



Washington
State Department of
Agriculture

Non-Agricultural Pesticide Use in Puget Sound Counties



April 2014

Publication No. *AGR PUB 103-409*

Publication and Contact Information

This report is available on the Department of Agriculture's website at

<http://agr.wa.gov/FP/Pubs/NaturalResourcesAssessmentPubs.aspx>

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By

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Acknowledgments

The author of this report would like to thank the following people/organizations for their contributions to this study:

- Desirée Whittenberg, Washington State Department of Agriculture, for data review and analysis.
- Rodney Baker, Washington State Department of Agriculture, for assistance with data collection, report format, and document review.
- Eric Stebbins and Dennis Koong, USDA National Agricultural Statistics Service, Northwest Regional Field Office, for survey design, processing, and data analysis.
- Document review and technical assistance:
 - Washington State Department of Agriculture staff - Margaret Drennan, Kirk Cook, Val Davis, Rusty Sauls, Erik Johansen, and Robin Schoen-Nessa
 - Megan Warfield, Department of Ecology
 - Emily Sanford, Puget Sound Partnership
 - Lisa Niehaus, King County
 - Ray Willard, Washington State Department of Transportation
 - Alison Halpern, Washington State Noxious Weed Control Board

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Summary

From 2007-2011, the Washington State Department of Ecology completed three phases of scientific research on selected toxic chemicals in Puget Sound. This study, titled “*Control of Toxic Chemicals in Puget Sound: Assessment of Selected Toxic Chemicals in the Puget Sound Basin 2007-2011*” included an evaluation of seventeen toxic chemicals or chemical groups either currently causing harm or with the potential to cause harm to Puget Sound biota and their recovery. Copper was one of six elements that was included in this review, and the assessment underscored the need for a better understanding of copper-based pesticide use in non-agricultural settings.

The Washington State Department of Agriculture, under a National Estuary Program grant from Ecology, has recently completed a two-year study on the use of copper and other pesticide active ingredients in non-agricultural settings in Puget Sound counties. The study was conducted in three parts: the first evaluated residential property owner pesticide use; the second focused on the use of pesticides by public entities at the city, county, and state level; and the third focused on pesticide use by commercial applicators, lawn and garden maintenance companies, pest control companies, etc. The objective of this study is to provide regulatory agencies with a better understanding of typical pesticide use in the Puget Sound basin and lead to an increase in targeted education and outreach on pesticide use and potential impacts.

Introduction

In 2012, the Washington State Department of Agriculture (WSDA), along with the Puget Sound Partnership (PSP) and the Washington State Department of Ecology (Ecology) collaborated to develop a survey-based evaluation of non-agricultural pesticide use in 12 Puget Sound counties. This work was identified as a priority in the 2012 Action Agenda and a data gap in Ecology's recent evaluation of toxic chemicals in Puget Sound (PSP, 2012 and Ecology, 2011). When first developed, the study was targeted to look only at the use of copper-based pesticides. It then became apparent that there were very few copper-based pesticides available for non-agricultural use and the survey was expanded to include all pesticides available to the general public. The purpose of the study was not to establish loading estimates for pesticides; rather, the goal was to characterize typical pesticide use in non-agricultural areas around Puget Sound throughout the year. Ecology and the PSP approached WSDA because of WSDA's extensive experience gathering agricultural pesticide use information. The study was then designed and implemented by the Natural Resource Assessment Section (NRAS), a scientific research group within the Director's Office at WSDA. The grant funding this work was signed by Ecology and WSDA in August 2012, and work started shortly thereafter (Appendix A).

Pesticide use information on agricultural commodities has historically been gathered by NRAS to better evaluate the potential impacts of pesticides on surface water, ground water and threatened or endangered species. Washington State produces over 300 crops and is a leader in the production of tree fruit, berries, specialty seed crops, dry peas and lentils, and other high-dollar commodities. Pesticide use information for these commodities serves as an important component of WSDA's ecological risk assessment process. Pesticide use data is normally gathered by NRAS in one of two ways – through direct grower surveys working with the United States Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS), or via informal data-gathering workshops with growers, dealers, commodity groups, etc. The agency believed this same two-part process would work well for gathering non-agricultural pesticide use information.

The study was broken into three main sections. The first, and most difficult, was a residential survey of Puget Sound property owners and residents. The residential survey was the most

difficult due to survey design and defining the population. The second portion looked at pesticide use by the public sector, including roadside applications, schools, parks, public golf courses, ports, and airports. The third part of the survey was to obtain pesticide use information from for-profit entities, including lawn and garden maintenance companies, structural pest control companies, railroad, golf courses, nurseries, and other traditional chemical control companies.

Methodology

All surveys were conducted by NRAS staff and covered questions regarding all pesticide use, with a specific emphasis placed on copper-containing pesticide products. The difference in survey type for the residential survey does mean that this data does not lend itself to public versus private land use analysis.

Residential Survey

Design

The residential or homeowner portion of this survey was completed in the first phase of the project. To assist in survey design and implementation, NRAS contracted with USDA NASS, an agency regularly surveying farmers and other agricultural businesses for statistical purposes. In preparation for this project, NRAS staff conducted a retail shelf survey in the spring of 2012. Stores of varying size and specificity (from small feed stores and hardware stores to national general retailers and home improvement warehouses) were visited in Thurston, Pierce, King, and Snohomish counties. The result of this work was a list of the most common pesticides available for general public purchase (excluding any restricted use pesticides which required a pesticide license to purchase). The list of products included in the survey can be found in Appendix B on page 3 of the survey.

In the fall of 2012, NASS and NRAS collaborated to design a four page mail-out survey to be sent to properties in the 12 counties surrounding Puget Sound (Island, San Juan, Clallam, Jefferson, Kitsap, Mason, Thurston, Pierce, King, Snohomish, Skagit, and Whatcom). The survey was designed to query general knowledge as well as specific pesticide use information. Questions covered pesticide use, types of pest problems treated, treatment locations, number of treatments per year, who completed the pesticide application, pest tolerance, etc. The final page of the survey was a selectable list of pesticides available at stores throughout the area derived from a retail shelf survey conducted in early 2012. The retail shelf survey included an inventory of trade names, active ingredients, and formulations available at home improvement, garden, major grocery, and big box stores in the south and central Puget Sound counties.

The grant required WSDA to establish a stakeholder advisory committee. This committee reviewed and provided comments on the draft survey prior to finalization. NRAS pre-tested the survey design and questions for length and readability with members of the general public with varying pesticide knowledge. Special attention was paid to the amount of time required to complete the survey; as tested, the survey took approximately 7 minutes to complete. The pretest results are not included in the final data set. A complete version of the mailed survey can be found in Appendix B.

Survey fielding

Participant selection was conducted by NRAS staff using the University of Washington's Washington State Parcel Database, a GIS database fed information by all Washington county assessors as well as state agency property owners. A query was conducted that isolated specific property types in each of the Puget Sound counties with the exception of San Juan – NRAS staff were unable to get access to the parcel data in advance of survey mailing. Only 11 counties were included in the final mailing. The database query limited inclusion in the sample set to only those properties less than 0.5 acres in size and classified by the state as land use category 11 – single family residential. The intent was to eliminate (if possible) the inclusion of commercial, industrial, and multi-family residential properties in the final data set. NASS completed additional data normalizing, including:

- Out of state or country contacts were deleted and made ineligible for selection.
- On several files, records with no address were deleted and made ineligible for selection.
- Samples were then selected based on target sample sizes.
- Work to obtain the correct field(s) for mailing address and zip code.

The grant specified 9,000 surveys would be mailed out for this portion of the project. Due to budget savings during survey design, NRAS and NASS were able to expand the final count to 15,500. The counties were grouped by twos based on location, with two exceptions; King County and Thornton Creek (also in King County) were left as individual sample sets. These paired groupings are similar to those used by the Puget Sound Partnership in their Yard Care Practices Survey (PRR, 2013). See Table 1.

Table 1. Residential sample populations and sampling rates by county

Location	Properties identified	Targeted Sample Size	Sampling Rate (1 in)
Mason/Kitsap	62,723	2500	20.0892
Jefferson/Clallam	6,859	2503	2.74
Whatcom/Skagit	56,960	2501	22.784
Thurston/Pierce	206,966	2501	82.7
Snohomish/Island	197,635	2500	79.054
King	412,109	2501	164.8436
Thornton Creek	17,295	501	34.59

Thornton Creek was included as a special intensive sampling area for this project. Thornton Creek is a spring-fed creek located in north King County. The creek begins in the Northgate Mall parking lot and flows downhill to Lake Washington. It has been sampled for pesticides annually by NRAS for the past 10 years, and prior to that was sampled by King County and USGS. King County has done a great deal of environmental education about the health of the creek, contaminants and their impact on endangered salmon, and other positive water quality messaging in this watershed via events and mailers. Thornton Creek was included as an area with a known high knowledge base amongst residents, to be used as a comparison for the other surveyed counties.

Surveys were mailed to properties selected according to the specifications above in February 2013. WSDA put out a press release with the hope of increasing the rate of survey return. NASS accepted surveys by mail until May 1, 2013, to allow for the maximum amount of completed surveys. This allowed for some confidentiality in the survey submittals. The final rate of return is shown below for each sampling area (Table 2).

Table 2. Residential Survey return rates

Location	Surveys mailed	Number returned	% returned
Mason/Kitsap	2500	419	16.8
Jefferson/Clallam	2503	518	20.7
Whatcom/Skagit	2501	518	20.7
Thurston/Pierce	2501	426	17.0
Snohomish/Island	2500	411	16.4
King	2501	492	19.7
Thornton Creek	501	147	29.3

The final return rate for this survey across all counties was 18.9 percent, which represents the high end of the national average for this type of survey (1-20 percent is normal) (OMI, 2013). Of

the original mailing, 1,224 surveys were returned to NASS as undeliverable. A significant portion of these were from Kitsap, Mason, Clallam, and Jefferson counties, where many properties use P.O. boxes instead of home mail delivery (physical addresses were used on survey mailings). Had these not been returned, NRAS anticipates that the return rates in these counties would have been even higher. The survey return rate greatly exceeded agency expectations and allowed for more in-depth comparative statistical analysis. The survey did not outright define the term ‘pesticide’ for respondents; rather, it began by asking them to identify different types of pests controlled, easing them into the idea that ‘herbicides’ are only one type of ‘pesticide’.

Public Operator Survey

NRAS conducted public operator surveys in the spring and early summer of 2013. Public operators are licensed pesticide applicators working for a public employer, including schools, parks, ports, airports, public golf courses, and roads. Staff gathered data from small, medium, and large public organizations in Mason, Kitsap, Thurston, Pierce, King, Snohomish, Skagit, and Whatcom counties. Although this does not include all 12 Puget Sound counties, it does cover the major population areas. In each of the counties, public entities were varied in location; an attempt was made to include entities operating close to Puget Sound and urban, as well as upland communities that were more rural. School districts were contacted in each of the 12 counties, and no districts chose to participate. The reason given was budget cutbacks and staff reductions. Data was also gathered from state agencies and noxious weed control boards conducting pest control operations throughout the region.

This data was gathered both through in person interviews and via phone and email surveys. The data gathered was more qualitative than quantitative; that is, the purpose was to create a profile of typical pesticide use and use periods, rather than try to calculate an estimate of pesticide loading. NRAS received an extremely good response from the public entities contacted.

Commercial Applicator survey

In the fall of 2013, NRAS conducted a survey of commercial pesticide applicators working in Puget Sound counties. These included local, regional, and national lawn and garden maintenance and pest management companies. Non-public golf courses were also surveyed. Companies

surveyed covered both residential and commercial property applications in all 12 Puget Sound counties.

As with the public operator survey, this data was gathered through in person interviews and phone surveys. All surveys included questions about the pesticides used, application timing, application method, target pest, and type of application (spot, broadcast, etc.). Pest control companies were also queried about the state of the industry, changes on the horizon, new and emerging pest pressures, and regulatory impacts.

In the case of both public operators and commercial applicators, the people applying pesticides either have or are working under a licensed pesticide applicator. All licenses are issued by WSDA and require the applicant pass an exam and complete continuing education courses during each five-year period.

Survey Results

Residential

Respondents almost exclusively homeowners

The surveys were mailed to physical properties that met the size and ‘single family residence’ criteria, regardless of whether they were rental or owner-occupied properties. Respondents were first questioned about homeownership status; this survey found that 95.26% of those responding were owners, with the remaining 4.74% renters.

More than half applied pesticides to their property in the previous 12 months

Respondents were questioned on whether or not pesticides were applied around the outside of their homes during the previous 12 months; 45.1% (1,321 respondents) replied that no pesticides were used, while 51.5% (1,509 respondents) stated that pesticides were applied. The remaining 3.4% either preferred not to answer or chose “did not know.” Table 1 indicates those results by county groupings. The remaining table data in the sections below reflects only those respondents who stated pesticides were applied.

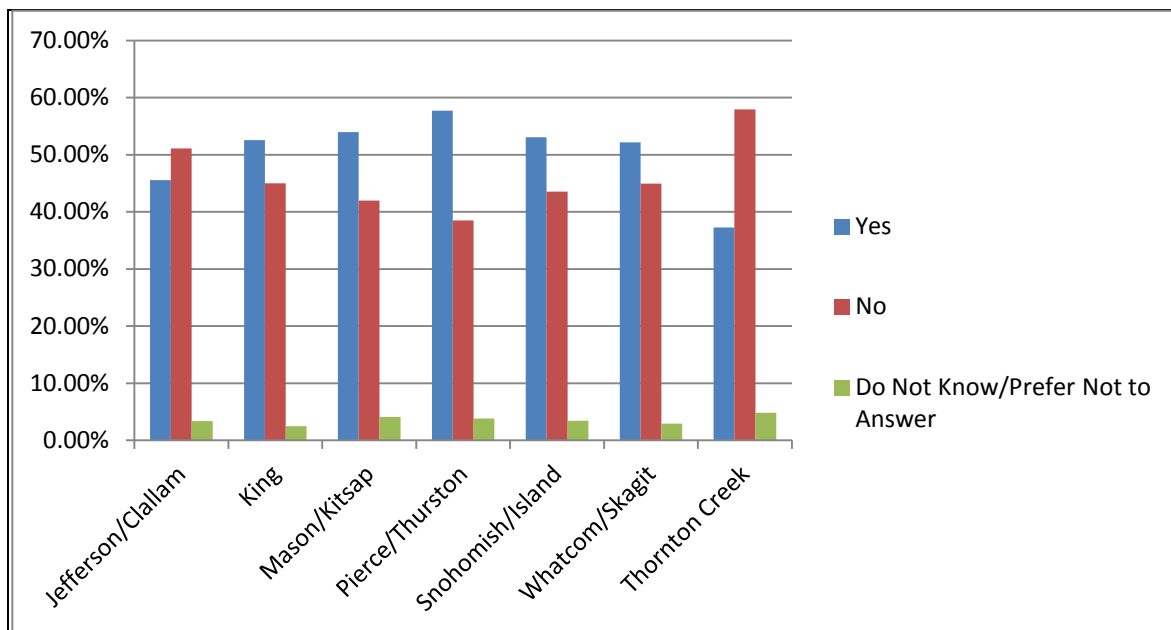


Figure 1. Respondents on Applying Pesticides by County Grouping

Weeds and moss are the most treated pest problems

In all sampled populations, weed treatments and moss treatments represented more than a combined 30% of the total pesticide applications. Insects and ants were the next two most treated categories for all counties sampled. These results were expected for pests of concern in a naturally wet climate like western Washington (Figure 2).

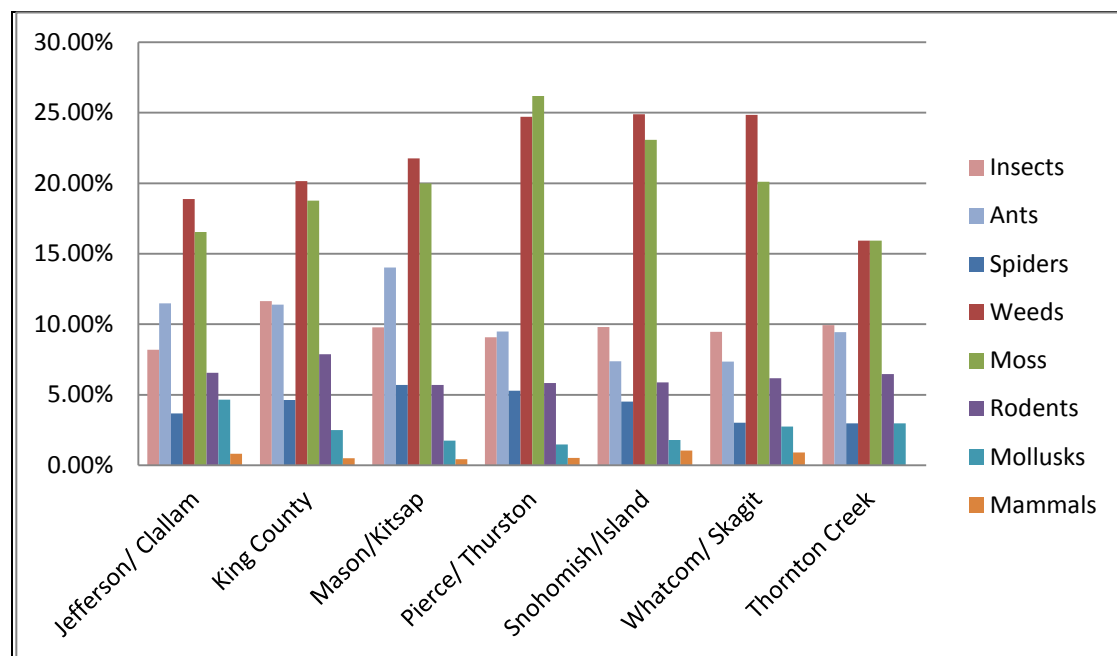


Figure 2. Most Targeted Pests by County Grouping

Lawn and turf areas most treated

Respondents were asked about the locations where treatments took place. The questionnaire allowed for a variety of answers, including lawn/turf, garden, patios, sidewalks, driveways/parking areas, roof, foundation, fruit trees, ornamental trees, and other. In all sample groupings, lawn/turf areas were the most treated, followed by garden, foundation, and roof applications. These results were consistent with the results from the previous question showing weeds and moss as the most treated pest problems (Figures 3 and 4).

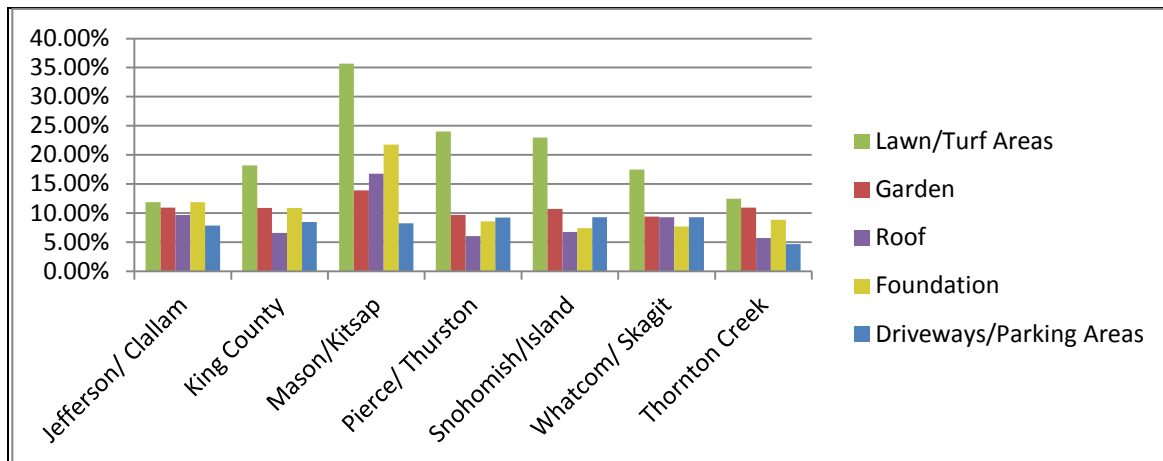


Figure 3. Most Frequently Treated Pest Control Locations

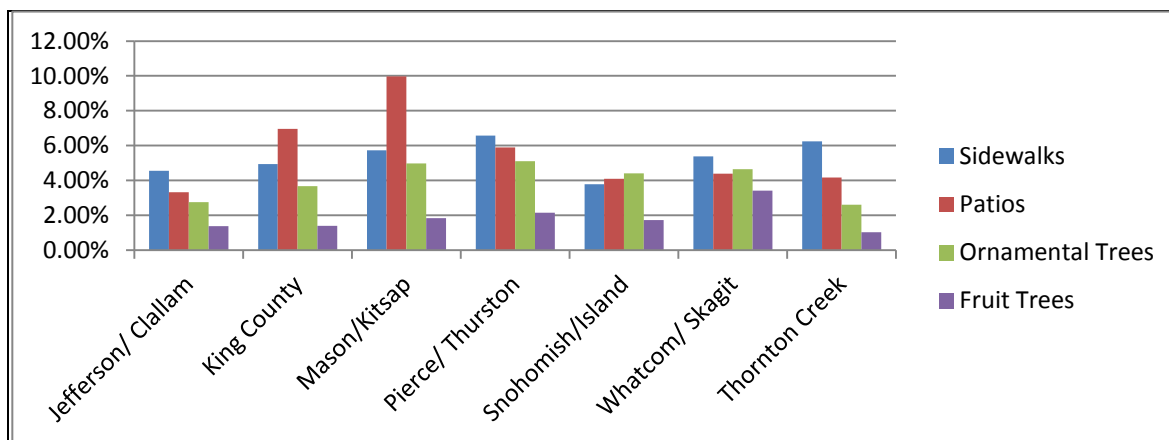


Figure 4. Less Frequently Treated Pest Control Locations

Understanding of pest pressures is relatively similar regardless of survey area

Respondents were questioned about how significant they perceived different types of pest problems to be. For instance, do they consider ants to be a minor pest problem or something bigger? All grading was done on a scale of 1=minimal problem to 5=major problem. They were questioned on ants, insects, moss, weeds, rodents, and new pests. They could also choose “prefer not to answer” or “do not know.” Because the results were very similar for all counties sampled they were grouped together in Figure 5. The pest problem which was the least concerning to residents is introduction of new pests. (The more detailed breakouts by county groupings can be found in Appendix C).

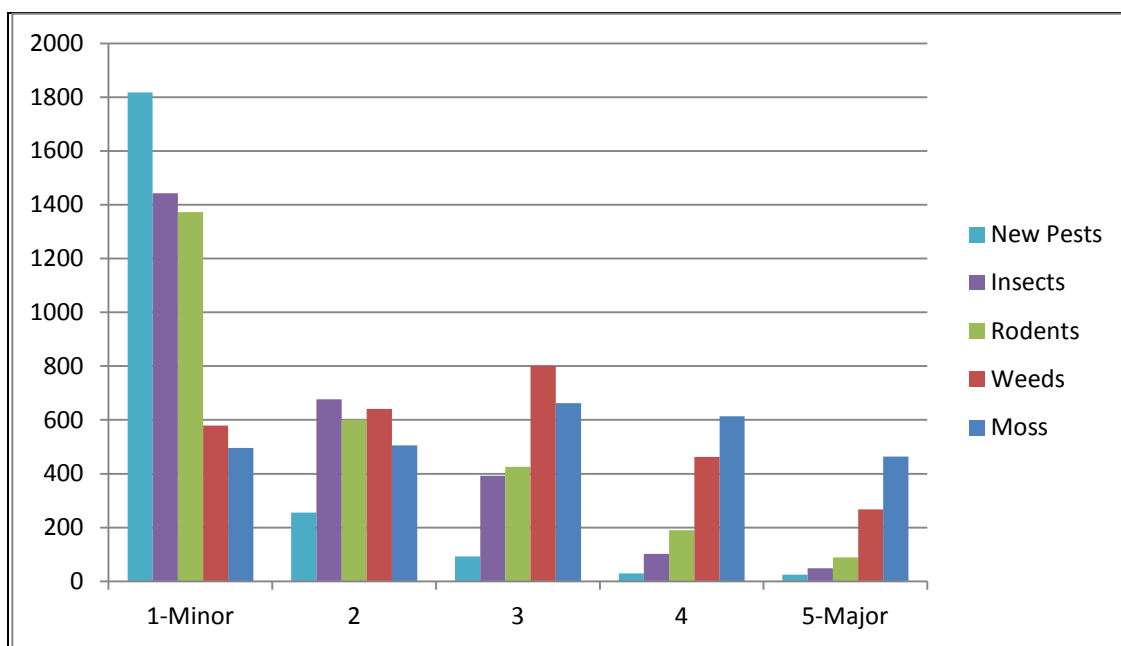


Figure 5. Respondent Count of Pest Problem Understanding, All Counties

75 percent apply pesticides themselves

Respondents who stated that pesticides were applied in the last 12 months were questioned about who made those applications – was it them or a family member? A contracted company? A landlord? Less than one percent of the respondents on this question were renters; on this question, their responses were not statistically significant, but are still shown on the chart. No other demographic information (gender, race, median household income) was collected for this survey. For the property owners, the dominant response was self treatment. Close to 25 percent of all who treated hired a company; the remainder conducted the treatments themselves. (Figure 6).

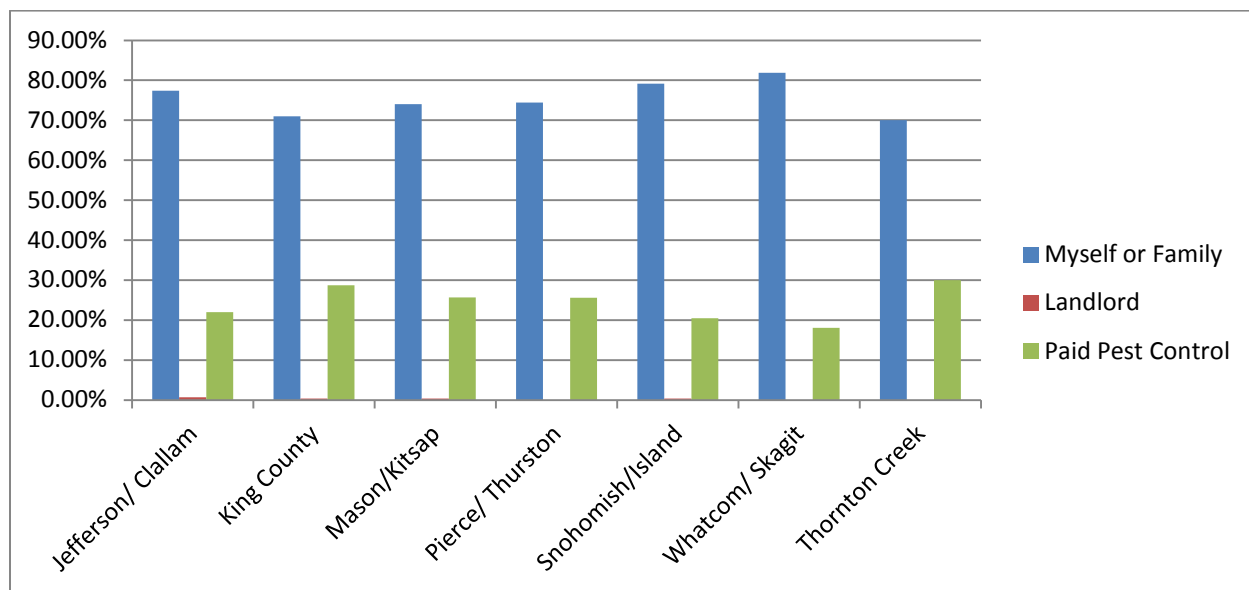


Figure 6. Person Conducting Pesticide Applications

These data correlate with the 2012 Puget Sound Partnership survey conducted on yard care practices, where 87 percent of respondents reported conducting pesticide applications themselves (PRR, 2013).

Safety and convenience were key reasons for hiring a pest control company

Respondents who stated they hired a pest control company to work on their properties were asked to provide a reason for the hiring. The most popular reason for hiring a company was convenience; the second reason was safety. As seen in Chart 7 below, all of the reasons offered

were chosen by more than 10 percent of respondents. The fact that almost 25 percent of respondents stated safety was the primary reason they chose to hire a contractor shows an understanding of the potential danger associated with pesticide application.

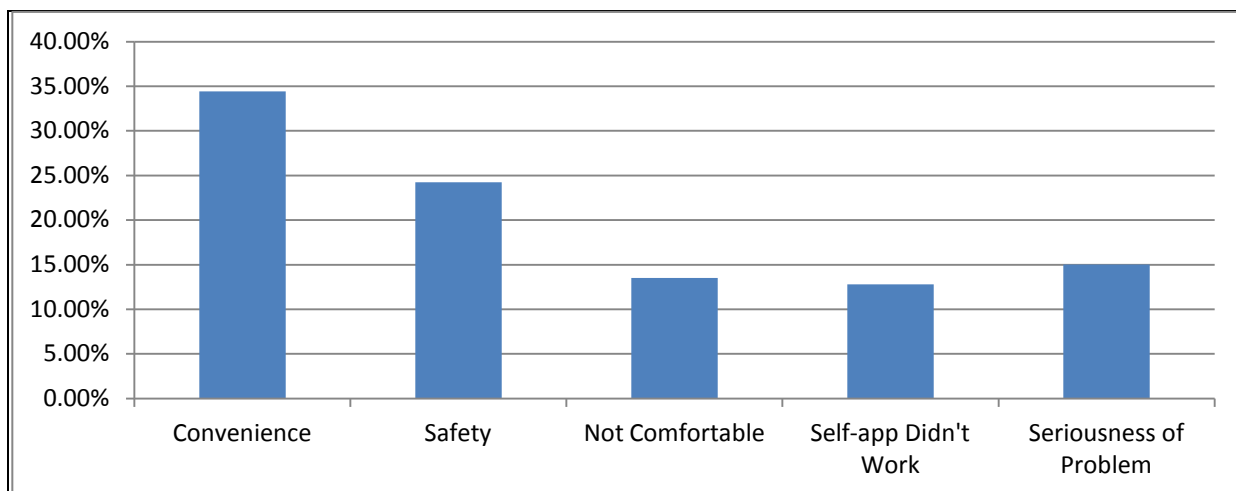


Figure 7. Reasons Provided For Choosing a Pest Control Company vs. Self-Treatment

Respondents that do apply pesticides are comfortable doing it

Those respondents who stated that they chose not to hire a licensed pesticide applicator were asked why not. Almost thirty percent responded they felt comfortable applying pesticides on their own or that over-the-counter products worked for their purposes. A smaller percentage (16%) reported hiring someone was too expensive. See Figure 8 below for the results displayed by county groupings.

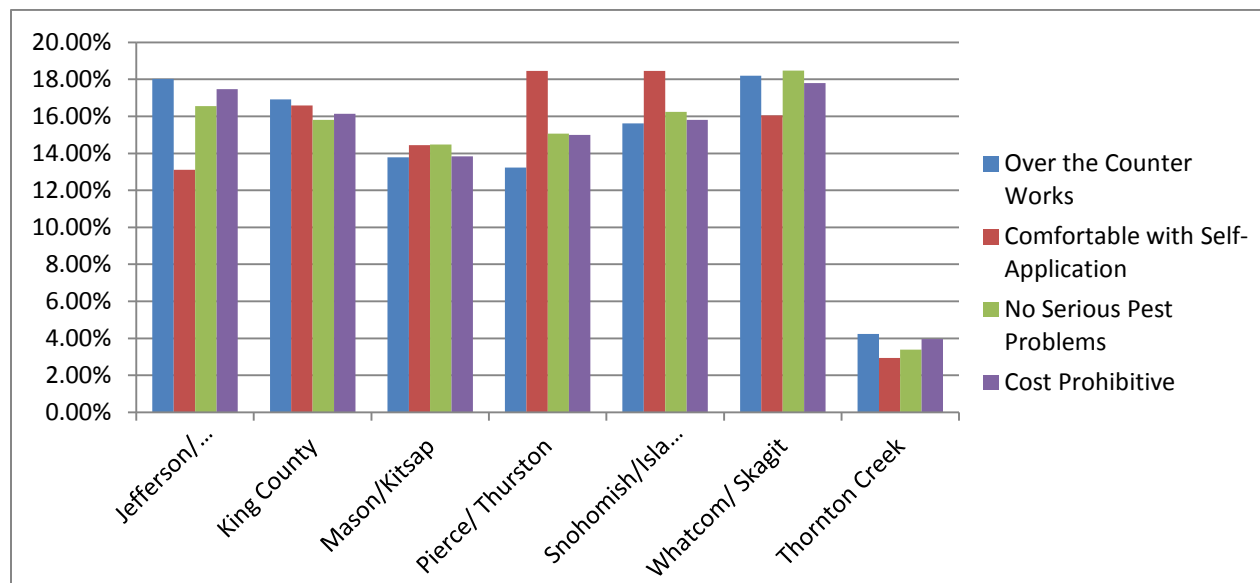


Figure 8. Reasons for Not Hiring a Professional Pesticide Applicator

1 to 2 treatments normal; some treat more than 5 times per year

All respondents were asked to provide a count on the number of outdoor pesticide applications in the previous twelve month period. In every county grouping except Pierce/Thurston counties, the most chosen option was no pesticides applied in the previous twelve months. Of those who did apply pesticides:

- An average of 31 percent of respondents chose 1-2 times across all counties.
- 17 percent, or close to one-fifth of respondents, reported treating their property 3 or 4 times during the previous twelve months.
- A very small percentage (< 6%) reported 5 or more treatments per year.

In the Thornton Creek watershed in north King County, a significant effort has gone into pesticide education and alternatives. This watershed has also been a focus of pesticide impacts on surface water for more than a decade. This sample group had both an extremely high response rate on the survey (29.3 percent) and was the only group where more than 50 percent of respondents made no outdoor pesticide applications. This could indicate that investments in education and outreach are effective in changing pesticide use practices. The treatment percentages for each county grouping are shown below on Figure 9.

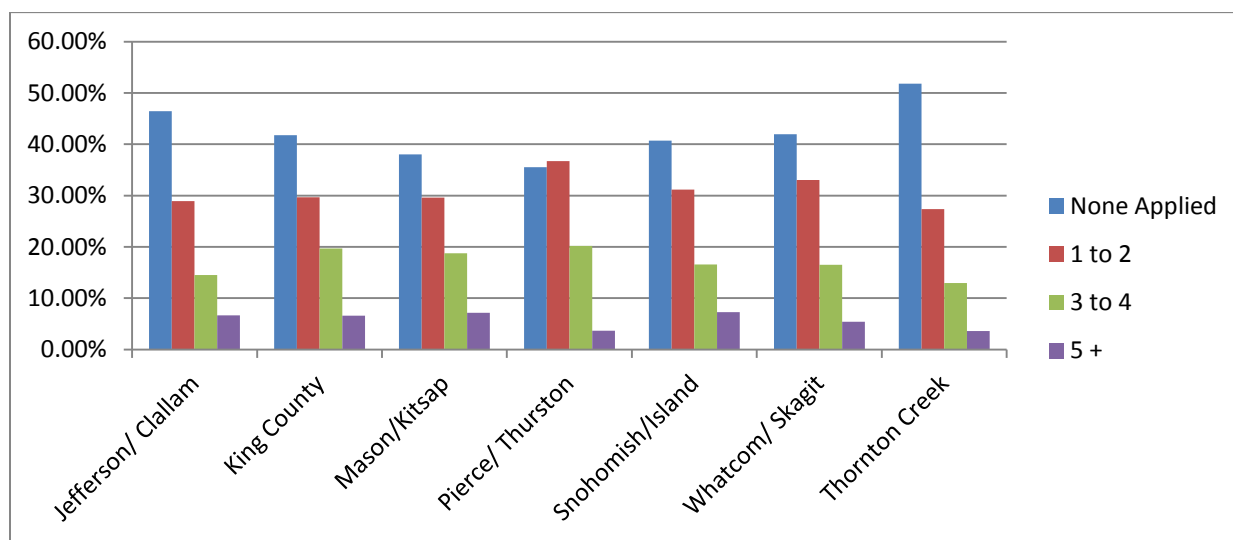


Figure 9. Number of Pesticide Applications per Twelve Month Period.

Typical treatment period is March through September

When questioned about the months when treatments occurred, respondents reported the bulk of applications occurred from March through September. This is the expected time period for pesticide treatments, given it matches up with western Washington’s peak growing season. It is expected some winter applications will occur due to Washington’s mild winters as well as the most common pest pressures being weeds and moss (Figure 10).

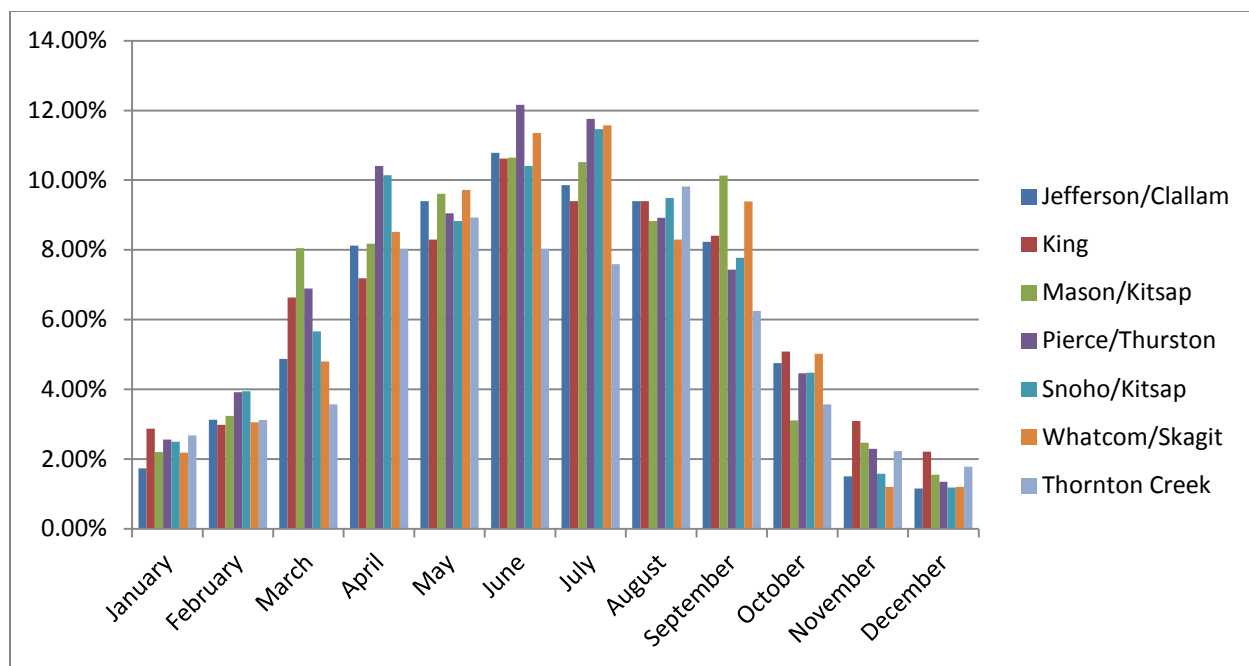


Figure 10. Pesticide Applications by Month

There is no clear purchasing preference

Respondents were questioned about where they choose to buy pesticides for use on their properties. No clear choice emerged from the answers; rather, it seems people tend to purchase more opportunistically and make less directed pesticide shopping choices. Given that this survey focused on properties less than 0.5 acres in size, it is not surprising that people would purchase pesticides when driven by convenience and availability. There is also no direct correlation between purchase location and urban/rural nature of the county groupings. Figure 11 shows the purchase locations by county sample groups, and Figure 12 shows the percentage for each purchase location across all sample areas.

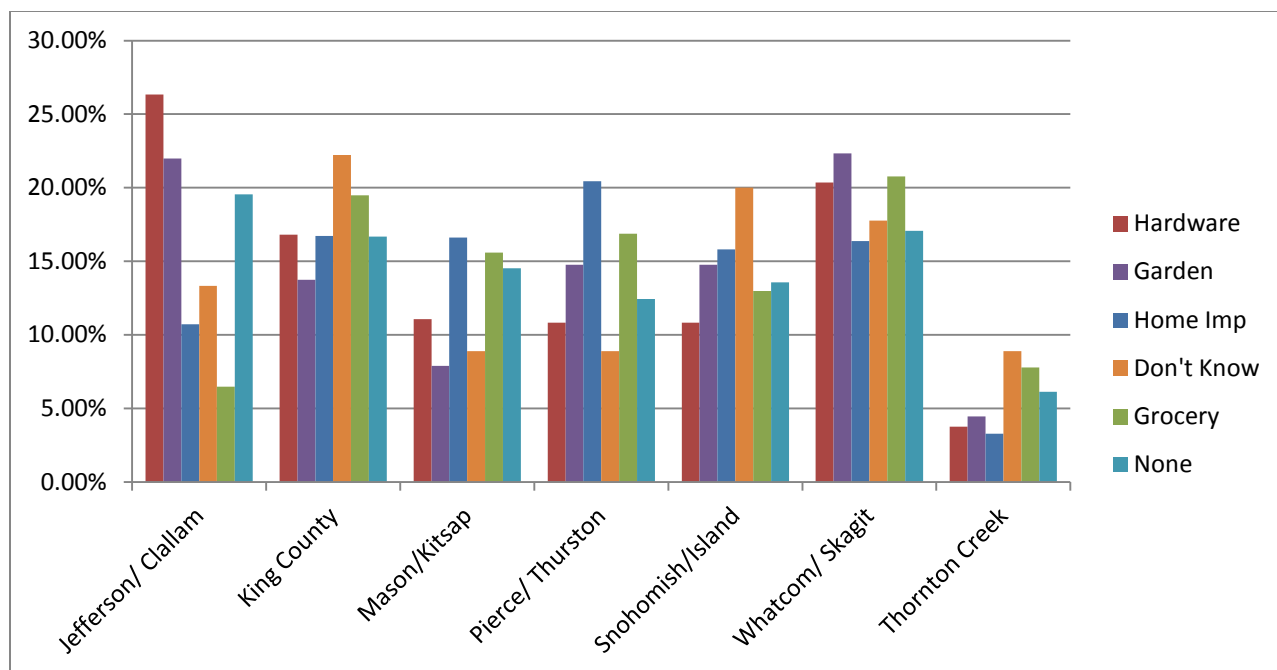


Figure 11. Pesticide Purchasing Locations

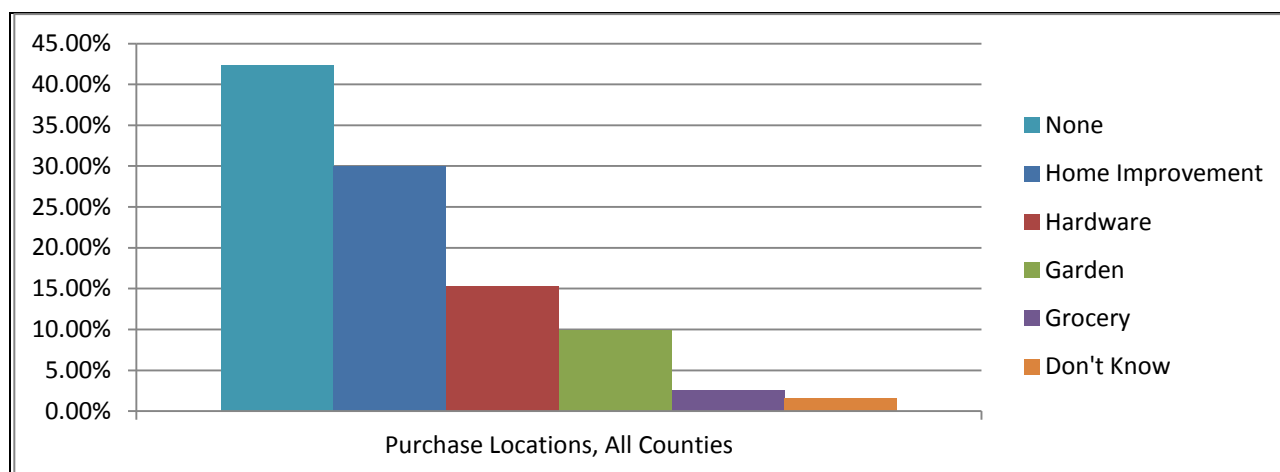


Figure 12. All Pesticide Purchase Locations by Percentage of Total

Liquid formulations were the first choice when purchasing pesticides

Respondents were asked what form of pesticide they purchased; options were liquid concentrate, dry formulations to be mixed with water, and both liquid and dry ready to use (RTU) products. 1,113 respondents chose liquid products (either concentrates or ready to use liquids). This constitutes 56.9 percent of the total responses received (1,957). This is not surprising given that the two top treated problems in this survey were weeds and moss, and the majority of the pesticides available to treat those pests are liquid. The remaining 844 responses were for dry

products. In the case of ready to use versus concentrates to be mixed by the purchaser, respondents predominantly purchased ready to use formulations (65.2 percent). The percentages are shown in Figure 13.

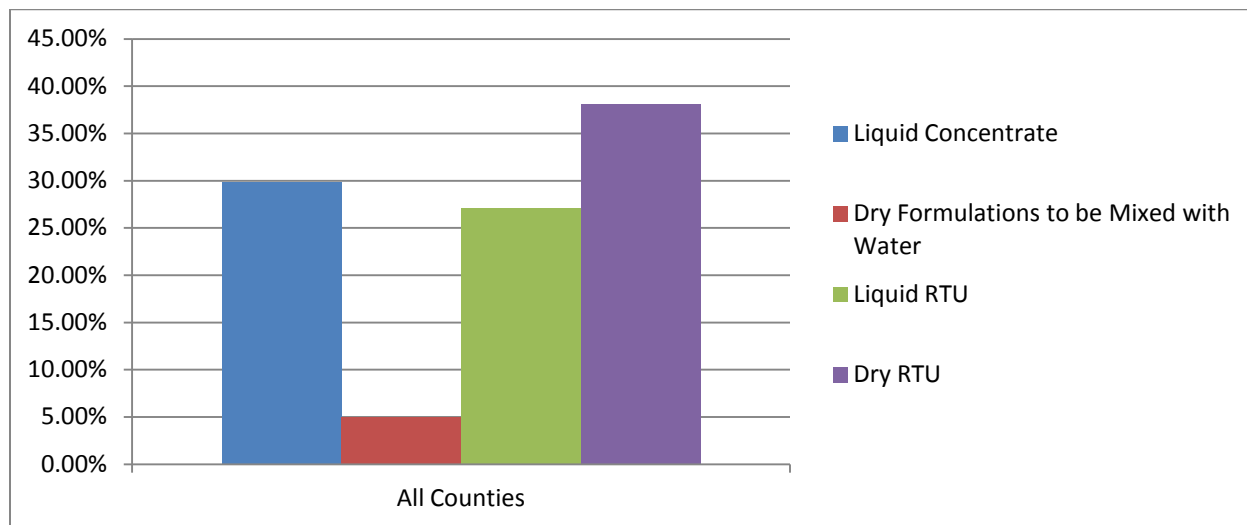


Figure 13. Purchased Pesticide Formulations across All Sampled Counties

A variety of natural and synthetic pesticides used

The final question on the residential survey provided respondents with the opportunity to select different trade name pesticides from a list. The purpose of this question was to better understand what classes of chemicals are purchased and applied around a property. This question was only answered by respondents who either still had the container they purchased or remembered what they used.

This final question was broken into types of pests targeted; all herbicides grouped together, insecticides together, slug and snail products, etc. There were also blanks added for people to include products they had used but were not in the pre-populated list.

Analysis of these results included separating the answers either by active ingredient or chemical family (i.e. glyphosate or pyrethroids). Copper based products were separated for analysis as well.

Product Use Results

Insecticides

Although weeds and moss are the most controlled pest problems in the targeted areas of the survey, ant control and spider control are also very common. Table 3 shows the breakout of insecticide information in detail. Two chemical classes, pyrethroids and neonicotinoids totaled 84.7 percent of the known insecticides applied.

Table 3. Insecticide Purchase Responses, All Counties

Total insecticide purchases	988
Chemical information known	680
Chemical unknown	308
Pyrethroids by count	397
Pyrethroids percentage of known	58.4%
Neonicotinoids by count	179
Neonicotinoids percentage of total	26.3%
Total other chemicals	15.3%

Pyrethroids and neonicotinoids are the most common classes of insecticides available to homeowners today, accounting for almost three quarters of the insecticides found during the 2012 retail shelf survey. The use data received during this survey directly correlates with that availability data. Pyrethroids and neonicotinoids are replacement chemical families for the older organophosphate and carbamate insecticides that were common throughout the late 20th century. These older chemical classes were highly toxic to both insects and mammals, making pesticide applications more dangerous. Pyrethroid and neonicotinoid insecticides are very low in toxicity to mammals, making them safer to apply.

Pyrethroid and neonicotinoid insecticides fall into a newer category of pesticides registered as “reduced risk”. While that refers specifically to a reduced toxicity to humans, it is important to note that these chemicals tend to be active at lower levels for a much longer period of time than the older pesticides. Runoff from the use of pyrethroids and neonicotinoids could result in negative impacts to aquatic invertebrate populations. Aquatic invertebrates are a vital food

source for endangered Puget Sound salmon species. The neonicotinoid family of insecticides is also under scrutiny right now for the role it plays in honey bee population changes (both direct and indirect impacts). Older chemistries still available for use include carbamate and organophosphate (OP) insecticides, which are known to have both short- and long-term human health impacts. Insecticide purchases by major use class are shown in Figure 14.

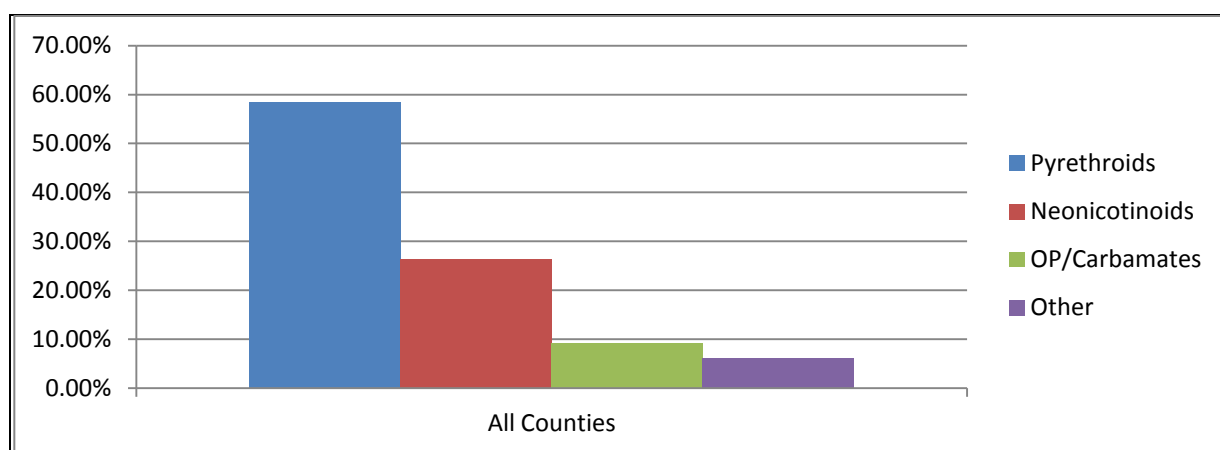


Figure 14. Insecticide Use Data, All Counties

Herbicides

Herbicides, or weed control products, were reported as purchased 2,271 times in the previous twelve months over the entire survey sample. Given only half of the respondents (~1,500) reported using pesticides on their property, much of this can be attributed to multiple purchases by single users. This is the most widely used category of pesticides surveyed. Data analysis was done to isolate specific active ingredients within the final dataset.

Glyphosate is the number one used pesticide in the world. It is the active ingredient in a variety of products, including its most famous trade name, Roundup™. Herbicides containing the active ingredient glyphosate were used a reported 823 times in the previous 12 months, equaling 36.6 percent of the total herbicide applications. Glyphosate is a systemic general herbicide, meaning it affects and kills the whole plant, and is not selective to certain types of plants (it will kill grass as well as weeds). It is commonly used on driveways, patios, and other areas intended to be “plant free.” The active ingredient glyphosate has low environmental toxicity and is registered for use in aquatic settings. Glyphosate formulated for use in terrestrial settings often carries a “Toxic to Aquatic Life” warning due to other inert ingredients in the final product.

The second most common herbicide active ingredient purchased by respondents was 2, 4-D. 2, 4-D is best known as the active ingredient in Weed-n-Feed™ products. It is the most common selective herbicide, meaning that it is selective to broadleaf weeds and can be used on turf or lawn. Herbicides containing 2, 4-D were applied 699 times, representing 31.1 percent of the total herbicides used by survey respondents. 2, 4-D is available in both amine and ester formulations; the amine formulation is registered for use in water, and is often applied in salmon-bearing waters in Washington state for the control of invasive Eurasian watermilfoil. The ester formulation is more toxic and more restricted in its water and near water uses. Household vinegar is included in the ‘Other herbicides’ in Figure 15. There are acetic acid herbicides available for organic use, but those listed here were assumed to be household vinegar, applied without label instructions. Vinegar was reported as applied 43 times by respondents (1.9 percent).

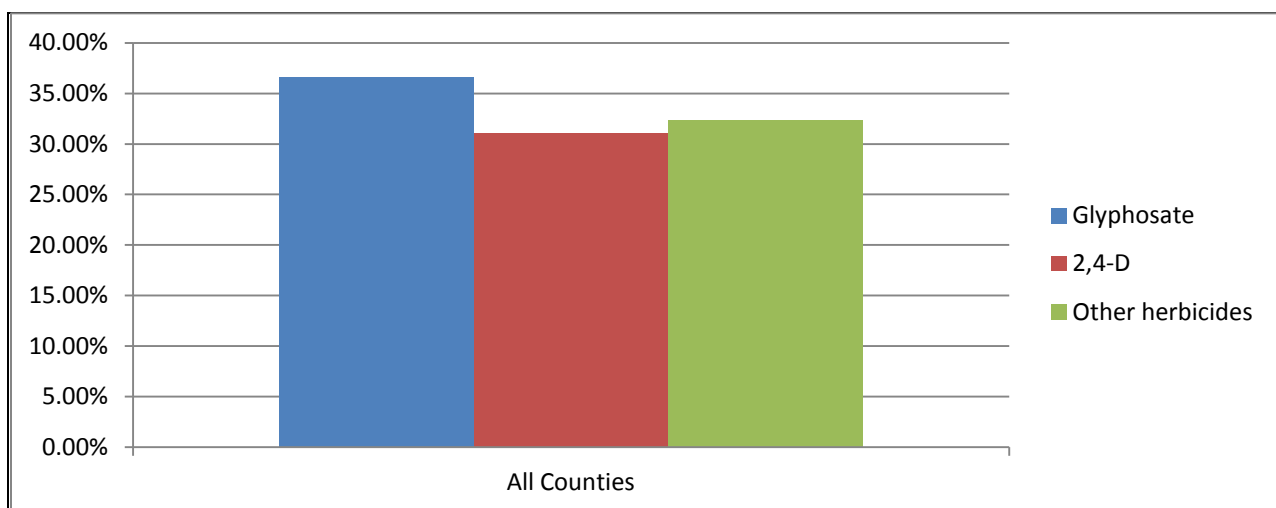


Figure 15. Herbicide Active Ingredient Information, All Counties

Moss Control Products

Moss is one of the most commonly controlled pest problems in Puget Sound counties. It is a pest that thrives in Washington’s temperate, wet climate. Due to long periods of dampness, moss problems are found in turf and lawn settings, on sidewalks and patios, and on roofs.

This survey captured 1,280 moss control product uses. Almost one-third of the products used contained the active ingredient ammonium salts of fatty acids (soap); the second most common active ingredient was potassium laurate. A significant number of responses are shown as ‘Other’

– these include detergent and bleach products not labeled to control moss (32 or 2.5 percent).

Figure 16 shows the active ingredient percentages across all counties.

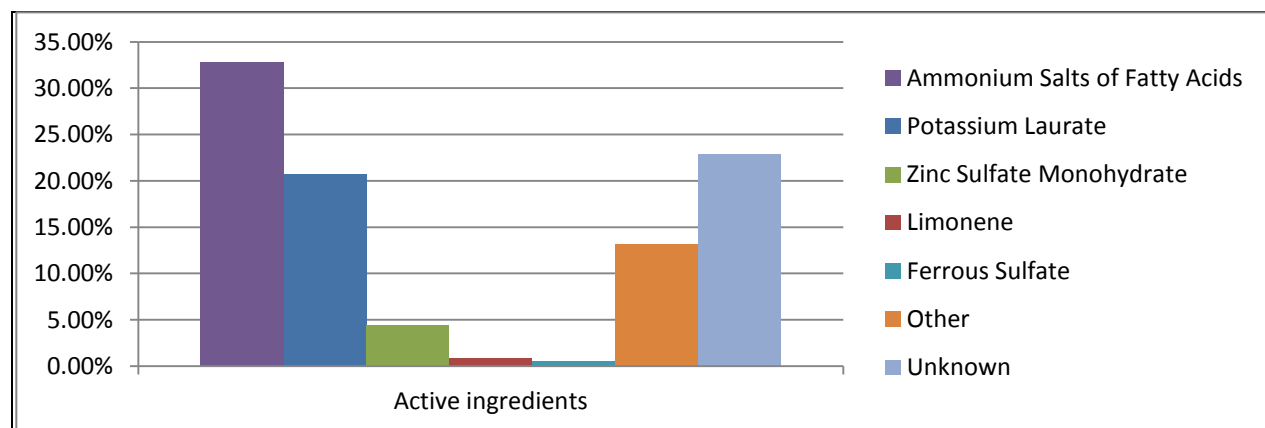


Figure 16. Moss Control Active Ingredients, All Counties

Fungal Control Products

Plant diseases and infections are quite common in the Pacific Northwest due to the mild, wet climate. Given the weather conditions in the area it might be expected that many pesticide applications take place to control disease; the survey data shows this is not true. Of 356 total use acknowledgments, more than three quarters (76.7 percent) knew that some fungicide was applied to their property, but were not aware of what was used. It is possible that a portion of those unknowns were copper-based.

Copper fungicide uses accounted for 6.5 percent of all fungicide applications where the chemical used was known. The most common active ingredient used to control disease was sulfur; this is also the most commonly used fungicide in agricultural settings.

There does not seem to be a correlation between the amount of fungicide applied by Puget Sound homeowners and the rate of plant disease; it is possible most people are unaware of what causes their outdoor plants to sicken and die. The major active ingredient percentages are found in Figure 17.

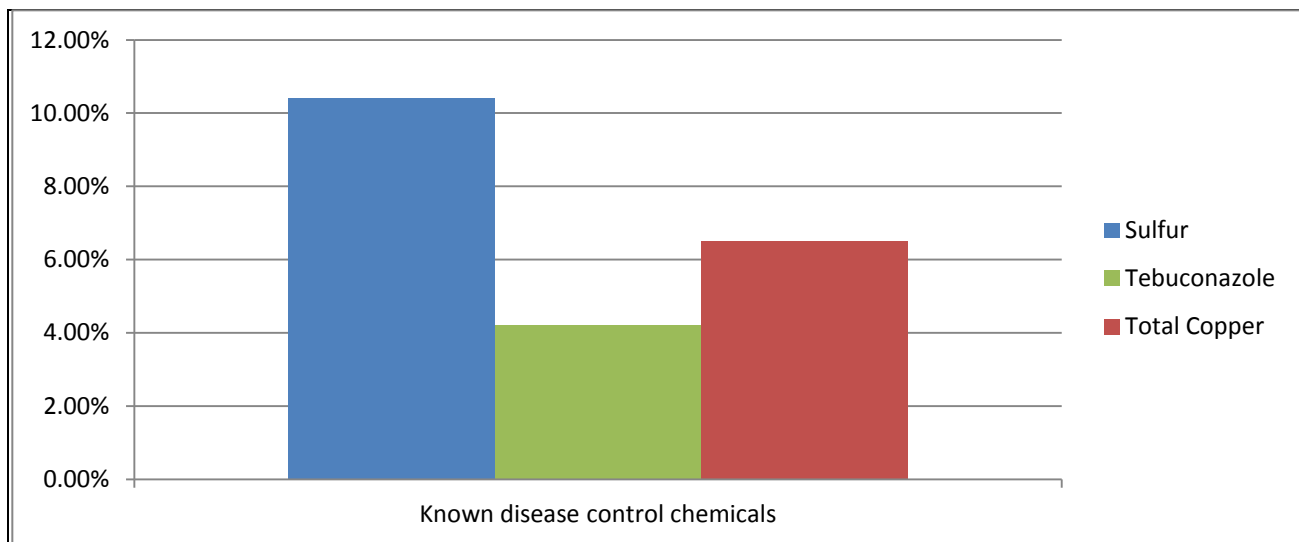


Figure 17. Fungal/Disease Control Products across All Sampled Counties

Mole and Gopher Products

Moles, gophers, and other burrowing animals are considered a nuisance and controlled in lawn and garden areas. Most products available are repellents and not actual pesticides, but there are also control tools available. Many people choose to trap and remove moles and gophers rather than eliminate them. Only 221 mole and gopher control uses were reported by respondents; the most frequently used active ingredient was bromethalin, followed closely by zinc phosphide. The most significant category, other, contained chemicals not registered for controlling moles and gophers. The active ingredients are shown by percentage in Figure 18.

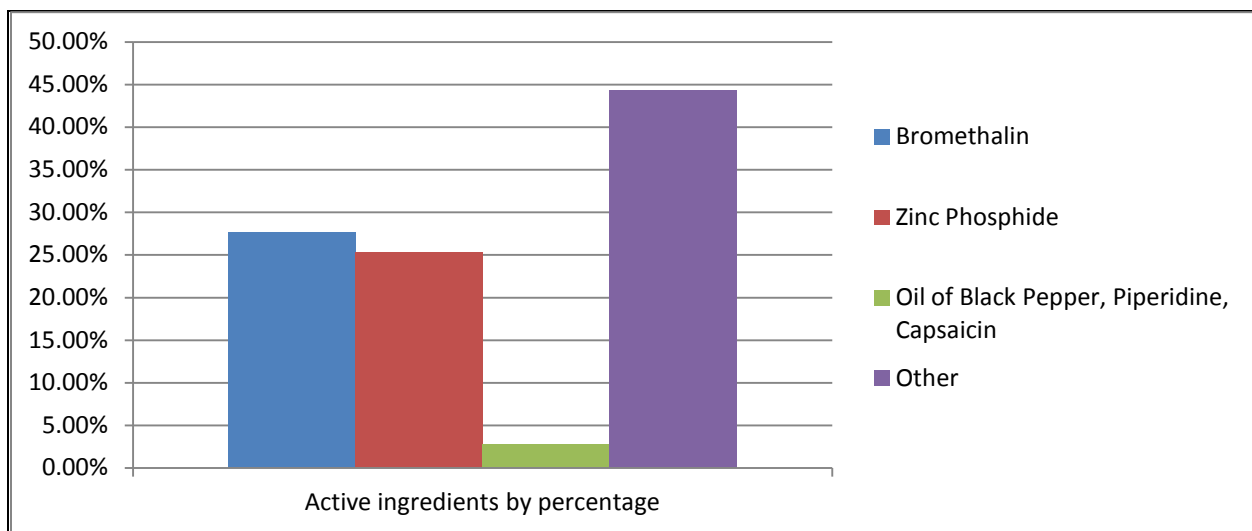


Figure 18. Mole and Gopher Control Products, All Counties

Slug and Snail Control

Slugs and snails do not retain moisture, and are therefore often found in abundance in wetter climates. The temperate, wet climate of the Pacific Northwest is an ideal environment for these pests. Snails and slugs were controlled 749 times by respondents. This category of pest control was where the most non-labeled pesticide use occurred; the use of rodenticides and insecticides in place of products intended for slug and snail control was noted frequently by respondents. On an interesting note, 49 respondents reported the use of beer or yeast to control slugs (7 percent of total). Beer and yeast are not labeled pesticides for this purpose. The most commonly applied chemical for this pest category was iron phosphate, accounting for 65.6 percent of the total responses. Slug and snail control results are shown in Figure 19.

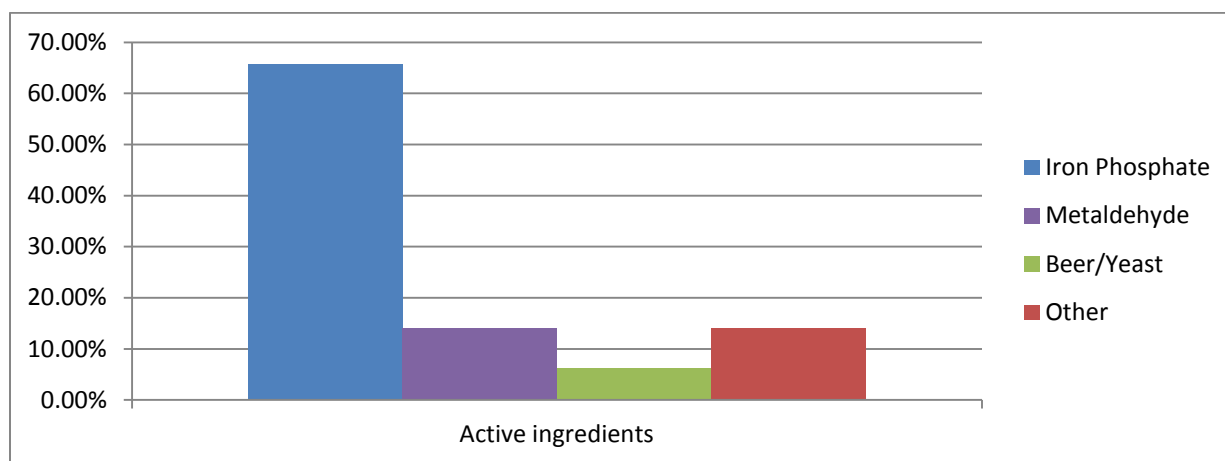


Figure 19. Slug and Snail Control, All Counties

Copper is not widely available or often used in the residentia environment

Copper pesticides were of specific concern in this survey. Water sampling in Puget Sound and its tributaries indicates relatively high copper concentrations – Ecology’s toxic loading study identified non-agricultural pesticide use as a potentially large provider of that copper. Copper based pesticides are registered for a variety of uses in non-agricultural settings, including algae

and moss control in pools, algae and aquatic plant control in ponds and lakes, antifouling boat paint, disease control in ornamentals, and as a wood preservative.

Due to its toxicity to salmon, copper has been banned from use in Washington waters (ponds and lakes) since 2001. People are allowed to use copper in man-made, wholly enclosed aquatic settings (dug lakes, lined ponds, etc.) and in agricultural irrigation systems regulated under the Clean Water Act. In the Puget Sound counties, this survey only evaluates disease control uses of copper (boat antifouling, pool and pond algae control, and wood preservative uses are not included).

Both the retail shelf survey and the residential survey sought to better understand copper product availability and use. Copper based pesticides accounted for 0.4 percent of total pesticides purchased and used by respondents for this application context.

Total applications varied little across the grouped counties

When tallied, the total pesticide applications varied minimally across all of the groupings as shown below in Figure 20 (with the exception of the subset sampling in the Thornton Creek watershed).

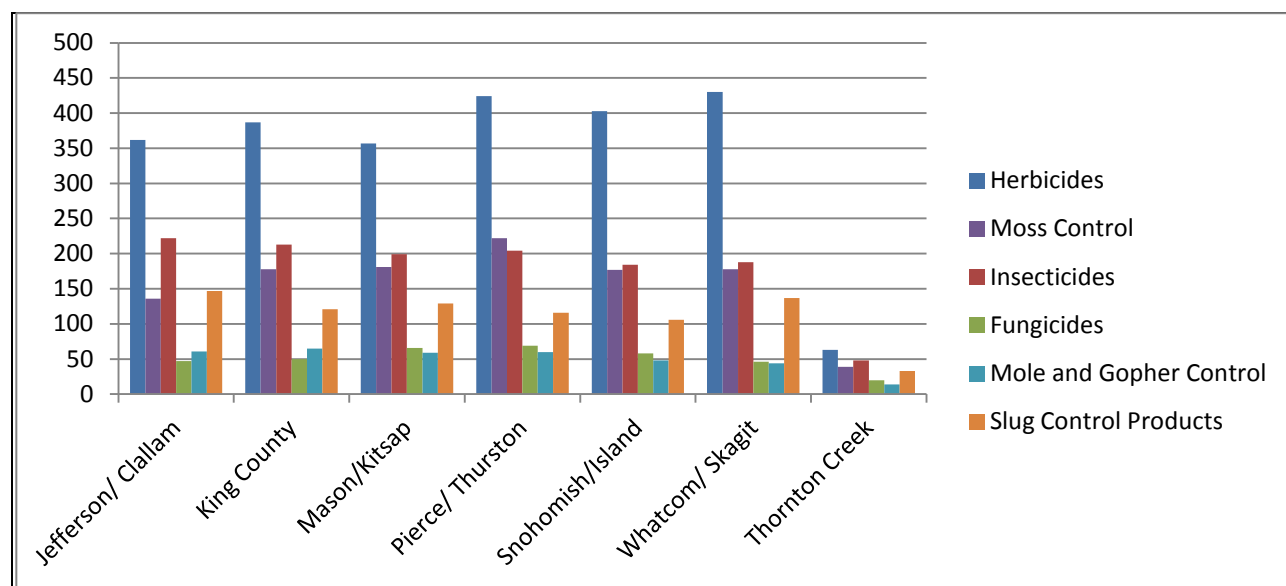


Figure 20. Total Count of Responses by Use Category by County Groupings

Residential Summary

- More than half of all respondents completed one or more pesticide applications on their property in the 12 months prior to the survey. Of those, 70 to 80 percent were completed by the property owner or a family member rather than a hired professional applicator.
- Weeds and moss together represent the most frequently treated pests. In addition, they are the pests most likely to be considered major problems in the surveyed counties.
- **Copper is not widely available or often used as an outdoor pesticide in residential settings.**
- There is a lack of knowledge or understanding of new and emerging pest problems.
- Pyrethroids and neonicotinoids totaled 84.7 percent of the known insecticides reported as applied in this survey.
- Many people feel comfortable completing pesticide use on their own property, citing label understanding, convenience and comfort as the primary reasons rather than cost savings.
- Pesticide purchases are made based on convenience and not based on expertise of help staff at a store; home improvement stores are by far the most frequented for these purchases, while nursery/garden stores generally have more trained personnel to assist in the proper purchases.
- Respondents seem to have a minimal understanding of disease or infection in ornamental plants and trees. This leads to less fungicide use overall.
- Liquid concentrate products, requiring precision mixing, are often purchased by homeowners instead of ready-to-use premixed products.
- Many respondents did not follow the pesticide label or used products not labeled for pest control (for example, vinegar for weed control, bleach for moss control, and rodenticides for mole control). This is an area where education campaigns could improve use practices and increase general understanding.

Public Operators

In late spring 2013, NRAS staff met with public operators in Thurston, Mason, Pierce, Kitsap, King, Snohomish, and Whatcom counties. The data collected includes pesticide active ingredient, target pest, application method, and treatment month. The characterization presented below is not individualized to specific jurisdictions; rather it is generalized across all users of that type. Specific questions were asked regarding the use of copper pesticides, since that was a targeted information area for this survey.

Roads

Use information was gathered from more than a dozen city, county and state road maintenance programs. Herbicides are the only class of pesticide used by these programs. The main reason for weed and grass control by road programs is to prevent damage of the road surface by roots. A secondary reason for controlling plants growing on roadsides is to alleviate visibility concerns. For this user group, there are no copper based pesticides used – copper primarily works as a fungicide.

Integrated Vegetation Management

Every program contacted follows an integrated vegetation management (IVM) program, which requires an evaluation of all pest problems and all potential solutions, including no control, chemical, mechanical, and biological control options. All of the various sized programs throughout the Puget Sound, including the state Department of Transportation, use a combination of mechanical (mowing) and chemical (herbicide) control methods. During the recent recession, many local governments have gone with programs that are more mechanical than chemical – although this is more labor intensive and oftentimes less affective, as budgets tightened, use of mowers and existing labor required no additional cost (versus herbicide purchasing). The following six Puget Sound counties operate vegetation management programs without the use of herbicides:

- ❖ Clallam
- ❖ Jefferson
- ❖ Snohomish
- ❖ Thurston
- ❖ Island
- ❖ San Juan

Many of the cities in these counties also operate no-spray vegetation management programs. Integrated vegetation management includes establishing action thresholds, such as a certain amount of weed pressure in a given area triggering a pesticide application. Action thresholds are most common with herbicide applications – mowing programs tend to occur on a schedule.

An IVM program also lays out the types of herbicides available within the program and an evaluation of when each chemical would be most effective (time of year, plant growth stage, mode of action, etc.). Most of the cities and counties that participated in this survey follow the well-established and regularly updated IVM developed by the Washington State Department of Transportation (WSDOT).

Application Method

Herbicide applications along roadsides are completed in one of two ways; truck-mounted sprayers or backpack sprayers. Truck-mounted equipment refers to a large tank mounted on a truck or ATV with either a hose or boom. With a spray boom, herbicide applications can occur as far as six feet or as little as a foot from the actual tank, allowing for precision applications depending on the weed and grass pressure. Boom precision allows the operator to adjust droplet size as well as the width of the spray area to minimize overspray and pesticide drift.

Backpack sprayers are used in areas that are either inaccessible by trucks or ATV's, or when treatments are needed in sensitive habitats. These are typically spot applications to noxious weeds or other problem plants.

Treatment Timing

Road treatments occur throughout the region beginning in late February or early March (depending on weather) and continue on as needed until late September or early October. This corresponds with the normal growing season in western Washington. Pesticide applications occur regularly in most cities and counties around Puget Sound with the exception of counties where herbicide use restrictions are in place (Thurston, Jefferson, Clallam, San Juan, Island, and Snohomish counties). In those counties, treatments along county roads and properties are limited to areas where mowing cannot be used or designated noxious weeds are found.

In early spring, most road programs survey to identify weed pressures and needed treatment locations. Areas where weeds are growing in close proximity to the road surface are of most concern, because of the potential to either affect sight distance or the integrity of the road surface. Chemical use during this part of the season is usually focused on systemic herbicides (with whole plant toxicity) or bare ground soil active herbicides (that inhibit weed seed growth).

The remainder of the growing season (April – October), herbicide applications consist of a combination of contact (burn down) and systemic herbicides applied using truck-mounted sprayers. These applications are primarily to control grasses and designated noxious weeds, and keep sight corridors open. Every jurisdiction interviewed indicated extra care is taken in or near sensitive habitats.

Table 4. Common Active Ingredients Used to Control Right-of-Way Weeds and Grasses

triclopyr TEA	triclopyr BEE
imazapyr	glyphosate isopropylamine salt
2,4-D ester	aminopyralid
dicamba	metsulfuron methyl
fluroxypyr	indaziflam
topramezone	isoxaben
fosamine ammonium salt	2,4-D amine
2,4-D acid	chlorsulfuron
flumioxazin	sulfometuron methyl
diuron	dichlobenil
oryzalin	metsulfuron

Many of the active ingredients listed above are part of combination products. Products combining two or three active ingredients are becoming more and more common, and even those that are individually packaged often are tank-mixed with other products before application. As newer active ingredients are formulated for roadside uses, they are often applied at rates as low as two ounces per acre, while older products still have application rates upwards of 12 pounds per acre. WSDOT recently reported that due to changes in chemicals within their IVM program, the total amount of pesticide pounds applied per year decreased by almost 70 percent from 2003-2009; they are treating at least the same number of road miles as before. The majority of the new pesticides are lower in initial toxicity than the older chemicals.

In sensitive or wet areas, jurisdictions interviewed stated they are using approved aquatic formulations of the active ingredients above. Those pesticide active ingredients have undergone rigorous risk assessments both at the federal and state level prior to being jointly approved for aquatic use by the state departments of Ecology and Agriculture. Products formulated for aquatic use are generally classified as either practically non-toxic or slightly toxic to all forms of aquatic life; they are also paired with approved aquatic adjuvants that make the product more effective. The active ingredients glyphosate (isopropylamine salt) and imazapyr are the most common herbicides used for roadside aquatic or riparian applications.

Ports

Port staff were interviewed in Thurston, Pierce, King, and Skagit counties. Information about pest control efforts at the Port of Seattle is not included here because that entity operates a pesticide free program. In the other counties, it was quickly made clear the pressures for controlling pests are quite different at ports than anywhere else in the Puget Sound.

Weed Control

Port properties must keep all weeds and grasses at least three feet away from fencing. Fenced areas contain goods received and those being prepped for shipment; due to the value of these commodities all fences are pressure and motion sensitive. Any plant material coming in contact with these fences would set off alarms across the port complex. Due to the regular and confined nature of this type of weed control, most ports reported using herbicides regularly to prevent weeds and grasses along the perimeters of fenced areas. Weed treatments begin in late February/early March and continue throughout the growing season. Weed treatments also occur as necessary during the winter months.

Rodent Control

Rodents are a commonly reported pest problem on port properties as a result of the many food sources available at these locations. Given the vulnerability of food and grain exports to rodents, a great deal of effort is dedicated to baiting and trapping these pests on port properties. Baits and traps are placed throughout port properties year-round to prevent contamination and property damage.

Invasive Species

Because containers are shipped from all over the world and received in these ports, concerns over introduction of non-native species are very high. Significant efforts are put into surveying for invasive species; samples of potential invasive species are sent to USDA and WSDA for identification. When the pest identified is a serious economic or environmental threat, aggressive control measures are warranted. The Port of Tacoma is currently attempting to eradicate a population of the Mediterranean vineyard snail; control activities include both surveys and regular applications of a molluscicide for eradication. Table 5 includes information about pesticides used on Puget Sound port properties.

Table 5. Pesticide Active Ingredients Used on Puget Sound Port Properties

glyphosate isopropylamine salt	imazapyr
metaldehyde	dicamba
2, 4-D	MCPA
MCPP	aminopyralid
bromadiolone	diphacinone

Parks

Parks departments from cities and counties in Thurston, Pierce, King, Kitsap, and Whatcom counties were interviewed for this survey. Depending on the size and developed scale of the parks within each jurisdiction, a typical year includes the limited use of herbicides, fungicides, insecticides, and moss control tools.

Weed Control

In the late winter and early spring, most parks departments are surveying and taking stock of current pest pressures. Treatments at this time are most often pre-emergent herbicides, intended to prevent weed growth. Treatment areas include walkways, paths, and parking lots. Dichlobenil is often used for pre-emergent weed control in underdeveloped parks (odor makes this an unpopular tool in heavily used areas). Most weed control occurs in the spring, and is almost always spot applications within grassy areas, parking lots, flower beds, and other heavily trafficked areas.

All jurisdictions surveyed reported minimal weed control in most areas, with the exception of maintained sports fields and planted flower beds, where weed tolerance is quite low. Once spring

applications occur, the remainder of the treatment season (June – October) the herbicide applications primarily target noxious weed infestations.

Insect Control

Insecticide use is limited to two scenarios – public complaints regarding stinging and biting insects (bee and wasp nests, fire ants, etc.) or turf insect problems such as crane fly. Only under these limited situations are insecticides applied in public use areas of parks. Applications are usually made with either liquid or aerosol formulations.

Other Pesticide Uses

Moss control was only conducted in areas where public safety was at risk (such as slippery wooden trails, gravel or paved walkways, or similar areas).

Rodent control is also done in areas near garbage dumpsters, bathrooms, and other public facilities. In areas where turf quality is important, parks departments will use baits to control moles or gophers.

The parks departments spoken to for this survey did not conduct fungicide applications except in extremely limited situations where ornamental plantings were at risk. Below is a list of the various pesticides parks departments throughout the region reported using.

Table 6. Pesticide Active Ingredients Used by Parks

triclopyr amine and ester	2, 4-D amine
aminopyralid	imazapyr
glyphosate isopropylamine salt	permethrin
<i>Bacillus thuringiensis israelensis</i>	dichlobenil
oryzalin	pendimethalin
carfentrazone-ethyl	carbaryl (ants)
metaldehyde	MCPA
dicamba	acephate (aphids)
dithiopyr	isoxaben
MCPP	flumioxazin
trifluralin	azoxystrobin
bromethalin	bromedialione
ammonium salts of fatty acids	fluazifop-p-butyl

Public Noxious Weed Control

Noxious weeds are non-native terrestrial and aquatic plants that have the potential to degrade Washington's land, water, and other natural resources if left uncontrolled. Noxious weed control is overseen by a state weed board that helps direct the activities of 49 county weed control boards and districts statewide. They also advise WSDA on noxious weed control issues throughout the state. The main goal of the weed board is to focus efforts on eradication, containment, and control of existing noxious weeds.

Like public road maintenance programs, weed boards and districts utilize an integrated vegetation management approach when possible. They also conduct extensive surveying to identify noxious weed infestations early, leading to less overall herbicide use. Most treatments are done by a licensed pesticide applicator.

Noxious weeds can be controlled by manual, mechanical, biological, or chemical methods. Certain Puget Sound counties, including Jefferson, Island, Mason, and San Juan, restrict chemical use (some counties are no-spray and typically use only mowing and hand removal), but recognize the need to sometimes use selected chemical methods.

The state weed list dictates the need for control. Class A weeds are typically new invasions and very limited in distribution. The potential threat from these weeds is very high. If a Class A noxious weed is identified, mandatory control is required for targeted eradication. The goal with these plants is to prevent establishment, and while chemical controls are often used, the small scale of infestation also makes digging or other mechanical removal feasible.

Class B weeds are non-native plants with limited distribution in some areas and widespread in others. They represent a serious threat to uninfested areas, and the goal is to contain Class B noxious weeds in areas where they are widespread, and controlling them in areas where they are still absent or limited by preventing seed production and propagule dispersal. The State Weed Board designates Class B noxious weeds for mandatory control in the regions of the state where they are absent or limited. Each local county weed board has the option of selecting non-designated Class B noxious weeds for control in its county if there is a local need for control.

Chemical control is commonly used for this class of weed, except in counties where mechanical and manual methods are primary tools.

Class C weeds meet the criteria of a noxious weed and are often too widespread for a statewide control strategy. The state weed board does not require control of Class C noxious weeds, though county weed boards can select them for mandatory control if there is a local need.

It is unusual to conduct large scale noxious weed pesticide applications. The most common use of herbicides for noxious weed control is spot application on a single plant or group of plants. There are instances where large scale weed control occurs; this is most common when a site is being prepped for another purpose, such as the removal of reed canarygrass prior to installation of a wetland mitigation site. Large-scale weed control efforts also take place if a landowner does not comply with the weed laws and the county weed board performs the control work itself, such as to control tansy ragwort in pastureland.

Aquatic Pesticide Applications

Aquatic plant and algae control is regulated under the Clean Water Act by the Washington State Department of Ecology. Herbicides and algaecides approved for use under this permitting program have undergone federal as well as state risk assessment and environmental review prior to final approval. In-water and near water pesticide applications occur in all 12 Puget Sound counties. Lakes, ponds, and their riparian areas are treated under the Aquatic Plants and Algae National Pollutant Discharge Elimination System (NPDES) Permit. Estuarine and river riparian and in-river noxious weed control occurs under a separate Aquatic Noxious Weed Control NPDES Permit. With the exception of cases where an entire lake is being treated for noxious weeds, all of these are spot applications for either nuisance (native) or invasive non-native plants or algae. Currently there are more than 200 separate permits issued for aquatic and riparian plant control in the 12 Puget Sound counties. Applications are either conducted using a boat and tank-mixed pesticide applied via direct hose injection, or from handheld or backpack sprayers on the shore. Tables 7 and 8 detail common active ingredients found in terrestrial and aquatic noxious weed control.

Table 7. Pesticide Active Ingredients Used for Terrestrial Noxious Weed Control

triclopyr amine and ester	2, 4-D
clopyralid	imazapyr
glyphosate isopropylamine salt	aminopyralid

Table 8. Pesticide Active Ingredients Used for Aquatic Nuisance and Noxious Weed Control Chemicals

endothall (mono and dipotassium salt)	2, 4-D (amine and ester)
carfentrazone-ethyl	bispyribac-sodium
diquat dibromide	flumioxazin
fluridone	glyphosate isopropylamine salt
imazamox	imazapyr
penoxsulam	sodium carbonate peroxyhydrate
triclopyr TEA	

Golf Courses

Data on pesticide applications on public golf courses is included with the private golf course data in the next section of this report.

Public Operator Summary

- Most public pesticide applications are spot treatments.
- The majority of public entities operate their programs using an integrated pest management approach, combining manual, mechanical, and chemical control methods.
- Although most public entities are licensed by WSDA to apply restricted use pesticides, the majority apply products containing active ingredients available to the general public.
- Significant efforts are made to limit pesticide applications in or near sensitive or aquatic areas.
- The majority of public entities spend a great deal of time surveying for and responding to pest pressures early, limiting significant pesticide applications.
- Some local governments are now contracting with commercial applicators to conduct more complex applications, including road shoulder treatments, rodent control, and even large scale ornamental tree/planting treatments. It is more expensive but leaves local governments with reduced liability if something goes wrong.
- With the exception of road shoulder applications, most public entity pesticide applications occur using either handheld equipment or backpack sprayers.
- Vegetation management along roadways operates under an active IPM program that has lessened the total amount of herbicide applied by 50-70 percent over the last 10 years.

Golf Courses

Golf courses are significant users of pesticides. Fairways and greens can be damaged easily by plant, insect, and disease pests, and require constant maintenance in order to preserve uniformity (a necessity for the intended use). This is the primary category of public use that does see the application of disease or fungal control products.

Due to the need for constant maintenance, many golf courses use strict integrated pest management programs encouraging chemical rotation. Pesticide rotation is extremely important, as it can prevent or delay pesticide resistance issues. Most if not all pest pressures are dealt with using a combination of cultural, manual, mechanical, and chemical control methods. The best defense against most golf course pests is an extremely dense, healthy turf.

Fungicide Use

Golf courses in western Washington suffer from a variety of fungal and disease issues due to our mild, wet climate. Fungicide applications can occur as infrequently as quarterly, and as often as monthly depending on the targeted problem and grass type grown. Golf course fungicide applications are typically limited to greens, which make up only a small percentage of the total land managed. In a survey of public and private golf courses, only one copper fungicide was identified as in very limited use currently, although many remarked on more regular copper use 10-20 years ago. Copper can cause phytotoxicity at higher application rates on sensitive grass species; the application of copper on golf course turf could result in additional fertilizer applications.

One way golf courses have lessened their fungicide use over time is by changing the types of grass used on fairways and greens; bentgrass and fescue are much hardier grasses than traditionally used bluegrass. There is also a significant amount of *Poa annua* (annual bluegrass), a hardy grass weed that makes up a large portion of all Washington fairways. Mowing is often used to help dry the grass and prevent disease. The active ingredients listed in Table 9 below are often used to control disease and fungal problems on golf courses. This study did not examine application rates or frequency of applications.

Table 8. Common Golf Course Fungicide Active Ingredients

azoxystrobin	chlorothalonil
triticonazole	PCNB
fludioxonil	propiconazole
mancozeb	thiophanate-methyl
iprodione	aluminum tris
mefenoxam	tebuconazole
fluazinam	copper hydroxide
<i>Bacillus subtilis</i>	metalaxyl-M
trifloxystrobin	thiram
fluopicolide	propamocarb hydrochloride
metconazole	myclobutanil
polyoxin D zinc salt	mineral oil
trinexapac-ethyl	etridiazole
pyraclostrobin	

Herbicide Use

Most golf course weed control occurs during two specific times of the year – the beginning of the growing season (March-April) and again in September. Herbicide applications usually involve spot treatment for the control of weeds in maintained ornamental beds or along fairways and greens. In May or September, fairway clover control may occur. All herbicide use is minimal and fairways and greens are mowed regularly to increase uniformity and decrease weed propagation. Table 9 lists some of the common active ingredients used to control weeds on golf courses.

Table 9. Common Golf Course Herbicide and Moss Control Active Ingredients

glyphosate	triclopyr TEA
fluroxypyr	MCPA
pendimethalin	isoxaben
trifluralin	quinclorac
2,4-D	dicamba
carfentrazone-ethyl	MCP
oxadiazon	oryzalin
ferrous sulfate	zinc sulfate monohydrate

Insecticide Use

The main insect problems on Puget Sound golf course properties are ants, cutworms/sod webworms, and European crane fly. There are also potential aquatic insect problems (mosquitoes) due to stagnant water in ponds. There are many non-chemical options for

controlling insect populations in turfgrass, including vertical mowing, spiking, and core aeration. Every effort is made to maintain healthy, dense turf, lessening the potential for turf-damaging insects. In aquatic settings, fountains and aeration can be used in place of chemical control.

When queried, local golf courses explained that little to no insecticide applications occur on the golf courses today, although treatments for crane fly were very normal 10 to 15 years ago. Some ant treatments do occur in public and wooded areas adjacent to courses. Common insecticides applied on golf courses include:

- ❖ D-phenothrin
- ❖ abamectin
- ❖ *Bacillus thuringiensis israelensis*

Application Method

Most golf course pesticide applications are large in scale when a disease or other pest problem is identified. Truck or ATV-mounted application equipment is often used, as are smaller hand spreaders and backpack sprayers (for sensitive areas). When conducting pesticide applications on greens, equipment includes either a utility vehicle or a golf cart modified for that purpose; these are specifically designed to leave no tracks on the greens.

Golf Course Summary

- The intended use of golf course properties necessitates regular pesticide applications to maintain uniformity and turf health.
- The majority of golf courses follow integrated pest management programs that rely on rotation to prevent pesticide resistance.
- Golf courses conduct very few insecticide applications today; prior to implementation of cultural controls (aeration, spiking, etc.), broadcast insecticide applications were routine.
- The use of copper-based fungicides on golf courses in our area has been mostly phased out, mainly due to phytotoxicity problems and the need for additional treatments when used. It has been replaced by fungicides with lower environmental toxicity.

Commercial Applicators

Local, regional, and national pest control companies were contacted and surveyed for this report. Similar to questioning of public operators, these companies were asked to identify pesticides by trade name, timing, and target pest, as well as application method (if available).

Two different types of operations were surveyed – landscape professionals (lawn and turf weeds/pests), and traditional pest control companies (external and internal pest control). The survey only included questions for outdoor pests, given that the focus of this report is on the potential impact of pesticides on Puget Sound.

Outdoor (non-turf) pest control

Local (one or two counties), state regional (three to six counties), U.S. regional (western states), and national pest control companies operating in the Puget Sound counties were surveyed for this report. Pest control in all 12 Puget Sound counties is characterized as follows. Eight companies of varying sizes were surveyed to provide a representative sample of commercial applications. The surveys were conducted in a manner similar to the public operator surveys.

With few exceptions, the majority of pest control calls for local and regional companies are residential (80-90%). The national companies surveyed conducted significant numbers of commercial application (50% or more of their business). The treatment of commercial properties includes restaurants, grocery stores, multi-family residential, hotels, warehouse distribution centers, etc.

Of those surveyed, 40 to 50 percent of the problems are ant related. These problems include primarily odorous house ants, other nuisance ants, and carpenter ants. Another 40 percent of all problems are rodents, primarily mice and rats. The remaining 10-20 percent of problems are everything else, including other wood-boring organisms, moles and gophers, bees and wasps, and other insect pests.

Most residentially-focused companies remain profitable through the winter months by signing customers up for an annual pest program, involving quarterly visits with inspections and pesticide applications. One of the benefits of these types of programs is they provide the company an opportunity to inspect the property regularly and identify pest problems or potential

problem areas that can be dealt with before a pest problem becomes severe. This allows for an integrated approach, which is very appealing to most homeowners. It can also lower total pest control costs over time.

Ant Control

In our temperate climate, ant problems usually begin in February or early March. The problem can continue into November depending on the weather. For more urban residential properties, the problem is usually odorous house ants (an irritant only); in more wooded areas, carpenter ants pose a serious structural risk. For commercial properties, many of which are concrete construction, any type of nuisance ant or insect is of potential concern. Ants are especially problematic at any facility that serves or stores food.

As mentioned above, many pest control companies offer exclusion services in addition to pesticide applications. One of the major pathways for ant infestations is vegetation too close to foundations, walls, or rooflines. While most companies do not offer pruning, they will give you a list of things that, if remedied, could alleviate some of the pest pressures on your home. Completion of these activities does not usually negate the problem, but they should help decrease future ant pathways into a home. Once ants have established a ‘trail’ into your home, chemical control is almost always needed – ants will track the chemical back to the nest and the queen will be killed. Removal of the queen is the only way to kill a colony.

There are five main conventional chemicals used for ant control:

- ❖ cyfluthrin
- ❖ indoxacarb
- ❖ fipronil
- ❖ bifenthrin
- ❖ imidacloprid

These are primarily classified as neonicotinoids or pyrethroids, which have low mammalian toxicity, making them extremely safe for use around children and pets. They tend to provide a residual chemical signature, protecting a property for sometimes 30 days or longer.

For people interested in only organic control options, the naturally occurring pyrethrins are available for this type of pest. The goal of these exterior applications is to prevent ant colonies

looking inside of houses for food sources. Unfortunately, most treatments do not occur until the infestation moves inside, making it necessary to conduct internal and external treatments.

Applications for residential ant control are done using either a handheld sprayer (one to three gallons) or a backpack sprayer. In the case of most commercial property treatments, ant control is conducted on a large scale using granular products or truck-mounted spray equipment. While local and regional companies mix their own tanks, the national companies surveyed now carry fewer chemical options on their trucks, but all of the product is pre-mixed at their main office, decreasing the chances for mistakes in mixing, over concentrated product, and worker exposure.

Rodent control

In recent years, rat infestations have become a year-round problem for many Puget Sound property owners. Norway rats, which are best known for causing infestations in lower-levels of properties, crawl spaces, basements, etc. have been found moving throughout houses, into roofs, attics, and other insulated spaces. Roof rats, another common type found here, are most often found in eaves and attics. Rodents are a year-round problem for food storage and distribution businesses (restaurants, grocery stores, warehouses, etc.), pose a significant health risk and should not be left uncontrolled.

Most companies offer a multi-tiered approach to controlling rodent populations. The first issue to address is how they are getting into your dwelling. This is often termed exclusion. During the drier, warmer times of the year when outdoor food sources are abundant, rats are unlikely to inhabit houses. This is a time when companies can come out and block pathways into your home. If this type of work is not possible on a property (i.e. commercial), then rodent problems usually begin in early fall as temperatures drop and food sources dwindle. On properties with consistent rodent infestations, chemical baits are set around the exterior of the dwelling after interior treatments are completed to deal with the current problem. The most common chemicals used in these baits are bromethalin, bromethalalone and diphacinone.

Lawn and Garden Maintenance

As evidenced in the residential portion of this survey, the top two pest control areas for most homeowners in the Puget Sound are weeds and moss. Companies are also hired to treat insect and disease problems in trees, shrubs, and other ornamentals.

For this survey, local and national lawn and garden maintenance companies were contacted and queried about chemical use and timing.

Lawn care

Lawn and garden maintenance companies work on commercial and residential properties in all 12 counties around the Puget Sound. As mentioned with previous findings, weeds and moss are the two most commonly treated pest problems in our area. Our temperate, wet climate is ideal for the propagation of grasses, weeds, and moss. Most companies that conduct this type of work attempt to contract with their customers for quarterly treatments that include both cultural and chemical control techniques. Moss control, for instance, is conducted by aerating the soil in the spring and fall, and also using iron and zinc based products (applied using a hand or broadcast spreader). This type of integrated approach lessens the need for large pesticide applications and reduces the risk of pesticide resistance.

Throughout the growing season (March – October) lawns and other problem areas (patios, driveways, sidewalks) are treated with herbicides to control unwanted weeds and grasses. Commercial properties are more likely than all other property types to have regular herbicide applications – these businesses are required to install ornamental plantings, lawn, and other aesthetically pleasing landscape pieces when their property is developed. They must also maintain those landscapes, leading to a very low threshold for pesticide applications. These properties also pose the greatest risk to Puget Sound via pesticide runoff – they tend to be predominantly covered in impervious surface, making them more susceptible to offsite pesticide transport.

The companies spoken with stated that in order to tackle many types of weeds at one time, they are often using either a combination product (three or four chemicals pre-mixed) or building their own tank mix of two or more herbicides from concentrate. For precision and safety, some

companies have gone exclusively with pre-mixed products. Most herbicides are applied in liquid rather than granular form.

Application method depends on the size and complexity of the project area. Small treatments occur using either a handheld (one to three gallon) spray container or a backpack. Treatments too large for hand application are completed using either a backpack sprayer or from an ATV-mounted tank (10 to 50 gallons). In the case of large treatments (or multiple properties being treated with the same product), companies will often mix large 100 gallon truck-mounted tanks and then apply product by a long hose. For extremely large treatments, pump trucks can be used to apply moss control products (similar to how fertilizer is sometimes applied).

Table 10. Commercial Weed and Moss Control Active Ingredients

2,4-D	pendimethalin
MCPP	MCPA
dicamba	triclopyr TEA and BEE
glyphosate isopropylamine salt	fluroxypyr
dichlobenil	ferrous sulfate
zinc sulfate monohydrate	

Trees and ornamentals

Many ornamental trees in the Pacific Northwest are treated in the late winter to prevent insect and disease pests from damaging the new growth and soft surface of trees in early spring. There are two main ways to prevent this early season damage; painting the bottom sections of trees with a liquid pesticide or through soil injection adjacent to the root system. Both of these types of treatments result in little excess pesticide use. The two most common active ingredients for this type of treatment are the neonicotinoid insecticides imidacloprid and dinotefuran. Neonicotinoid insecticides have been linked to acute bee poisoning incidents (honey bee and bumble bee) in several states.

Late spring and early summer pests include diseases like rust and insects, including aphids and others. Pesticide applications for these problems would usually be completed using truck-mounted spray equipment and a canopy spray. Canopy applications must be made very carefully

following the label to avoid non-target impacts. Many flowering ornamental trees support honeybees and other pollinators that could be adversely affected by pesticide applications.

Table 11. Tree and Ornamental Insecticide and Fungicide Active Ingredients

bifenthrin	imidacloprid
dinotefuran	permethrin
myclobutanil	horticultural oils
prallethrin	bifenazate
chlorothalonil	

Commercial Applicator Summary

- While some commercial properties get scheduled treatments, it is uncommon for residential properties to be treated without a documented pest problem.
- Commercial applicators have retained and even grown their businesses during the recession by offering year-round pest protection, including but not limited to exclusion, baits, source identification, cleanup, and pesticide applications.
- To reduce the risk of worker exposure and limit potential over application, many companies have gone to pre-mixed materials rather than having the products mixed on site by the applicator. This has also narrowed the number of products available to an applicator when addressing a new problem.
- Every effort is made to limit pesticide applications in or near sensitive or aquatic areas.
- With the exception of road shoulder applications, most commercial pesticide applications occur using either handheld equipment or backpack sprayers.
- Residential encroachment into rural and wooded areas has increased pest pressures in non-agricultural areas, resulting in an increase in the number of licensed commercial applicators as well as the number of companies competing for application business.

Conclusions

This study began collecting data in late winter/early spring 2013 and concluded data collection on December 31, 2013. The intent of this survey was not to create an estimate of pesticide loading to Puget Sound, but rather, to capture a snapshot in time of pesticide use among non-agricultural entities. The results presented here are intended to help advise education and outreach efforts, as well as identify data gaps and inform future research needs.

The residential response to the unsolicited mail out survey was tremendous. An average response rate of almost 20 percent indicates residents in the Puget Sound counties are invested in providing information if they believe it will help in Puget Sound recovery. Language at the beginning of the survey helped encourage participation as information gathering for Puget Sound recovery efforts. The support behind these efforts should be used as a building block to an educational campaign related to pesticides.

The residential survey results may be a snapshot in time, but given the sample size, should be expected to generally represent residential small property (less than 0.5 acres) pesticide use. Just over 50 percent of the homes responding to the survey treated for some type of outdoor pest problem in the previous 12 months. Similar results would be expected with a larger sample size with the same demographics. The top two pests treated were weeds and moss; again, this is fairly representative of the basin.

The takeaway from the survey of public operators is that both the types of treatments and the chemicals applied are usually the safest available. While the departments surveyed all had pesticide application licenses, the majority are applying products that do not require a license, and are available to the general public. Licensed applicators are required to not only pass a test in order to obtain a license; they also must complete continuing education in order to maintain their licenses in every five year period. Many attend workshops and recertification classes held around the sound; as resources allow, WSDA staff present pesticide information at these courses.

When questioned, public applicators were very adept at reading and interpreting pesticide labels, choosing products that were more protective of aquatic life, and limiting treatments in sensitive

areas. Their cautiousness is directly correlated with the visibility of this type of work to the public.

Commercial applicators have tailored their businesses to create year-round income and reduce staffing changes (winter staffing reductions used to be common). Most companies have continuing education requirements and encourage cross-training. Also, as the public becomes more educated about pesticides and potential environmental impacts, commercial applicators have also had to become more adept at conversing and understanding these topics.

There was little evidence of regular copper-based pesticide use in residential settings by non-agricultural entities in the Puget Sound counties. When retail shelves were surveyed, very few copper products were found available to the public – their use was reported by just over six percent of the respondents in the residential survey. Golf courses were the most likely users of copper-based fungicides, but a survey of that industry found little to no use in the last ten years, as newer and better targeted fungicides have come to the marketplace. Non-agricultural copper use does not appear to be a significant contributor to dissolved copper concentrations in Puget Sound, although this study does not include an estimate of loading from copper-based bottom paints used on boats.

There are four user groups that were not included in this survey; school districts, railroads, military installations and airport properties. Over thirty school districts in the 12 counties were approached for inclusion in this survey – all responded back that due to budget cuts, resources were not available at this time to participate.

Results from this survey are encouraging. Changes in pesticide labeling and use practices over the last ten years show that licensed pesticide applicators are excelling at limiting human health impacts, choosing low toxicity products, and decreasing the risk of runoff from traditional pesticide applications. Due to the continuing education requirements for licensure, they are the best informed and the most easily reached with new information about the risk of certain pesticides to Puget Sound biota.

This survey accomplished its intended goal – obtain data on and better understand typical pesticide use practices by non-agricultural users. The results found here should be used by local, state, and federal agencies to address key concerns – public understanding of pesticide labeling

and risk, off-label uses, best management practices, and mitigation measures. It also identifies a need to simplify label language on products intended for use by unlicensed applicators (homeowners).

Every effort should be made for local, state and federal agencies, and university staff to collaborate and share information to better inform decision making and educate the public. New and emerging pest problems, along with new and emerging pesticide issues should be discussed and disseminated among regulators, scientists, and the media to better inform the public about risks and responsibilities.

Homeowners and residents feel a responsibility to help create and foster a healthier Puget Sound. While their pesticide practices alone are not causing degradation, they are contributing to impacts. Every effort should be made to help residents make better choices for themselves and Puget Sound. The results from this survey highlight the need for Puget Sound education campaigns focused on homeowners as pesticide end users rather than on licensed and trained applicators.

Recommendations

The residential survey data highlights a need for education to the general public about pesticides and information about how to use them properly and limit offsite impacts. One option to address this issues would be to design an education campaign in local stores about pesticide options that are protective of Puget sound; for instance, using only those chemicals labeled for your target pest, the risks associated with using household cleaners and other “unlabeled” products as pesticides, impacts of over application (via runoff), etc. This type of campaign would need to be tackled by either a state or federal agency to have a significant impact on use and behaviors. The program would need to target all store types for handouts, brochures, posters, etc.

One tool that would be extremely useful in the dissemination of information would be a series of fact or focus sheets for different pest problems. Struggling with blackberries? Here is a handout with information about the plant, when to control it, what tools are most effective, what application methods work best, etc. For instance, homeowners purchasing an ant control chemical should also be made aware of needing to remove the queen in order to prevent reoccurrence. This would allow the public to be better informed on needed cultural changes to prevent pest infestations from day one, decreasing the amount of pesticide applications needed. Many of these fact sheets have been created for Pacific Northwest pests (WSU Extension and others), but should be updated and disseminated equally across Puget Sound counties. The update could be completed by a local agency or non-profit, but a partnership with either a state or federal entity would most likely be needed to help encourage local and national retailers to carry these information handouts in their stores.

NRAS has previously issued quarterly newsletters with information about water quality, trending pesticide issues, endangered species, etc. This newsletter should be used as a vehicle to make emerging research on pesticides and environment available to the public.

Licensed applicators are most easily reached through presentations given at local and state association meetings, conferences, and pesticide recertification courses hosted by Washington State University. Staff can share information with thousands of applicators from both the public and private sector in these venues. It is recommended that relevant staff at WSDA present in these venues as research and information changes. This is also the best venue for disseminating

best management practices and changes in application techniques that can aid in Puget Sound recovery.

Local and regional planning authorities dictate planting requirements on commercial, large-scale residential and industrial projects. Most building companies are required to install ornamental plantings along the perimeter of developed properties, leading to a potential need for future pest control. Failure to maintain these landscapes can result in code enforcement and fines for the future property holder. An effort should be made to reach out to local planning departments and assist (where feasible) with updates to their landscape design standards to emphasize low maintenance planting options.

The biggest emerging area of pesticide use is with the reduced risk nicotine-derived and pyrethrum-derived insecticides. As mentioned before, these two chemical classes are popular because of their high efficacy and low toxicity to the applicator, pets, and children. Over 60 percent of the insecticides available to homeowners today are in one of these two chemical classes. Areas of high use in other states have seen stream sediment invertebrate impacts because of these chemicals long residual life and tendency to bind tightly to organic material. Research should be conducted to establish whether or not these chemicals are having a similar effect on Puget Sound stream health. This research could be conducted by local, regional, state, or federal government entities, or a university in the area. Since these chemical classes are used both in urban and agricultural environments, it would be useful to survey for potential impacts in more than one stream location.

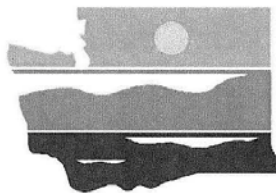
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Appendix A: NEP Grant Scope of Work

WSDA Contract No. K922



DEPARTMENT OF
ECOLOGY
State of Washington

INTERAGENCY AGREEMENT No. C1200278

BETWEEN

THE STATE OF WASHINGTON DEPARTMENT OF ECOLOGY

AND

THE STATE OF WASHINGTON DEPARTMENT OF AGRICULTURE

Project Title: Pesticide Use Survey

THIS AGREEMENT is made and entered into by and between the DEPARTMENT OF ECOLOGY, hereinafter referred to as the "DEPARTMENT" and the DEPARTMENT OF AGRICULTURE, hereinafter referred to as the "RECIPIENT" pursuant to the authority granted by Chapter 39.34 RCW.

IT IS THE PURPOSE OF THIS AGREEMENT to provide federal pass through funds to the RECIPIENT as part of the Puget Sound Action Agenda: Ecosystem Restoration and Protection project.

Contractor Name: Washington Department of Agriculture
PO Box 42560
Olympia, WA 98504-2560

The Contract Manager for each of the parties below shall be the contact person for all communications and billings regarding the performance of this Contract.

Project/Financial Manager for the RECIPIENT: **Kelly McLain, Director's Office**
Natural Resource Assessment
WA State Department of Agriculture
360-902-2067
Email Address: kmclain@agr.wa.gov

Project Manager for the DEPARTMENT: **Andrew Kolosseus**
Water Quality Program
WA State Department of Ecology
P.O. Box 47600
Olympia, WA 98504
360-407-7543
Email address: andrew.kolosseus@ecy.wa.gov

Financial Manager for the DEPARTMENT: **Sarah Ralph**
Water Quality Program
WA State Department of Ecology
P.O. Box 47600
Olympia, WA 98504

WSDA Contract No. K922

ATTACHMENT A

STATEMENT OF WORK/BUDGET

Statement of Work

In 2011, the DEPARMTNET completed a toxics loading study showing high concentrations of copper in Puget Sound urban watersheds. Pesticides are identified as one of the potential sources in this study. As a result, the draft 2012 Puget Sound Action Agenda requests that RECIPIENT investigate the use of copper in non-agricultural settings. The RECIPIENT, along with the United States Department of Agriculture (USDA) National Agriculture Statistics Service (NASS) Washington Field Office, will develop and complete three surveys of urban pesticide use in the Puget Sound Basin. A mail-out/phone survey of nine thousand five hundred homeowners will be completed by NASS, and surveys of professional commercial applicators and public operators will be completed by RECIPIENT. The goal of these surveys is to develop a profile of typical urban pesticide use, including copper-based compounds, in the Puget Sound Basin. Survey results will be compiled into a report.

Work Plan:**Task 1 – Stakeholder Advisory Committee**

The RECIPIENT will establish a stakeholder advisory committee to review the draft Quality Assurance Project Plan (QAPP) and the draft report. The committee will be comprised of the RECIPIENT, DEPARTMENT, Puget Sound Partnership (PSP), EPA, at least one expert from a local jurisdiction, and any other appropriate experts. At least one meeting will be held prior to conducting the surveys.

Deliverable: RECIPIENT will send a membership list for the committee to The DEPARTMENT.

Due Date: September 4, 2012

Cost: \$0

Task 2 – Quality Assurance Project Plan (QAPP) Project Waiver and Survey Design

The RECIPIENT will complete a QAPP Project Waiver. The RECIPIENT will complete a survey design that will include:

- The plan for all the work to be done in Tasks 3 and 4.
- The quantitative criteria for an assessment of project success.

The designs of three surveys and the follow-up phone questionnaire will be provided to the stakeholder group for comment. This will also include development of the two survey lists for random residential sampling.

RECIPIENT will send the survey to OFM for approval.

Deliverable: RECIPIENT will send the final QAPP Project Waiver and survey design to the DEPARTMENT.

Due Date: December 31, 2012

Cost: \$19,000

Task 3 – Conduct Surveys

The surveys are composed of three parts: a survey of residential pesticide use; a survey of private commercial operators; and a survey of public operators. The RECIPIENT will meet with representatives from private commercial operators and public operators and complete surveys of typical pesticide use. These surveys will follow RECIPIENT's established procedures used to collect pesticide use data from commodity groups throughout the state.

WSDA Contract No. K922

The RECIPIENT will coordinate with USDA NASS to mail out, receive, and complete follow-up phone surveys of residential users. The residential survey will be completed in partnership with the USDA NASS. It will consist of a mail-out survey to at least 9,500 urban households in multiple communities with a follow-up phone survey. The household survey will use NASS's statistically based sampling methods and procedures that are the basis of pesticide use surveys conducted for agricultural commodities.

All surveys will focus on gathering information on which pesticides are used, application rate, and timing of application in urban areas throughout Puget Sound.

Deliverable: RECIPIENT will send compiled data to the DEPARTMENT.

Due Date: June 30, 2013

Cost: \$73,985

Task 4 – Draft and Final Report

The RECIPIENT will write a draft report evaluating the typical use of pesticides in the urban environment. The RECIPIENT will submit the draft report to the stakeholder committee and USDA NASS for review. The RECIPIENT will respond to comments in writing and revise the draft report. The RECIPIENT will post the final report on its website.

The report will compile the findings of the project. The report will characterize pesticide use in Puget Sound lowlands, coupled with existing surface water monitoring efforts for pesticides in urban streams, to evaluate whether or not copper (or other urban pesticides) are significant contributors to Puget Sound loading of toxics.

Deliverable: RECIPIENT will send a final report to the DEPARTMENT.

Due Date: December 31, 2013

Cost: \$28,000

Task 5 – Project Management

The RECIPIENT will administer the project. Responsibilities will include, but not be limited to: maintenance of project records; submittal of payment vouchers, fiscal forms, and progress reports; compliance with applicable procurement, contracting, and interlocal agreement requirements; application for, receipt of, and compliance with all required permits, licenses, easements, or property rights necessary for the project; and submittal of required performance items.

The RECIPIENT must manage the project. Efforts will include conducting, coordinating, and scheduling project activities and assuring quality control. Every effort will be made to maintain effective communication with the RECIPIENT designees; the DEPARTMENT; all affected local, state, or federal jurisdictions; and any interested individuals or groups. The RECIPIENT must carry out this project in accordance with any completion dates outlined in this agreement.

The RECIPIENT must ensure this project is completed according to the details of this agreement. The RECIPIENT may elect to use its own forces or it may contract for professional services necessary to perform and complete project-related work.

Required Performance:

1. Effective administration and management of this grant project.
2. Maintenance of all project records.
3. Timely submittal of all required performance items including reports and vouchers.

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Deliverable: RECIPIENT will send quarterly progress reports to The DEPARTMENT
Due Date: Quarterly progress reports due October 10th, January 10th, April 10th, and July 10th of each year. Project management continues through the duration of the project: December 31, 2013.
Cost: \$15,000

Task Timeline and Cost		
Project Task	Cost	Completion Date
Task 1- Stakeholder Advisory Committee	\$0	September 4, 2012
Task 2- QAPP Project Waiver and Survey Design	\$19,000	December 31, 2012
Task 3- Conduct Surveys	\$73,985	June 30, 2013
Task 4- Draft and Final Report	\$28,000	December 31, 2013
Task 5- Project Management	\$15,000	December 31, 2013
Total:	\$135,985.00	December 31, 2013

Appendix B: Final Mail Survey Form

Urban Pesticide Use Survey



Dear Resident:

The Washington State Department of Agriculture (WSDA) is asking for your help to collect information about the types of pest control products and practices used throughout the year within the Puget Sound Region.

Please consider taking a few minutes to complete this short survey.

Once complete, simply return the form in the postage-paid envelope. All information you provide will remain anonymous and be used only for statistical purposes.

Thank you for your help.

1. Do you own or rent your property?

- Own (010)
- Rent (011)

2. During the last 12 months were any pest control products applied to your yard or any outside areas of your property?
(Please include any products to control insects, weeds, moss, spiders, rodents, etc.)

- Yes (012)
- No (013)
- Do not know (014)
- Prefer not to answer (015)

3. During the last 12 months my outside property was treated for:
(Check all that apply.)

- Insects (016)
- Weeds (019)
- Other _____ (022)
- Do not know (025)
- Ants (017)
- Moss (020)
- Other _____ (023)
- Prefer not the answer (026)
- Spiders (018)
- Rodents (mice, rats, etc) (021)
- Other _____ (024)
- No pesticides applied (027)

4. Where on your outside property were pest control products applied during the last 12 months?
(Check all that apply.)

- Driveways (028)
- Lawn or turf areas (032)
- Foundation (036)
- Sidewalks (029)
- Ornamental trees or shrubs (033)
- Other areas _____ (039)
- Patios (030)
- Fruit trees (034)
- Do not know (037)
- Garden (031)
- Roof (035)
- Prefer not to answer (038)
- No pesticides applied (039)

5. Please rate the following questions.

- Insects are a problem on my property (040).....
- Rodents are a problem on my property (041)
- Weeds are a problem on my property (042).....
- Moss is a problem on my property (043)
- New pests are a problem on my property (044)

	Minimal or No Problem			Major Problem		Do not know	Prefer not to answer
	1	2	3	4	5		
Insects are a problem on my property (040).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rodents are a problem on my property (041)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Weeds are a problem on my property (042).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moss is a problem on my property (043)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
New pests are a problem on my property (044)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. Who applied pesticide products to your outside property (in the last 12 months).
(Check all that apply.)

- Myself or other family members (050)
- Landlord (051)
- Paid Pest Control Applicator (052)
- Do not know (053)
- Prefer not to answer (054)
- No pesticides applied (055)

7. If you paid someone to apply pesticides, please select the reason(s) why.
(Check all that apply.)

- Convenience (056)
- Safety (057)
- Not comfortable working with pesticides (058)
- Self-application does not seem to work effectively (059)
- Seriousness of the problem (060)
- Do not know (061)
- Prefer not to answer (062)
- Did not use a commercial applicator (063)

8. If you chose not to hire someone, please select the reason(s) why.
(Check all that apply.)

- No serious pest problems (064)
- Too expensive to hire commercial applicator (065)
- I am comfortable applying pesticides myself (066)
- Over-the-counter products work fine (067)
- Do not know (068)
- Prefer not the answer (069)
- Did not apply any pesticides (070)

9. How many times during the past 12 months were pesticides applied to your outside property.
(Include all applications made by yourself or anyone else.)

- 1-2 times (071)
- 3-4 times (072)
- 5 or more times (073)
- Do not know (074)
- Prefer not to answer (075)
- No pesticides applied (076)

10. During what months were pesticide products applied to your outside property?
(Check all that apply.)

- January (080)
- February (081)
- March (082)
- April (083)
- May (084)
- June (085)
- July (086)
- August (087)
- September (088)
- October (089)
- November (090)
- December (091)
- No pesticides were applied in the last 12 months (092)
- Do not know (093)
- Prefer not the answer (094)

11. If you purchased pesticides, where did you buy them?
(Check all that apply.)

- Home improvement store outlets (095)
- Local hardware store (096)
- Grocery or drug store (097)
- Garden supply store/nursery (110)
- Do not know (098)
- Prefer not the answer (099)
- Did not purchase any pesticides (100)


12. If you purchased any pesticides, what types of products did you buy?
(Check all that apply.)

- Liquid concentrates that you mixed with water (101)
- Dry formulations that you mixed with water (102)
- Ready-to-use liquid products (did not have to mix) (103)
- Ready-to-use dry products (did not have to mix) (104)
- Other formulations _____ (105)
- Do not know (106)
- Prefer not to answer (107)
- Did not purchase any pesticides (108)

13. Please indicate which products below were applied by you or anyone else on your outside property during the past 12 months.
(Check all that apply.)

Weed Control Products (Herbicides)	Insect and Spider Products (Insecticides)	Other Pest Control Products
<input type="checkbox"/> Bayer Advanced Brush Killer Plus (200) <input type="checkbox"/> Bayer All in One Lawn Weed & Crabgrass (201) <input type="checkbox"/> Bayer Season Long Weed Control (202) <input type="checkbox"/> Bonide Kleen Up (203) <input type="checkbox"/> Bonide Stump and Vine (204) <input type="checkbox"/> Brush Killer (205) <input type="checkbox"/> Casoron (206) <input type="checkbox"/> Casoron 4G (207) <input type="checkbox"/> Crossbow (208) <input type="checkbox"/> Durazone RTU (209) <input type="checkbox"/> Grass B Gon (210) <input type="checkbox"/> Hi-Yield KillZall (211) <input type="checkbox"/> Image Brush and Vine Killer (212) <input type="checkbox"/> Image Brush and Vine Killer R-T-U (213) <input type="checkbox"/> Lilly Miller Noxall Granules (214) <input type="checkbox"/> Lilly Miller Noxall Liquid (215) <input type="checkbox"/> Miracle Gro Garden Weed Preventer (216) <input type="checkbox"/> Ortho Ecosense Lawn Weed Killer (217) <input type="checkbox"/> Ortho Ground Clear (218) <input type="checkbox"/> Ortho Max Poison Ivy and Brush (219) <input type="checkbox"/> Preen Garden Weed Preventer (220) <input type="checkbox"/> Rangestar (221) <input type="checkbox"/> Roundup (222) <input type="checkbox"/> Roundup Extended Control (223) <input type="checkbox"/> Roundup RTU Wild Blackberry (224) <input type="checkbox"/> Scott's Liquid Turf Builder (225) <input type="checkbox"/> Scott's Turf Builder Plus 2 Weed (226) <input type="checkbox"/> Spectracide Bug & Weed (227) <input type="checkbox"/> Spectracide Weed & Grass (228) <input type="checkbox"/> Ultra Kill (229) <input type="checkbox"/> Weed B Gone – Chickweed Clover (230) <input type="checkbox"/> Weed B Gone Max (231) <input type="checkbox"/> Weed Beater Ultra (232) <input type="checkbox"/> Weed Whacker Jet Spray (233) <input type="checkbox"/> Weed-n-Feed (234) <input type="checkbox"/> WeedStop (235) <input type="checkbox"/> Worryfree Weed and Grass Killer (236) <input type="checkbox"/> Other _____ (250) <input type="checkbox"/> Other _____ (251) <input type="checkbox"/> Other _____ (252) <input type="checkbox"/> Other _____ (253) <input type="checkbox"/> Other _____ (254) <input type="checkbox"/> Do not know (298) <input type="checkbox"/> Prefer not to answer (299)	<input type="checkbox"/> Ace Home Insect Control (301) <input type="checkbox"/> All Season Spray Oil (302) <input type="checkbox"/> Ant Shield (303) <input type="checkbox"/> Bayer Advanced Termite Killer (304) <input type="checkbox"/> Bayer Ant Killer (305) <input type="checkbox"/> Bayer Natria Home Pest Control (306) <input type="checkbox"/> Bayer Tree & Shrub Protect & Feed (307) <input type="checkbox"/> Bonide Ant Killer (308) <input type="checkbox"/> Bonide Fruit Tree Spray (309) <input type="checkbox"/> Bonide Malathion (310) <input type="checkbox"/> Bug Barrier (311) <input type="checkbox"/> Carpenter Ant & Termite (312) <input type="checkbox"/> Grants Ant Bait (313) <input type="checkbox"/> Monterey Garden Insect Spray (314) <input type="checkbox"/> Ortho Home Defense Max (315) <input type="checkbox"/> Rose & Flower Care (316) <input type="checkbox"/> Sevin (317) <input type="checkbox"/> Triazicide Insect Killer (318) <input type="checkbox"/> Other _____ (350) <input type="checkbox"/> Other _____ (351) <input type="checkbox"/> Other _____ (352) <input type="checkbox"/> Other _____ (353) <input type="checkbox"/> Other _____ (354) <input type="checkbox"/> Do not know (398) <input type="checkbox"/> Prefer not to answer (399)	<p>Moss Control Products</p> <input type="checkbox"/> Moss B Gone (400) <input type="checkbox"/> Moss B Ware (401) <input type="checkbox"/> Moss Max (402) <input type="checkbox"/> Moss Out (403) <input type="checkbox"/> Rid Moss (404) <input type="checkbox"/> Safer Brand Moss & Algae Killer (405) <input type="checkbox"/> Worry Free Moss & Algae Control (406) <input type="checkbox"/> Other _____ (450) <input type="checkbox"/> Other _____ (451) <input type="checkbox"/> Do not know (498) <input type="checkbox"/> Prefer not to answer (499)
		<p>Mole and Gopher Products</p> <input type="checkbox"/> Critter Ridder (500) <input type="checkbox"/> Mole & Gopher Bait (501) <input type="checkbox"/> Mole Killer (502) <input type="checkbox"/> Other _____ (550) <input type="checkbox"/> Other _____ (551) <input type="checkbox"/> Do not know (598) <input type="checkbox"/> Prefer not to answer (599)
	<p>Fungus Control Products (Fungicides)</p> <input type="checkbox"/> Bayer Advanced Disease Control (600) <input type="checkbox"/> Bonide Fungonil (601) <input type="checkbox"/> Bonicide Garden Dust (602) <input type="checkbox"/> Bonide Liquid Copper (603) <input type="checkbox"/> Concern Copper Soap (604) <input type="checkbox"/> Earth-Tone Garden Fungicide (605) <input type="checkbox"/> Liqui-Cop Fungicide Garden Spray (606) <input type="checkbox"/> Microcop Fungicide (607) <input type="checkbox"/> Ortho Disease-B-Gon Copper Fungicide (608) <input type="checkbox"/> Ortho Ecosense Garden Disease Control (609) <input type="checkbox"/> Ortho Elemental Garden Disease Control (610) <input type="checkbox"/> Safer Garden Fungicide (611) <input type="checkbox"/> Serenade (612) <input type="checkbox"/> Other _____ (650) <input type="checkbox"/> Other _____ (651) <input type="checkbox"/> Do not know (698) <input type="checkbox"/> Prefer not to answer (699)	<p>Slug Control Products</p> <input type="checkbox"/> All-Natural Snail & Slug Spray RTU (700) <input type="checkbox"/> Bonide Bug & Slug Killer (701) <input type="checkbox"/> Garden Safe Slug & Snail Bait (702) <input type="checkbox"/> Go-West Meal (703) <input type="checkbox"/> Sluggo (704) <input type="checkbox"/> Other _____ (750) <input type="checkbox"/> Other _____ (751) <input type="checkbox"/> Do not know (798) <input type="checkbox"/> Prefer not to answer (799)

Would you like to participate in a follow-up survey that will help provide more detailed answers regarding pesticide use in our state?

<input type="checkbox"/> Yes <small>(800)</small>		Name:
		Phone Number: () -
<hr/>		
<input type="checkbox"/> No Thanks		

➤ ***Please return your survey using the enclosed postage-paid envelope.***

Comments:

Thank you for your help completing this important survey.

Appendix C: Pest Problem Response, County Groupings

