largest percentage of barley acreage

(39.4%), and in the largest total quantity (2817 pounds). Average application rates for herbicides ranged from 0.013 pounds a.i. per acre for thifensulfuron to 0.786 pounds a.i. per acre for difenzoquat. Average annual application frequencies varied from 0.92 for imazethabenz to 1.06 for 2,4-D.

Among insecticides, disulfoton was applied by the largest percentage of barley growers using pesticides (7.6%), carbofuran was applied to the largest percentage of barley acreage (8.5%), and carbaryl was applied in the largest total quantity (681 pounds). Average application rates for insecticides ranged from 0.075 pounds a.i. per acre for lindane (as a seed treatment) to 1.104 pounds a.i. per acre for malathion. Average annual application frequencies varied from 0.33 for methyl parathion (applied by only one grower) to 1.03 for carbofuran.

Strychnine was the only vertebrate poison reported from barley and was used by very few growers. It was applied by 1.6% of barley growers using pesticides to a total of 0.4% of the barley acreage, with a total quantity of 0.2 pounds. Strychnine was applied to barley at an average rate of 0.003 pounds a.i. per acre and at an average frequency of twice per year.

Vertebrate repellents were applied to barley only as seed treatments and were used by very few growers. Among vertebrate repellents, captan was applied by the largest percentage of barley growers using pesticides (1.6%), to the largest percentage of barley acreage (0.7%), and in the largest total quantity (2.8 pounds). Vertebrate repellents were applied at rates ranging from 0.031 pounds a.i. per acre for captan to 0.130 pounds a.i. per acre for thiram. All vertebrate repellents were applied to barley an average of once per year.

Pesticide Use Patterns In Oats

Use patterns for pesticides applied to Utah oats are summarized in Table 11. Compared to barley and wheat, reported uses of pesticides on oats were relatively few. This may have been due, at least in part, to the low percentage of oats growers that responded to the survey.

Among oats growers using pesticides, herbicide use was reported most often (92.0%), followed by insecticides and vertebrate poisons (4.0% each). Herbicides were applied to largest percentage of oats acreage (46.2%), followed by insecticides (3.5%), and vertebrate poisons (0.6%). Calculated totals of pesticides applied to oats were 197.0 pounds of herbicides, 6.6 pounds

of insecticides, and 0.054 pounds of vertebrate poisons. There were no reported uses of fungicides or vertebrate repellents on oats.

Among herbicides, 2,4-D was applied by the largest percentage of oats growers using pesticides (56.0%), to the largest percentage of oats acreage (31.5%), and in the largest total quantity (168.1 pounds). Average application rates for herbicides ranged from 0.014 pounds a.i. per acre for thifensulfuron to 0.506 pounds a.i. per acre for glyphosate. Average annual application frequencies varied from 0.77 for glyphosate to 1.00 for dicamba, thifensulfuron, and tribenuron.

Among insecticides, only carbofuran use was reported. It was applied by only one grower to 3.5% of the reported oats acreage, at 0.188 pounds a.i. per acre and 1.00 application per year. The calculated total of carbofuran applied was 6.6 pounds.

Similarly, among vertebrate poisons, only strychnine use was reported. It was applied by only one grower to 0.6% of the reported oats acreage, at 0.003 pounds a.i. per acre and 3.00 applications per year. The calculated total of strychnine applied was 0.054 pounds. Pesticide Use Patterns In Wheat

Use patterns for pesticides applied to Utah wheat are summarized in Table 12. Among wheat growers using pesticides, herbicide use was reported most often (82.6%), followed by insecticides (15.0%), vertebrate repellents (2.1%), and fungicides (0.7%). Herbicides were applied to largest percentage of wheat acreage (59.5%), followed by insecticides (10.5%), vertebrate repellents (less than 0.7%), and fungicides (0.3%). Calculated totals of pesticides applied to wheat were 13.3 pounds of fungicides, 8399.3 pounds of herbicides, 2928.0 pounds of insecticides, and 6.8 pounds of vertebrate repellents. No uses of vertebrate poisons were reported from wheat.

Fungicides were applied to wheat only as seed treatments with a reported use from only one grower. The fungicide thiram was applied to 0.3 percent of the acreage, at 0.104 pounds a.i. per acre and an average annual frequency of 1.00. The calculated total of thiram applied was 13.3 pounds. In some cases, thiram was applied as a vertebrate repellent (see below) since is labeled as both a fungicide and repellent.

Among herbicides, 2,4-D was applied by the largest percentage of wheat growers using pesticides (35.8%), to the largest percentage of wheat acreage (37.4%), and in the largest total quantity (6986.4 pounds). Average application rates for herbicides ranged from 0.008 pounds a.i. per acre for chlorsulfuron to

0.875 for diclofop methyl. Average annual application frequencies varied from 0.33 for diclofop methyl to 1.15 for glyphosate.

Among insecticides, carbofuran was applied by the largest percentage of wheat growers using pesticides (6.1%) and to the largest percentage of wheat acreage (3.5%). Malathion was applied in the largest total quantity (1416.7 pounds). Average application rates for insecticides ranged from 0.50 pounds a.i. per acre for disulfoton to 1.120 pounds a.i. per acre for malathion. Average annual application frequencies varied from 0.33 for methyl parathion (applied by only one grower) to 1.04 for malathion.

Vertebrate repellents were applied to wheat only as seed treatments and were used by very few growers. Lindane, normally considered an insecticide, was applied in a formulation combination with captan, this formulation being labeled as a vertebrate repellent. Captan plus lindane and thiram were applied by an equal percentage of wheat growers using pesticides (0.7%). Captan plus lindane was applied to the largest percentage of wheat acreage (0.3%). Lindane was applied in the largest total quantity (3.4 pounds). Vertebrate repellents were applied at rates ranging from 0.016 pounds a.i. per acre for lindane to 0.104 pounds a.i. per acre for thiram. All vertebrate repellents were applied to wheat an average of once per year.

Major Target Pests In Barley

Target pests for pesticides applied to barley are summarized in Table 13. Pesticides were applied to barley for the control of two diseases, nine insects, three vertebrates, and eight weeds. Pesticide treatment reports from barley indicated weeds as target pests most often (80.4%), followed by insects (15.7%), vertebrates (2.8%), and plant diseases (1.1%). The percent of acreage treated and amounts of pesticides applied to barley for the control of specific diseases, insects, vertebrates, and weeds are summarized in Tables 14 through 21.

Loose smut was the major disease treated in barley and was indicated as a target pest in 1.6% of the reports. Maneb was the primary fungicide applied for loose smut, with 0.4% of the barley acreage treated using a total of 10.6 pounds of fungicide.

Cereal leaf beetle and Russian wheat aphid were the major insect pests treated in barley. Both of these insects were indicated as target pests in 9.8% of the reports. Carbaryl was the primary insecticide applied for control of cereal leaf

beetle, with 5.2% of the acreage treated using a total of 681.2 pounds of insecticide. Disulfoton was the primary insecticide applied for control of Russian wheat aphid, with 6.2% of the acreage treated using a total of 575.4 pounds of insecticide.

Birds were the major vertebrate pest treated in barley and were indicated as a target pest in 2.7% of the reports. Captan was the primary pesticide applied for their control, with 0.7% of the acreage treated using a total of 2.8 pounds of repellent. (Although normally considered a fungicide, certain formulations of captan are also labeled as a vertebrate repellent.)

Broadleaf annuals, bindweed, and kochia were the major weed pests treated in barley. These weeds were indicated as target pests in 36.4%, 35.9%, and 35.3% of the reports, respectively. 2,4-D was the primary pesticide applied for control of all three weeds, with 27.2% of the acreage treated using a total of 1979 pounds of herbicide for broadleaf annuals, 20.3% of the acreage treated using a total of 1372 pounds of herbicide for bindweed, and 19.5% of the acreage treated using a total of 1364 pounds of herbicide for kochia.

Major Target Pests In Oats

Target pests for pesticides applied to oats are summarized in Table 22. Pesticides were applied to oats for the control of four insects, one vertebrate, and six weeds. Pesticide treatment reports from oats indicated weeds as target pests most often (88.4%), followed by insects (9.3%), and vertebrates (2.3%). Diseases as target pests in oats were not indicated in any reports. The percent of acreage treated and amounts of pesticides applied to oats for the control of specific insects, vertebrates, and weeds are summarized in Tables 23 through 28.

Only one grower reported insects as target pests in oats. Four insect target pests (black grass bug, cereal leaf beetle, Russian wheat aphid, and other grain aphids) were indicated as the object of a single treatment by this grower. Carbofuran was applied to 3.5% of the oats acreage with a total of 6.6 pounds applied.

Only one grower reported vertebrates as target pests in oats, with rodents being the object of the treatments. Strychnine was the only pesticide applied for their control, with 0.6% of the acreage treated using a total of 0.054 pounds of poison.

Kochia, broadleaf annuals, and bindweed were the major weed pests treated in oats. These weeds were indicated as target pests in 40.0%, 36.0%, and 32.0% of the reports, respectively. 2,4-D was the primary pesticide applied for control of all three weeds, with 17.2% of the acreage treated using a total of 75.5 pounds of herbicide for kochia, 17.2% of the acreage treated using a total of 106.9 pounds of herbicide for broadleaf annuals, and 18.6% of the acreage treated using a total of 102.1 pounds of herbicide for bindweed.

Major Target Pests In Wheat

Target pests for pesticides applied to wheat are summarized in Table 29. Pesticides were applied to wheat for the control of two diseases, eight insects, three vertebrates, and nine weeds. Pesticide treatment reports from wheat indicated weeds as target pests most often (83.7%), followed by insects (13.8%), vertebrates (1.7%), and plant diseases (0.7%). The percent of acreage treated and amounts of pesticides applied to wheat for the control of specific diseases, insects, vertebrates, and weeds are summarized in Tables 30 through 37.

Only one grower reported diseases as target pests in wheat, with both loose smut and seed decay being the object of a single treatment. Thiram was the only pesticide applied for their control, with 0.3% of the acreage treated using a total of 13.3 pounds of poison.

Cereal leaf beetle and Russian wheat aphid were the major insect pests treated in wheat. These insects were indicated as target pests in 7.4% and 5.4% of the reports, respectively. Carbaryl was the primary insecticide applied for control of both insects, with 1.8% of the acreage treated using a total of 700.0 pounds of insecticide. Treatments for grain aphids (other than Russian wheat aphid) accounted for the largest quantity of any insecticide, with 2.6% of the acreage treated using a total of 1269 pounds of malathion.

Birds were the major vertebrate pest treated in wheat and were indicated as a target pest in 2.0% of the reports. Captan was the primary pesticide applied for their control, with 0.3% of the acreage treated using a total of 1.8 pounds of repellent.

Bindweed, broadleaf annuals, and kochia were the major weed pests treated in barley. These weeds were indicated as target pests in 41.9%, 41.9%, and 29.1% of the reports, respectively. 2,4-D was the primary pesticide applied for control

of all three weeds, with 12.4% of the acreage treated using a total of 2813 pounds of herbicide for bindweed, 30.3% of the acreage treated using a total of 5601 pounds of herbicide for broadleaf annuals, and 11.8% of the acreage treated using a total of 2277 pounds of herbicide for kochia.

Comparison Of County Acreages

Reported small grain acreages from the survey and official state acreages are shown in Table 38. Counties included are those from which responses to the small grain survey were received (eleven total counties). Official state acreages were taken as the planted acreages listed in the 1997 Utah Agricultural Statistics, which are actually planted acreages from the 1996 growing season.

The small grain survey responses reported a total of 14,050 acres of barley, compared to 82,000 acres in the official state total for the counties included (17.1%). For oats, a total of 991 acres were reported, compared to a state total of 16,300 acres (6.1%). For wheat, a total of 40,712 acres were reported, compared to a state total of 124,800 acres (32.6%).

Within counties, all reported survey acreages were smaller than the official state acreage for the counties, with the exception of wheat in Juab county. In this case, the survey reported 1221 acres more than the official state acreage for this county.

Coefficients of correlation ($df=10$) were calculated for comparisons of survey acreages and official state acreages. A strong correlation was found for barley ($R=0.977$, $P>.95$) and wheat ($R=0.984$, $P>.95$). The correlation for oats was weaker but still significant ($R=0.582$, $P>.95$).

Pesticide Use Comparisons By County

The amounts of pesticides applied by county were compared by calculating relative percentages. Since the total use of a pesticide (pounds applied) varies with the total acreage in a county and the amount applied per acre varies with the pesticide, relative percentage values were calculated for each pesticide to remove the effect of these factors.

Relative percentage values by county for barley, oats, and wheat are shown in Tables 39 through 41. For each pesticide and county a relative percentage was calculated by first dividing the total amount of the pesticide applied in a county

by the total county crop acreage, then dividing this quantity by a second quantity: the total amount of the pesticide applied in the state divided by the total state crop acreage. Acreage values used here were those from the survey, not official state acreages.

County Comparisons For Barley

Cache County had the highest overall relative use of pesticides in barley and accounted for about 24.5% of the total pesticide use in this crop. Of 22 total pesticides reported from barley, 17 were applied in Cache County. Cache County had the highest official state acreage for barley (24,500 acres). When separate pesticide groups are considered, Cache County had the greatest total relative use of fungicides, herbicides, and insecticides. Davis County had the greatest total relative use of vertebrate repellents, and Juab and Sevier Counties each accounted for half of the relative use of vertebrate poisons.

Duchesne County had the lowest overall relative use of pesticides in barley and accounted for only 0.8% of the total pesticide use in this crop. Of 22 total pesticides, only 3 were applied in Duchesne County, all of which were herbicides.

County Comparisons For Oats

Sevier County had the highest overall relative use of pesticides in oats and accounted for about 41.3% of the total pesticide use in this crop. Of 7 total pesticides reported from oats, four were applied in Sevier County. Sevier County had the highest official state acreage for oats (3,000 acres) of those counties included in the survey responses.

When separate pesticide groups are considered, Sevier County had the greatest total relative use of herbicides, while Cache County had the greatest total relative use of insecticides and vertebrate poisons. No use of fungicides or vertebrate repellents was reported from oats.

Juab County had the lowest overall relative use of pesticides in oats and accounted for only 1.2% of the total pesticide use in this crop. Of seven total pesticides, only one herbicide was applied in Juab County.

County Comparisons For Wheat

Box Elder County had the highest overall relative use of pesticides in wheat and accounted for about 22.7% of the total pesticide use in this crop. Of 25 total pesticides reported from wheat, 16 were applied in Box Elder County. Box Elder County had the highest official state acreage for oats (76,800 acres).

When separate pesticide groups are considered, Box Elder County had the greatest total relative use of herbicides, Cache County had the greatest total relative use of insecticides, Davis County had the greatest total relative use of vertebrate repellents, and Box Elder and Juab Counties each accounted for half of the total relative use of fungicides. No use of vertebrate poisons was reported from wheat.

Sevier County had the lowest overall relative use of pesticides in wheat, where no pesticide use was reported. This county tied for the lowest official state wheat acreage (900 acres) of those counties included in the survey responses.

Extrapolated State Totals

One of the purposes of the pesticide use survey was to produce estimates of the total amounts of pesticides applied to small grains in Utah. Data from the survey was extrapolated to generate these estimates and is shown in Table 42. According to the 1997 Utah Agricultural Statistics, there were totals of 110,000 acres of barley, 45,000 acres of oats, and 205,000 acres of wheat planted in Utah in 1996. These values were used to create multipliers for the total amounts of pesticides applied by dividing the official state acreage by the reported survey acreage. A value of 7.829 was used for barley (110,000 divided by 14,050), a value of 45.409 was used for oats (45,000 divided by 991), and a value of 5.035 was used for wheat (205,000 divided by 40,712).

An estimated total of 219.2 pounds of fungicides are applied to Utah small grains annually. Fungicides applied to small grains included three different active ingredients. Among fungicides, maneb was applied in the greatest estimated amount to barley and thiram in the greatest estimated amount to wheat. No fungicide use was reported from oats.

An estimated total of 78,914.6 pounds of herbicides are applied to Utah small grains annually. Herbicides applied to small grains included fifteen different active ingredients. Among herbicides, 2,4-D was applied in the greatest quantity to all three small grain crops. Glyphosate was applied in the second greatest quantity to all three crops. Dicamba was applied in the third greatest

quantity to oats and wheat, while triallate was applied in the third greatest quantity to barley.

An estimated total of 29,550.5 pounds of insecticides are applied to Utah small grains annually. Insecticides applied to small grains included five different active ingredients. Among insecticides, carbaryl was applied in the greatest quantity to barley and in the second greatest quantity to oats and wheat. Carbofuran was applied in the greatest quantity to oats, and in the third greatest quantity to wheat. Malathion was applied in the greatest quantity to wheat, and in the third greatest quantity to barley.

An estimated total of 2.0 pounds of vertebrate poisons are applied Utah small grains annually. Strychnine was the only vertebrate poison reported and was applied only to barley and oats, with barley accounting for a slight majority of the use.

An estimated total of 85.8 pounds of vertebrate repellents are applied to Utah small grains annually. Vertebrate repellents applied to small grains included three different active ingredients. Among vertebrate repellents, captan was applied in the greatest quantity to barley and lindane in the greatest quantity to wheat. No use of vertebrate repellents was reported from oats.

SUMMARY AND CONCLUSIONS

Survey Design And Responses

The survey design was deemed to be adequate, with a reasonable percentage (in terms of design) of Utah small grain growers receiving the survey. Response rates were adequate for barley and wheat growers, but less than adequate for oats growers. In particular, responses from oats growers with larger acreages were lacking, and no data was obtained from two of the largest oats-producing counties. Since many growers failed to respond even though they received the survey, increasing the number of recipients should bring the number of responses to a more suitable level, particularly for more minor crops such as oats. The response rate obtained here could be used as a base-line value in determining a suitable sample size and total number of recipients for any future surveys of Utah growers.

Cropping Patterns And Crop Acreage

Growers were equally likely to use pesticides whether they produced barley, oats, or wheat. However, growers of barley treated a significantly higher percentage of acreage than wheat and oats growers. Although some growers produce two or three different small grain crops, the majority of Utah grain growers are involved in the production of a single small grain crop. Growers producing more than one small grain crop were no more likely to use pesticides than those producing a single small grain crop. However, growers with large crop acreages were more likely to use pesticides than those with small acreages.

Treatment Methods

Treatment methods used in small grains included ground equipment (including hand probes), aircraft, and seed treatment, but no chemigation. Treatment by ground equipment was the major method of application for herbicides, insecticides, and vertebrate poisons in all three crops and was used by significantly more growers than the other two methods combined. Aircraft applications were used most often in wheat, predominantly for the application of herbicides. Seed treatment was the major method of application for vertebrate repellents and fungicides. Seed treatment was used most often in barley for applications of fungicide and vertebrate repellents.

Pesticide Use Patterns

Growers that used pesticides treated an average of about 70% of their small grain crops with a pesticide and applied pesticides an average of just slightly more than once per season. Herbicides were by far the most common pesticides used in Utah small grains, followed by insecticides. Even when combined, the use of fungicides, vertebrate poisons, and vertebrate repellents was very minor by comparison. Herbicides were used on small grains in the largest percentage of treatments (78.2%), applied to the largest percentage of treated acreage (80.1%) and total acreage (59.8%), and were applied in the largest total percentage of total amounts (71.5%). Insecticides were ranked second in all of these categories (17.4%, 18.1%, 13.5%, and 28.2%, respectively). The combined use of fungicides, vertebrate poisons, and vertebrate repellents accounted for only 4.4% of treatments, 0.9% of the treated acreage, 0.7% of the total acreage, and 0.3% of the total amounts of pesticides. Compared to insecticides, herbicides were applied in about 6 times as many treatments, to about 4 times as much acreage, and in about 3 times the total amount. Compared to fungicides, vertebrate poisons, and vertebrate repellents

combined, herbicides were applied in about 30 times as many treatments, to about 50 times the acreage, and in about 250 times the total amount.

Major Pesticides

Among herbicides, 2,4-D was by far the most commonly used, followed by glyphosate and dicamba. Dicamba was not used in oats, where triallate was ranked third. A total of fifteen different herbicide active ingredients were reported from Utah small grains. The four major insecticides used in small grains were difficult to separate in terms of importance. These insecticides were carbaryl, carbofuran, disulfoton, and malathion. When all aspects of use patterns are considered, their importances can be considered essentially equal. A total of five different insecticide active ingredients were reported from Utah small grains. Although their use was very minor, thiram was the most commonly used fungicide, strychnine was the only vertebrate poison, and captan was the most commonly used vertebrate repellent. A total of four different active ingredients were included among these minor pesticides.

Major Target Pests

The major weed pests reported from Utah small grains were bindweed, broadleaf annuals, and kochia. Broadleaf annuals and kochia were generally treated with 2,4-D, dicamba, or tribenuron plus thifensulfuron (a formulation combination). Bindweed was generally treated with one of the above or with glyphosate alone or in combination with 2,4-D. Cereal leaf beetle and Russian wheat aphid were the major insect pests reported from Utah small grains. Cereal leaf beetle was generally treated with carbofuran, while disulfoton was generally used for treatments of Russian wheat aphid. Plant diseases in Utah small grains seldom required treatment, but loose smut was treated most often, using thiram. Likewise, vertebrate pests were seldom a problem, but treatments were applied most often for birds, using captan as a repellent.

County Comparisons

Among Utah Counties included in the survey responses, Box Elder, Cache, and Sevier Counties were notable as reporting the greatest relative amount of herbicide and insecticide use for wheat, barley, and oats, respectively. Interestingly, Box Elder County is the largest wheat-producing county in Utah, Cache County is the largest barley-producing county in Utah, and Sevier County is the largest oats-producing county among those counties included in

the survey responses. Even when variations in crop acreage and application rates are factored out using relative amounts, counties that were the largest producers of a crop tended to be the counties that were the largest users of pesticides on that crop.

Usefulness Of The Data

The survey was successful in its goal of obtaining data regarding pesticide use on small grains in Utah. The results provided useful information about the major pesticides, target pests, treatment methods, and pesticide use patterns, and total amounts of pesticides used in barley, oats, and wheat. Data from this survey will eventually be added to a national database maintained by NAPIAP, and should prove to be useful in responding to future NAPIAP information requests or requests from others interested in pesticide use patterns. The results also provided a measure of the importance of pesticides and target pests on small grains in various Utah counties and on a state-wide basis. This information should be useful to those involved in providing pest control recommendations to Utah small grain growers.

ACKNOWLEDGMENTS

The authors wish to thank Dr. Diane Alston and Mike Redding of USU Extension Entomology for conducting the small grain survey and allowing us to include our pesticide use questions. Production of this summary would not have been possible without their efforts.

REFERENCES CITED

- 1) Anonymous. 1996. 1996 Crop Protection Reference, 12th Edition. Chemical and Pharmaceutical Press, New York.
- 2) Fisher, G., J.DeAngelis, C. Baird, R. Stoltz, L. Sandovol, A. Antonelli, E. Beers, and D. Mayer. 1996. 1996 Pacific Northwest Insect Control Handbook. Extension Services of Oregon State University, Washington State University, and the University of Idaho.

- 3) William, R.D, D. Ball, T.L. Miller, R. Parker, K. Al-Khatib, R.H. Callihan, C. Eberlein, D.W. Morishita. 1996. 1996 Pacific Northwest Weed Control Handbook. Extension Services of Oregon State University, Washington State University, and the University of Idaho.
- 4) Anonymous. 1996. Pest-Bank databanks of pesticide chemicals on CD-ROM. August 1996. Purdue Research Foundation, West Lafayette, IN.
- 5) Scheaffer, R.L., W. Mendenhall, and L. Ott. 1979. Elementary survey sampling. Duxbury Press, North Scituate, MA.
- 6) Anonymous. 1997. 1997 Utah agricultural statistics and Utah Department of Agriculture and Food annual report. U.S. Department of Agriculture National Agricultural Statistics Service, Utah Agricultural Statistics Service, and Utah Department of Agriculture and Food.
- 7) Anonymous. 1992. 1992 census of agriculture. U.S. Department of Agriculture National Agricultural Statistics Service
- 8) Steele, R.G.D, and J.H. Torrie. 1960. Principles and procedures of statistics with special reference to the biological sciences. McGraw-Hill Book Company, Inc., New York, NY.

SUMMARY TABLES

Table 1: Grower responses, total reported acreage, and treated acreage for Utah small grain crops (188 total grower responses for small grain acreage).

Treated Acreage In Crop Summaries	Number Of Percent Of Growers Included Reporting Included In Acreage Treated	Number Of Growers Included In Summaries *	Total Acreage Reported	Total Acreage Included Summaries
Barley 11531	140 87.8	128	14050	13131

Oats	31	31	991	991
499	50.3			
Wheat	103	93	40712	38606
27309	70.7			

* Some growers reported pesticide usage but did not provide sufficiently detailed usage patterns for inclusion in the pesticide use summaries.

Table 2: Cropping patterns and pesticide use among Utah growers reporting small grain acreage.

Number Of Crop Or Growers ** Combination Using Of Crops Pesticides	Percent Of Growers ** Reporting Using Acreage Pesticides	Number Of Growers Reporting Acreage	Percent Of Growers * Reporting Acreage
Barley		66	35.1
41	62.1		
Oats		7	3.7
3	42.9		
Wheat		40	21.3
26	65.0		
Barley and Oats		12	6.4
8	66.7		
Barley and Wheat		51	27.1
35	68.6		
Oats and Wheat		1	0.5
0	0.0		
Barley, Oats, and Wheat		11	5.9
9	81.8		

* Based on 188 total responses.

** Within each group of growers reporting the Crop Or Combination Of Crops.

Table 3: Acreage and pesticide use among Utah growers reporting barley acreage.

Acreage Range	Growers Producing Crop	Growers Using Pesticides	Percent Growers Using Pesticides
---------------	------------------------------	--------------------------------	---

0 to 50	69	42	61
51 to 100	33	23	70
101 to 200	26	18	69
201 to 500	9	8	89
501 or more	3	3	100

Totals:	140	94	Average: 67

Table 4: Acreage and pesticide use among Utah growers reporting oats acreage.

Acreage Range	Farms Producing Crop	Farms Using Pesticides	Percent Farms Using Pesticides
0 to 50	27	14	52
51 to 100	3	1	33
101 to 200	1	1	100
201 to 500	0	0	---
501 or more	0	0	---

Totals:	31	16	Average: 52

Table 5: Acreage and pesticide use among Utah growers reporting wheat acreage.

Acreage Range	Farms Producing Crop	Farms Using Pesticides	Percent Farms Using Pesticides
0 to 50	42	26	62
51 to 100	12	7	58
101 to 200	17	14	82
201 to 500	11	7	64
501 or more	21	16	76

Totals:	103	70	Average: 68

Table 6: Acreage and pesticide use among Utah growers reporting small grain acreage (barley, oats, and wheat combined).

Acreage Range	Farms Producing Crop	Farms Using Pesticides	Percent Farms Using Pesticides
0 to 50	138	82	59
51 to 100	48	31	65

101 to 200	44	33	75
201 to 500	20	15	75
501 or more	24	19	79

Totals:	274	180	Average: 66

Table 7: Pesticide types and application methods for treatments made to barley.

Application Method *		Percent Of Crop Treated Using		
		Application		Application
Total For		By Ground	By Aircraft	Or Ground
Application	Pesticide	By Ground	By Aircraft	Or Ground
By Seed	Type - All	Equipment	Equipment	Equipment
Pesticide Type	By Aircraft	Equipment	Equipment	Equipment
Treatment	Methods			
Fungicides		---	---	---
1.1	1.1			
Herbicides		2.2	58.7	1.1
---	61.9			
Insecticides		3.5	16.0	3.1
0.9	23.4			
Vertebrate Poisons		---	0.4	---
---	0.4			
Vertebrate Repellents		---	---	---
1.0	1.0			

Totals For Methods:		5.7	75.1	4.1
3.0	87.8			

Table 8: Pesticide types and application methods for treatments made to oats.

Application Method *		Percent Of Crop Treated Using		
		Application		Application
Total For		By Ground	By Aircraft	Or Ground
Application	Pesticide	By Ground	By Aircraft	Or Ground

By Seed Pesticide Type Treatment	Type - All Methods	Application By Aircraft	By Ground Equipment	Or Ground Equipment
Fungicides	---	---	---	---
Herbicides	46.2	2.8	43.4	---
Insecticides	3.5	---	3.5	---
Vertebrate Poisons	0.6	---	0.6	---
Vertebrate Repellents	---	---	---	---
Totals For Methods:	50.3	2.8	47.5	---

Table 9: Pesticide types and application methods for treatments made to wheat.

Application Method *		Percent Of Crop Treated Using		
Application	Pesticide Type - All Methods	Application By Aircraft	By Ground Equipment	Application By Aircraft Or Ground Equipment
Fungicides	0.3	---	---	---
Herbicides	59.4	9.4	49.6	0.5
Insecticides	10.4	1.3	4.9	4.2
Vertebrate Poisons	---	---	---	---
Vertebrate Repellents	0.6	---	---	---
Totals For Methods:	70.7	10.7	54.4	4.7

Table 10: Use patterns for pesticides applied to Utah barley.

Average Percent Of Pesticide Acreage Name (Formulation) Treated	Average Application Generic Rate (lbs. a.i. per acre)	Total Amount Of Reports For Applica- Usage Of tions Per Pesticide Year	Percent Reports For Pesticide Usage Of Applied Pesticide (lbs.)	Total Acreage Treated	
-Fungicides-					
Carboxin (D) 0.104	1.00	1 6.0	0.5	58.0	0.4
Maneb (D) 0.182	1.00	1 10.6	0.5	58.0	0.4
Thiram (D) 0.130	1.00	1 2.9	0.5	22.0	0.2
-Herbicides-					
2,4-D (EC,SC) 0.525	1.06	69 2816.7	37.5	5171.2	39.4
Clopyralid (EC) 0.103	1.00	2 3.0	1.1	29.7	0.2
Dicamba (SC) 0.098	1.04	14 63.3	7.6	631.0	4.8
Difenzoquat (SC) 0.786	0.90	5 141.8	2.7	185.0	1.4
Glyphosate (SC) 0.539	0.98	15 216.3	8.2	452.8	3.4
Imazamethabenz (EC) 0.425	0.92	6 99.7	3.3	235.1	1.8
Thifensulfuron (DF) 0.013	0.94	8 7.6	4.4	617.5	4.7
Triallate (EC) 1.100	1.00	5 180.9	2.7	161.9	1.2
Tribenuron (DF) 0.018	0.95	10 5.6	5.4	649.5	4.9
-Insecticides-					
Carbaryl (EC) 1.000	0.75	7 681.2	3.8	681.2	5.2
Carbofuran (F) 0.203	1.03	8 236.1	4.4	1112.5	8.5
Disulfoton (EC) 0.696	0.92	14 575.4	7.6	810.5	6.2
Lindane (D) 0.075	1.00	3 9.5	1.6	118.0	0.9

Malathion (EC)		6	3.3	227.3	1.7
1.104	0.96	258.1			
Methyl Parathion (EC)		1	0.5	123.8	0.9
0.750	0.33	92.8			

-Vertebrate Poisons-

Strychnine (B)		3	1.6	51.0	0.4
0.003	2.00	0.2			

-Vertebrate Repellents-

Captan (D)		3	1.6	90.0	0.7
0.031	1.00	2.8			
Lindane (D)		1	0.5	30.0	0.2
0.063	1.00	1.9			
Thiram (D)		1	0.5	15.0	0.1
0.130	1.00	2.0			

Table 11: Use patterns for pesticides applied to Utah oats.

Average Percent Of Pesticide Acreage Name (Formulation) Treated	Average Application Generic Rate (lbs. a.i. per acre)	Total Amount Of Reports For Applica- Usage Of tions Per Pesticide Year	Percent Reports For Pesticide Usage Of Applied Pesticide (lbs.)	Total Acreage Treated
--	---	---	---	-----------------------------

-Fungicides-

[No uses reported]

-Herbicides-

2,4-D (EC, SC)		14	56.0	311.9	31.5
0.503	0.96	168.1			
Dicamba (SC)		2	8.0	75.0	7.6
0.110	1.00	8.9			
Glyphosate (SC)		5	20.0	30.7	3.1
0.506	0.77	19.6			
Thifensulfuron (DF)		1	4.0	20.0	2.0
0.014	1.00	0.3			
Tribenuron (DF)		1	4.0	20.0	2.0
0.007	1.00	0.1			

-Insecticides-

Carbofuran (F)		1	4.0	35.0	3.5
0.188	1.00	6.6			

-Vertebrate Poisons-

Strychnine (B)		1	4.0	6.0	0.6
0.003	3.00	0.0			

-Vertebrate Repellents-

[No uses reported]

Table 12: Use patterns for pesticides applied to Utah wheat.

Average Percent Of Pesticide Acreage Name Treated	Average Application Generic Rate (lbs. a.i. per acre)	Total Amount Of Reports For Applica- Usage Of Pesticide Year	Percent Reports For Pesticide Usage Of Applied Pesticide (lbs.)	Total Acreage Treated	
--	---	--	---	-----------------------------	--

-Fungicides-

Thiram (D)		1	0.7	128.0	0.3
0.104	1.00	13.3			

-Herbicides-

2,4-D (EC, SC)		53	35.8	14440.0	37.4
0.483	1.09	6986.4			
Bromoxynil (EC)		1	0.7	85.0	0.2
0.375	1.00	31.9			
Chlorsulfuron (DF)		1	0.7	75.0	0.2
0.008	0.50	0.6			
Clopyralid (EC)		1	0.7	128.0	0.3
0.095	1.00	12.2			
Dicamba (SC)		19	12.8	2300.4	6.0
0.148	1.20	300.0			
Diclofop Methyl (EC)		1	0.7	2.0	<0.1
0.875	0.33	1.7			
Difenzoquat (SC)		1	0.7	20.0	0.1
0.750	1.00	15.0			
Glyphosate (SC)		12	8.1	1533.8	4.0
0.527	1.15	479.8			
Imazamethabenz (EC)		5	3.4	375.6	1.0
0.432	0.93	155.8			
MCPA (EC)		2	1.4	478.4	1.2
0.378	1.00	181.4			
Metsulfuron (DF)		4	2.7	757.6	2.0
0.038	0.73	28.8			
Picloram (SC)		2	1.4	106.2	0.3
0.188	0.67	25.8			

Thifensulfuron (DF)		7	4.7	1176.3	3.0
0.014	1.00	16.6			
Triallate (EC)		4	2.7	136.3	0.4
1.094	0.88	152.5			
Tribenuron (DF)		9	6.1	1317.3	3.4
0.019	1.00	10.8			

-Insecticides-

Carbaryl (EC)		1	0.7	700.0	1.8
1.000	1.00	700.0			
Carbofuran (F)		9	6.1	1336.4	3.5
0.209	0.80	321.6			
Disulfoton (EC)		5	3.4	446.3	1.2
0.500	0.62	211.3			
Malathion (EC)		6	4.1	1160.3	3.0
1.120	1.04	1416.7			
Methyl Parathion (EC)		1	0.7	371.3	1.0
0.750	0.33	278.4			

-Vertebrate Poisons-

[No uses reported]

-Vertebrate Repellents-

Captan (D)		1	0.7	110.0	0.3
0.016	1.00	1.8			
Lindane (D)		1	0.7	110.0	0.3
0.031	1.00	3.4			
Thiram (D)		1	0.7	15.0	<0.1
0.104	1.00	1.6			

Table 13: Target pests for pesticide applications to Utah barley.

Percent Of	Average	Total	Percent	Total
Acreage	Applications	Reports For	Reports For	Acreage
Target Pest	Per Year	Treatment	Treatment	Treated
Treated		Of Pest	Of Pest	

-Diseases-

Loose Smut		3	1.6	138.0	1.1
1.00					
Seed Decay		1	0.5	22.0	0.2
1.00					

-Insects-

Armyworms	1	0.5	123.8	0.9
0.33				
Black Grass Bug	5	2.7	612.0	4.7
1.40				
Cereal Leaf Beetle	18	9.8	1848.7	14.1
0.89				
Cutworms	1	0.5	123.8	0.9
0.33				
Grain Aphids	5	2.7	580.0	4.4
1.20				
Grasshoppers	4	2.2	385.8	2.9
1.33				
Mormon Cricket	2	1.1	212.0	1.6
2.00				
Russian Wheat Aphid	18	9.8	1270.7	9.7
0.89				
Wireworms	3	1.6	118.0	0.9
1.00				
-Vertebrates-				
Birds	5	2.7	135.0	1.0
1.00				
Deer	1	0.5	15.0	0.1
1.00				
Rodents	4	2.2	66.0	0.5
1.75				
-Weeds-				
Bindweed	66	35.9	3931.2	29.9
1.07				
Broadleaf Annuals	67	36.4	4840.4	36.9
1.03				
Canada Thistle	46	25.0	3365.6	25.6
1.00				
Foxtail	2	1.1	1.4	<0.1
2.00				
Jointed Goatgrass	5	2.7	103.1	0.8
1.00				
Kochia	65	35.3	4428.9	33.7
1.02				
Quackgrass	15	8.2	637.5	4.9
0.95				
Wild Oats	26	14.1	1348.1	10.3
0.88				

Table 14: Percent of Utah barley crop treated with fungicides for specific plant diseases.

Fungicide Generic Name	-Plant Diseases-	
	Loose	Seed
	Smut	Decay

Carboxin	0.4	
Maneb	0.4	
Thiram	0.2	0.2

Table 15: Total reported amounts (pounds) of fungicides applied to Utah barley for specific plant diseases.

Fungicide	Generic Name	-Plant Diseases-	
		Loose Smut	Seed Decay
Carboxin		6.0	
Maneb		10.6	
Thiram		2.9	2.9

Table 16: Percent of Utah barley crop treated with insecticides for specific insects.

Insecticide	Generic Name	Wheat	Cereal			Grain
			Black Grass	Leaf Beetle	Cutworms	
Carbaryl			1.9	5.2		2.7
Carbofuran			2.1	7.2		0.8
Disulfoton		0.8				0.3
Lindane						
Malathion			0.6	1.7		0.6
Methyl Parathion			0.9		0.9	

Table 17: Total reported amounts (pounds) of insecticides applied to Utah barley for specific insects.

Insecticide Generic Name				Black Grass	Cereal Leaf Beetle	Grain Cutworms
Grass- Aphids	Mormon hoppers	Wheat Cricket	Armyworms Aphid	Bug Wireworms		
Carbaryl				250.0	681.2	350.0
350.0						
Carbofuran				61.2	195.6	20.7
33.0	33.0	20.7				
Disulfoton						30.0
575.4						
Lindane						
9.5						
Malathion				100.0	257.8	100.0
154.7	100.0	0.3				
Methyl Parathion			92.8			92.8
92.8						

Table 18: Percent of Utah barley crop treated with vertebrate repellents or poisons for specific vertebrate pests.

Vertebrate Repellent or Poison Generic Name	Vertebrates		
	Birds	Deer	Rodents
Captan	0.7		
Lindane	0.2		
Strychnine			0.4
Thiram	0.1	0.1	0.1

Table 19: Total reported amounts (pounds) of vertebrate repellents or poisons applied to Utah barley for specific vertebrates.

Vertebrate Repellent or Poison Generic Name	Vertebrates		
	Birds	Deer	Rodents
Captan	2.8		
Lindane	1.9		
Strychnine			0.2
Thiram	1.9	1.9	1.9

Table 20: Percent of Utah barley crop treated with herbicides for specific weeds.

Herbicide		Weeds				
Generic Name		Orchard- Bindweed grass	Broadleaf Quack- Annuals grass	Burr Wild Buttercup Oats	Canada Thistle	Foxtail
2,4-D		20.3	27.2		17.3	
0.6	19.5		2.2	3.9		
Clopyralid					0.2	
Dicamba		3.3	2.8		2.7	
3.8			1.0			
Difenzoquat		0.5				
1.4						
Glyphosate		2.4			1.0	
0.2	1.0		1.5	1.0		
Imazamethabenz						
1.8						
Thifensulfuron		1.7	3.4		2.2	
4.7		0.6				
Triallate						
1.2						
Tribenuron		1.8	3.5		2.3	
4.8		0.6				

Table 21: Total reported amounts (pounds) of herbicides applied to Utah barley for specific weeds.

Herbicide		Weeds				
Generic Name		Orchard- Bindweed grass	Broadleaf Quack- Annuals grass	Burr Wild Buttercup Oats	Canada Thistle	Foxtail
2,4-D		1372	1979		1372	0.3
47.0	1364		150.9	246.2		
Clopyralid					3.0	
Dicamba		42.1	34.9		35.4	
46.7			11.8			
Difenzoquat		45.0				
141.8						
Glyphosate		159.6			70.8	0.3
8.7	70.5		96.2	70.8		
Imazamethabenz						
99.7						
Thifensulfuron		2.7	5.5		4.0	
7.6		0.7				

Triallate			
180.9			
Tribenuron	2.9	4.3	2.1
5.4	0.4		

Table 22: Target pests for pesticide applications to Utah oats.

Percent Of Acreage Target Pest Treated	Average Applications Per Year	Total Reports For Treatment Of Pest	Percent Reports For Treatment Of Pest	Total Acreage Treated
<hr/>				
-Diseases-				
[No pests reported]				
-Insects-				
Black Grass Bug		1	4.0	35.0
1.00				3.5
Cereal Leaf Beetle		1	4.0	35.0
1.00				3.5
Grain Aphids		1	4.0	35.0
1.00				3.5
Russian Wheat Aphid		1	4.0	35.0
1.00				3.5
-Vertebrates-				
Rodents		1	4.0	6.0
3.00				0.6
-Weeds-				
Bindweed		8	32.0	244.2
0.89				24.6
Broadleaf Annuals		9	36.0	185.8
1.00				18.7
Canada Thistle		3	12.0	80.0
1.00				8.1
Kochia		10	40.0	225.5
1.00				22.8
Quackgrass		7	28.0	41.4
0.76				4.2
Wild Oats		1	4.0	25.0
1.00				2.5

Table 23: Percent of Utah oats crop treated with insecticides for specific insects.

Insects						
Russian	Grass			Cereal		Grain
	Mormon	Wheat	Armyworms	Bug	Beetle	
Insecticide	Generic Name	Cricket	Aphid	Wireworms		
Carbofuran				3.5	3.5	3.5
3.5						

Table 24: Total reported amounts (pounds) of insecticides applied to Utah oats for specific insects.

Insects						
Russian	Grass			Cereal		Grain
	Mormon	Wheat	Armyworms	Bug	Beetle	
Insecticide	Generic Name	Cricket	Aphid	Wireworms		
Carbofuran				6.6	6.6	6.6
6.6						

Table 25: Percent of Utah oats crop treated with vertebrate repellents or poisons for specific vertebrate pests.

Vertebrates			
Vertebrate Repellent or Poison	Generic Name	Birds	Rodents
		Strychnine	

Table 26: Total reported amounts (pounds) of vertebrate repellents or poisons applied to Utah oats for specific vertebrates.

-----Vertebrates-----				
Vertebrate Repellent or Poison	Generic Name	Birds	Deer	Rodents
Strychnine				<0.1

Table 27: Percent of Utah oats crop treated with herbicides for specific weeds.

-----Weeds-----					
Herbicide	Orchard- Bindweed Goatgrass	Broadleaf Quack- Annuals grass	Burr Wild Buttercup Oats	Canada Thistle	Foxtail
2,4-D	18.6	17.2		6.6	
17.2	1.1	2.5			
Dicamba	6.1	1.5		1.5	
1.5					
Glyphosate					
3.1					
Thifensulfuron					
2.0					
Tribenuron					
2.0					

Table 28: Total reported amounts (pounds) of herbicides applied to Utah oats for specific weeds.

-----Weeds-----					
Herbicide	Orchard- Bindweed Goatgrass	Broadleaf Quack- Annuals grass	Burr Wild Buttercup Oats	Canada Thistle	Foxtail
2,4-D	102.1	106.9		34.7	
75.5	6.2	6.0			
Dicamba	7.5	1.4		1.4	
1.4					
Glyphosate	0.1				
19.6					
Thifensulfuron					
0.3					
Tribenuron					
0.1					

Table 29: Target pests for pesticide applications to Utah wheat.

Percent Of Acreage Target Pest Treated	Average Applications Per Year	Total Reports For Treatment Of Pest	Percent Reports For Treatment Of Pest	Total Acreage Treated	
-Diseases-					
Loose Smut 1.00		1	0.7	128.0	0.3
Seed Decay 1.00		1	0.7	128.0	0.3
-Insects-					
Armyworms 0.33		1	0.7	371.3	1.0
Black Grass Bug 1.67		3	2.0	1388.0	3.6
Cereal Leaf Beetle 0.89		11	7.4	1661.7	4.3
Cutworms 0.33		1	0.7	371.3	1.0
Grain Aphids 1.08		6	4.1	1777.5	4.6
Grasshoppers 1.00		7	4.7	2026.0	5.2
Mormon Cricket 2.00		2	1.4	1378.0	3.6
Russian Wheat Aphid 0.67		8	5.4	1161.5	3.0
-Vertebrates-					
Birds 1.00		3	2.0	235.0	0.6
Deer 1.00		1	0.7	15.0	<0.1
Rodents 1.00		1	0.7	15.0	<0.1
-Weeds-					
Bindweed 1.14		62	41.9	8278.9	21.4
Broadleaf Annuals 1.02		62	41.9	16878	43.7

Burr Buttercup 0.50	4	2.7	300.0	0.8
Canada Thistle 1.06	33	22.3	5487.2	14.2
Jointed Goatgrass 1.29	7	4.7	2557.0	6.6
Kochia 1.02	43	29.1	8472.9	21.9
Orchardgrass 1.00	1	0.7	5.0	<0.1
Quackgrass 1.20	9	6.1	105.2	0.3
Wild Oats 1.03	15	10.1	717.8	1.9

Table 30: Percent of Utah wheat crop treated with fungicides for specific plant diseases.

Fungicide Generic Name	-Plant Diseases-	
	Loose Smut	Seed Decay
Thiram	0.3	0.3

Table 31: Total reported amounts (pounds) of fungicides applied to Utah wheat for specific plant diseases.

Fungicide Generic Name	-Plant Diseases-	
	Loose Smut	Seed Decay
Thiram	13.3	13.3

Table 32: Percent of Utah wheat crop treated with insecticides for specific insects.

Insecticide Generic Name	-Plant Diseases-			
	Grass- Armyworms Aphids	Mormon hoppers Cricket	Wheat Cricket Aphid	Black Bug Wireworms
Carbaryl 1.8				Cereal Leaf Beetle Cutworms Grain 1.8

Carbofuran		2.2	1.0	
2.7	2.2			
Disulfoton				0.1
1.2				
Malathion		1.3	1.5	2.6
1.6	1.3			
Methyl Parathion		1.0		1.0
1.0				

Table 33: Total reported amounts (pounds) of insecticides applied to Utah wheat for specific insects.

Insects	Black Cereal				Grain	
	Grass	Leaf	Beetle	Cutworms		
Russian	Grass	Leaf	Beetle	Cutworms	Grain	
Grass-	Mormon	Wheat	Armyworms	Bug	Beetle	Cutworms
Insecticide	Generic	Name	Armyworms	Bug	Beetle	Cutworms
Aphids	hoppers	Cricket	Aphid	Wireworms		
Carbaryl					700.0	700.0
700.0						
Carbofuran			216.4	80.4		1.9
261.2	214.5	1.9				
Disulfoton						29.4
211.2						
Malathion			650.0	726.6		1269
737.5	650.0	5.7				
Methyl Parathion			278.4			278.4
278.4						

Table 34: Percent of Utah wheat crop treated with vertebrate repellents or poisons for specific vertebrate pests.

Vertebrate Repellent or Poison	Vertebrates		
	Birds	Deer	Rodents
Captan	0.3		
Lindane	0.3		
Thiram	<0.1	<0.1	<0.1

Table 35: Total reported amounts (pounds) of vertebrate repellents or poisons applied to Utah wheat for specific vertebrates.

		-----Vertebrates-----		
Vertebrate Repellent or Poison	Generic Name	Birds	Deer	Rodents
Captan		1.8		
Lindane		3.4		
Thiram		1.6	1.6	1.6

Table 36: Percent of Utah oats crop treated with herbicides for specific weeds.

		-----Weeds-----				
Herbicide	Generic Name	Orchard- Bindweed grass	Broadleaf Quack- Annuals grass	Burr Wild Buttercup Oats	Canada Thistle	Foxtail
2,4-D		12.4	30.3	0.4	10.9	
3.3	11.8		0.1	0.4		
Bromoxynil		0.2	0.2			
0.2						
Chlorsulfuron				0.2		
Clopyralid					0.3	
Dicamba		5.4	4.3		0.9	
1.1		0.1	0.1			
Diclofop Methyl						
<0.1						
Difenzoquat						
0.1						
Glyphosate		1.2				
3.3			0.1			
Imazamethabenz						
1.0						
MCPA		0.2	1.2			
1.2						
Metsulfuron		0.1	1.8	0.2		0.1
1.8						
Picloram		0.3				
Thifensulfuron		0.8	2.9			0.8
2.9						
Triallate						
0.4						
Tribenuron		0.9	3.0			1.2
3.0						

Table 37: Total reported amounts (pounds) of herbicides applied to Utah wheat for specific weeds.

-----Weeds-----					
Herbicide		Broadleaf	Burr	Canada	
Jointed	Orchard-	Quack-	Wild	Buttercup	Thistle
Generic Name	Bindweed	Annuals	Oats		Foxtail
Goatgrass	Kochia	grass	grass	Oats	
2,4-D		2813	5601	37.5	2343
546.0	2277		7.5	79.7	
Bromoxynil		31.9	31.9		
31.9					
Chlorsulfuron				0.6	
Clopyralid					12.2
Dicamba		280.7	186.2		30.8
37.2		7.9	1.9		
Diclofop Methyl					
1.7					
Difenzoquat					
15.0					
Glyphosate		193.6			
340.8		3.8	21.2		
Imazamethabenz					
155.8					
MCPA		31.9	181.4		
181.4					
Metsulfuron		1.5	25.9	2.9	1.5
25.9					
Picloram		25.8			
Thifensulfuron		4.4	15.9		4.4
15.8					
Triallate					
152.5					
Tribenuron		3.7	9.5		3.2
9.4					

Table 38. Comparison by county of reported survey acreages and official state acreages for Utah small grain crops.

					Crop Acreages
			Barley	Oats	
Wheat					

		Percent		Percent	
County	Survey	State *	Percent	Survey	State *
In Survey	Survey	State *	In Survey	In Survey	In Survey

Box Elder	3133	16000	19.6	177	2000
8.9	26541	76800	34.6		
Cache	5005	24500	20.4	152	1700
8.9	6522	28500	22.9		
Davis	30	2000	1.5	0	<500
0.0	325	4100	7.9		
Duchesne	529	5000	10.6	30	2900
1.0	4	700	0.6		
Juab	573	2500	22.9	20	<500
>4.0	3221	2200	146.4		
Morgan	420	3000	14.0	0	<500
0.0	0	600	0.0		
Sanpete	1497	6500	23.0	376	2600
14.5	177	1400	12.6		
Sevier	805	5500	14.6	105	3000
3.5	95	700	13.6		
Tooele	70	2500	2.8	69	1100
6.3	267	1500	17.8		
Utah	1588	12500	12.7	32	<500
>6.4	3262	5400	60.4		
Weber	400	2000	20.0	30	1000
3.0	298	2900	10.3		

Total or					
(Average):	14050	82000	(14.7)	991	16300
(5.1)	40712	124800	(29.7)		

* Official state acreages obtained from 1997 Utah Agricultural Statistics.

Table 39. Relative percent of pesticides applied to barley in Utah counties.

Pesticide Applied *		Relative Percent of						
		Box Elder	Cache	Davis	Duchesne	Juab	Morgan	

Pesticide Group								
and Generic Name		Box Elder	Cache	Davis	Duchesne	Juab	Morgan	
Sanpete	Sevier	Tooele	Utah	Weber				

-Fungicides-								
Carboxin			100.0					
Maneb			100.0					
Thiram		20.9				79.1		

-Herbicides-								
2,4-D		8.6	7.3	12.3	11.0	2.4	17.1	
10.6	6.3	14.7	5.9	4.0				
Clopyralid		75.0	25.0					

Dicamba		1.5	0.3	32.9	6.6	9.8
43.7	2.0	3.3				
Difenzoquat			21.5			
17.9		60.7				
Glyphosate		1.0	4.1		0.7	2.1
25.4	2.7	0.9	3.0			60.0
Imazamethabenz		30.0	40.3			
29.7						
Thifensulfuron		10.6	12.8			
76.6						
Triallate		19.3	80.7			
Tribenuron		4.8	4.8			
30.2		60.3				

-Insecticides-

Carbaryl			76.2			
23.8						
Carbofuran			22.5	18.3		59.2
Disulfoton					8.8	
25.7	64.8	0.7				
Lindane			2.9	97.1		
Malathion			38.4			
61.6						
Methyl Parathion		100.0				

-Vertebrate Poisons-

Strychnine					50.0	
50.0						

-Vertebrate Repellents-

Captan			1.3	98.7		
Lindane			2.9	97.1		
Thiram		20.9			79.1	

* Relative Percent of Pesticide Applied calculated from total amount applied in county divided by total county crop acreage, as a percentage of the total amount applied in state divided by the total state crop acreage.

Table 40. Relative percent of pesticides applied to oats in Utah counties.

Pesticide Applied *	Relative Percent of						
	Box Elder	Cache	Davis	Duchesne	Juab	Morgan	Sanpete
Pesticide Group and Generic Name	Utah	Weber					
	Sevier	Tooele					

 -Fungicides-

[No uses reported]

-Herbicides-

2,4-D			4.4	3.3	---	**	8.3	---	**
13.4	25.6	28.0	16.9						
Dicamba			6.9		---			---	
93.1									
Glyphosate				0.3	---			---	
3.1	63.3		33.4						
Thifensulfuron					---			---	
100.0									
Tribenuron					---			---	
100.0									

-Insecticides-

Carbofuran				100.0	---			---	
------------	--	--	--	-------	-----	--	--	-----	--

-Vertebrate Poisons-

Strychnine				100.0	---			---	
------------	--	--	--	-------	-----	--	--	-----	--

-Vertebrate Repellents-

[No uses reported]

 * Relative Percent of Pesticide Applied calculated from total amount applied in county divided by total county crop acreage, as a percentage of the total amount applied in state divided by the total state crop acreage.
 ** Dashes (---) indicate that no oats acreage was reported from these counties.

Table 41. Relative percent of pesticides applied to wheat in Utah counties.

Pesticide Applied *	Relative Percent of							
	Box	Elder	Cache	Davis	Duchesne	Juab	Morgan	
Pesticide Group and Generic Name	Sanpete	Sevier	Tooele	Utah	Weber			

 -Fungicides-

Thiram		50.0			50.0	---	**
--------	--	------	--	--	------	-----	----

-Herbicides-

2,4-D		6.3	4.9	6.6	23.8	12.4	---
15.8	23.3	5.8	0.9				
Bromoxynil				100.0			---
Chlorsulfuron							---
100.0							
Clopyralid		100.0					---
Dicamba		0.7	2.1	11.1		13.6	---
71.3	1.2						
Diclofop Methyl							---
100.0							
Difenzoquat							---
100.0							
Glyphosate		30.4	34.2			2.9	---
18.8		13.8					
Imazamethabenz		37.8	62.2				---
MCPA		5.4		94.6			---
Metsulfuron		13.0	4.3			63.0	---
19.6							
Picloram		100.0					---
Thifensulfuron		66.7	33.3				---
Triallate		85.9	14.1				---
Tribenuron		5.5	1.8				---
92.7							

-Insecticides-

Carbaryl			100.0				---
Carbofuran		0.9	36.9	56.3		5.8	---
Disulfoton		6.8				6.4	---
86.9							
Lindane				100.0			---
Malathion			96.2				---
3.8							
Methyl Parathion		100.0					---

-Vertebrate Poisons-

[No uses reported]

-Vertebrate Repellents-

Captan				100.0			---
Lindane				100.0			---
Thiram		50.0				50.0	---

 * Relative Percent of Pesticide Applied calculated from total amount applied in county divided by total county crop acreage, as a percentage of the total amount applied in state divided by the total state crop acreage.

** Dashes (---) indicate that no wheat acreage was reported from this county.

Table 42. Extrapolated amounts (pounds of active ingredient) of pesticides applied state-wide to Utah small grain crops.

Pesticide Group and Generic Name	Extrapolated Amounts Applied (lbs. a.i.)			
	Barley	Oats	Wheat	Total
-----Fungicides-----				
Carboxin	47.2			47.2
Maneb	82.6			82.6
Thiram	22.4		67.0	89.4
-----Herbicides-----				
2,4-D	22052.6	7632.3	35179.0	64863.9
Bromoxynil			160.5	160.5
Chlorsulfuron			3.0	3.0
Clopyralid	23.4		61.2	84.6
Dicamba	495.7	404.6	1510.8	2411.1
Diclofop Methyl			8.7	8.7
Difenzoquat	1109.9		75.5	1185.4
Glyphosate	1693.6	890.7	2415.8	5000.2
Imazamethabenz	780.3		784.6	1564.9
MCPA			913.2	913.2
Metsulfuron			145.0	145.0
Picloram			130.0	130.0
Thifensulfuron	59.3	12.7	83.4	155.4
Triallate	1416.2		768.1	2184.2
Tribenuron	43.6	6.4	54.5	104.5
-----Insecticides-----				
Carbaryl	5333.6		3524.8	8858.3
Carbofuran	1848.3	298.8	1619.4	3766.5
Disulfoton	4504.8		1063.7	5568.5
Lindane	74.1			74.1
Malathion	2020.6		7133.8	9154.4
Methyl Parathion	726.6		1402.0	2128.7
-----Vertebrate Poisons-----				
Strychnine	1.2	0.8		2.0
-----Vertebrate Repellents-----				
Captan	21.8		8.9	30.7
Lindane	14.8		17.2	32.0
Thiram	15.3		7.9	23.1

APPENDIX A

Pesticide Use Survey

Questionnaire

A reproduction of one section of the Pesticide Use Survey questionnaire is shown below. The actual survey contained two additional sections (which were essentially identical to the lower half of the text shown here), allowing information for up to three pesticides to be recorded.

Pesticide Use: If you apply pesticides to your grain crop, please fill out the following table(s).

If you use more than one pesticide, please report up to three of the most commonly used.

You may use the letter codes from the list below to indicate target pests:

Insects & Mites	Diseases	Weeds
Vertebrates		
A Russian wheat aphid	J Loose smut (seed treat)	L Bindweed
S Birds		
B Other grain aphids	K Seed Decay (seed treat)	M Wild
oats T Rodents		
C Cereal leaf beetle		N Jointed
goatgrass U Deer		
D Wheat stem maggot		O Kochia
E Brown wheat mite		P Canada
thistle		
F Grasshoppers		Q
Quackgrass		
G Mormon cricket		R
Broadleaf annuals		
H Cutworms & Armyworms		
I Black grass bug		

Pesticide 1

- 1) Pesticide applied: _____ Brand name and formulation

- 2) Target pest(s): _____ Use letter code(s) or name(s) from list

- 3) Crop(s) treated: _____ Check all that apply for this pesticide and pest combination
 Wheat Barley Oats

- 4) Application frequency: _____ Times per season OR
 Years between applications

5) Amount of crop treated: _____ Acres OR _____
Percent of acreage

6) Application rate: Check the nearest rate _____ Low
label rate _____ Middle label rate _____ High
label rate _____

7) Application method: Check the most common method _____
Ground equipment _____ Aircraft _____
Chemigation _____ Seed treatment _____

.pa

APPENDIX B

Pesticide Trade Name To Generic

Name Index

Example Trade Name [1] Generic Name(s) Of Active Ingredient(s)
Pesticide Type(s) Or Use Pattern(s)

Agrosol Thiram
Fungicide, Vertebrate Repellent
Ally Metsulfuron
Herbicide
Assert Imazamethabenz
Herbicide
Avenge Difenzoquat
Herbicide
Banvel Dicamba
Herbicide
Bronate Bromoxynil plus MCPA
Herbicide
Buctril Bromoxynil
Herbicide
Curtail Clopyralid plus 2,4-D
Herbicide
Cythion Malathion
Insecticide
Di-Syston Disulfoton
Insecticide
Enhance Plus Carboxin plus Lindane plus Maneb
Fungicide, Insecticide
Express Tribenuron
Herbicide
Far-Go Triallate
Herbicide
Formula 40 2,4-D
Herbicide

Furadan	Carbofuran
Insecticide	
Glean	Chlorsulfuron
Herbicide	
Gopher Getter [2]	Strychnine [2]
Vertebrate Poison [2]	
Harmony	Thifensulfuron plus Tribenuron
Herbicide	
Hoelon	Diclofop Methyl
Herbicide	
Isotox	Lindane plus Captan
Fungicide, Insecticide, Vertebrate Repellent	
Landmaster	Glyphosate plus 2,4-D
Herbicide	
Penncap-M	Methyl Parathion
Insecticide	
Roundup	Glyphosate
Herbicide	
Sevin	Carbaryl
Insecticide	
Tordon	Picloram
Herbicide	
Weedmaster	Dicamba plus 2,4-D
Herbicide	

Notes:

[1] Trade names shown here are examples of products registered in 1996 for use on at least one small grain crop (barley, oats, or wheat) in Utah. Other products may or may not be registered. Product registrations and labeling may change over time. The use of trade names here is not intended to imply any endorsement of a particular product or its efficacy for a particular purpose.

[2] Strychnine is used only in non-crop areas adjacent to small grain fields (for rodent control). It is not labeled for use on areas where barley, oats, or wheat are planted or growing.

.pa

APPENDIX C

Pesticide Generic Name To Trade

Name Index

Generic Name(s) Of Active Ingredient(s)	Example Trade Name [1]
Pesticide Type(s) Or Use Pattern(s)	

2,4-D	Formula 40
Herbicide	
Bromoxynil	Buctril
Herbicide	

Bromoxynil plus MCPA Herbicide	Bronate
Carbaryl Insecticide	Sevin
Carbofuran Insecticide	Furadan
Carboxin plus Lindane plus Maneb Fungicide, Insecticide	Enhance Plus
Chlorsulfuron Herbicide	Glean
Clopyralid plus 2,4-D Herbicide	Curtail
Dicamba Herbicide	Banvel
Dicamba plus 2,4-D Herbicide	Weedmaster
Diclofop Methyl Herbicide	Hoelon
Difenzoquat Herbicide	Avenge
Disulfoton Insecticide	Di-Syston
Glyphosate Herbicide	Roundup
Glyphosate plus 2,4-D Herbicide	Landmaster
Imazamethabenz Herbicide	Assert
Lindane plus Captan Fungicide, Insecticide, Vertebrate Repellent	Isotox
Malathion Insecticide	Cythion
Methyl Parathion Insecticide	Penncap-M
Metsulfuron Herbicide	Ally
Picloram Herbicide	Tordon
Strychnine [2] Vertebrate Poison	Gopher Getter [2]
Thifensulfuron plus Tribenuron Herbicide	Harmony
Thiram Fungicide, Vertebrate Repellent	Agrosol
Triallate Herbicide	Far-Go
Tribenuron Herbicide	Express

Notes:

[1] Trade names shown here are examples of products registered in 1996 for use on at least one small grain crop (barley, oats, or wheat) in Utah. Other products may or may not be registered. Product registrations and

labeling may change over time. The use of trade names here is not intended to imply any endorsement of a particular product or its efficacy for a particular purpose.

[2] Strychnine is used only in non-crop areas adjacent to small grain fields (for rodent control). It is not labeled for use on areas where barley, oats, or wheat are planted or growing.