Potential Environmental Contaminants on William L. Finley National Wildlife Refuge Corvallis OR

Prepared for
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November 1997

I. Introduction:

This report was prepared as one facet of the current research project entitled "Assessment of Impacts to Fish and Wildlife From Pesticide Use on the Western Oregon Refuge Complex". This research project was designed to investigate pesticide impacts on aquatic communities on refuge lands. The study is scheduled to be completed in 4 phases, including; (1) collection of background information, (2) collection and analysis of water samples, (3) performance of in-situ fish bioassay, and (4) collection and analysis of blood hormone levels in common carp and western pond turtles.

This report is a summary of background information gathered as the first phase of the research project.

The Western Oregon Refuge Complex consists of 11 National Wildlife Refuges (NWR's). Three Willamette Valley Refuges, William L. Finley, Ankeny, and Baskett Slough, were primarily established to provide wintering habitat for Canada Geese (Branta canadensis), especially dusky Canada Geese (B. c. occedentalis). In order to provide high quality, palatable forage for geese, a large percentage of the refuge lands are cultivated. Crops established on the refuge include annual ryegrass, perennial ryegrass, fescue, and a grass/clover (pasture) mix. Grass crops on the refuges must be of equal or better quality than adjacent private lands, in order to attract geese and reduce off-refuge crop depredation. Lush, dense stands of grass, provide excellent forage throughout the winter because these crops will grow back several times after being browsed. Farming of refuge crops is accomplished through cooperative agreements with local farmers. Pesticide use is necessary for the certification of grass seed produced, thereby making the refuge farming program attractive to local farmers. In addition, each of the valley refuges exists in a mosaic of croplands, dairies and timberlands, where agricultural chemicals are commonly applied. The potential for chemical contaminants to enter refuge waterways is of concern because aquatic communities and species that inhabit them may be harmed by exposure to such contaminants.

II. Objective:

The objective *of this portion of the research* was to determine pesticide use practices for refuge lands and surrounding areas.

III. Methods:

Information was gathered from (1) refuge records and refuge personnel, (2) county extension agents, (3) refuge cooperative farmers, and (4) private landowners. The emphasis throughout the information gathering phase was placed on William L. Finley NWR, because it is the largest of the Valley refuges, because Muddy Creek is a major drainage through Finley NWR, and because the proposed water sampling, bioassay, and blood sampling were designated to be conducted on Finley Refuge. However, land use practices both on and around the other valley refuges were investigated to a somewhat lesser extent and are similar to those of Finley.

1. The Western Oregon Refuge Complex maintains an Integrated Pest Management Plan (IPMP). This plan contains Pesticide Use Proposals (PUP) for chemical pesticides proposed for

use on refuge lands. Information from PUPs was used in preparation of this report. Also, pesticide and fertilizer record sheets provided by refuge cooperative farmers on an annual basis were used to determine pesticide use on refuge lands. Personnel at Finley refuge were interviewed regarding pesticide use in conjunction with maintenance of dikes and public use areas.

2. County extension specialists from Oregon State University (OSU) were contacted regarding typical pesticide use practices for specific crops located adjacent to refuge lands including; grass seed, pastures, oats, vegetable row crops (esp. corn), dairy management, Christmas trees and general forestry operations. Agents from Benton, Linn, Polk, Marion, and Yamhill counties participated in background information gathering. In addition, resource publications from the OSU extension service were used for reference and information gathering, particularly the 1997 Pacific Northwest (PNW) Weed Control Handbook, 1997 PNW Insect Control Handbook, and 1997 PNW Plant Disease Control Handbook.

3. Cooperative farmers on the Willamette Valley Refuges were interviewed regarding agricultural practices on refuge lands. An agricultural practices data form (Attachment 1) was used during these personal interviews. Completed pesticide use records from refuge cooperative farmers, which are prepared annually for the Refuge Manager, were also used to document pesticide use information on refuge lands.

4. Landowners neighboring Finley NWR were contacted by telephone. Records from the Benton county tax assessors office were used to identify neighbors. Emphasis was placed upon contacting neighbors owning > 50 acres. In cases where the landowner had leased land to be farmed, an attempt was made to contact the farmer that was actually working the land. The survey was either conducted in person, or over the telephone. The agricultural practices data form was employed during personal and telephone interviews.

IV. Results and Discussion:

The use of particular herbicides, fungicides, or insecticides varies depending on the presence of pest species. It is difficult to predict what may occur during any particular season, so I present information that is considered "typical" of a particular crop in the Willamette Valley of Oregon. However, I have also attempted to be complete, including several chemicals that may be used for particular purposes. Dates are also somewhat variable, because application of a pesticide may depend upon the life-history of the particular crop or pest being managed. I have attempted to identify time frames, although it should be recognized that weather conditions, and other factors may influence when pesticides are applied.

A. *Refuge maintenance*

On refuge property, all chemicals that are to be applied must go through a permitting process, and be approved for a specific use. These chemicals are listed, with their approved use, in Table 1. No restricted use chemicals, nor any insecticides are approved for regular refuge use. Over the past year, two insecticides, malathion and metaldehyde, were given emergency approval for limited use in association with specific pest infestations. The Refuge Complex employs chemicals

during routine facilities maintenance including; clearing parking lots, kiosk sites, areas of high-public use, maintaining dams and dikes for water impoundments. In addition a limited use of herbicide is employed for on-going research projects. Typically, maintenance is done selectively by applying herbicides, either glyphosate (Round-up) or 2,4-D (Crossbow or Weedmaster), using a backpack sprayer or ATV. Invasive woody shrubs can damage structures, such as dikes, and other plants such as poison-oak present a safety hazard in high public-use areas. Herbicies are also employed in the control of noxious exotic weeds such as Meadow Knapweed (Centaurea jacea X C. nigra).

B. ***Grass seed crops***

Grass seed crops are the majority of cultivated refuge land, and are the major land use surrounding the refuge. The following discussion relates to agricultural practices both on and off refuge land. Table 2 summarizes agricultural chemicals that may be applied to grass seed crops.

Agricultural standards for grass seed crops require that grass seed crops be "weed free" in order for seed to be certified for national and international distribution. Because each crop is intended to produce a particular variety (genetic strain) of seed, the definition of "weeds" in a grass seed field encompass all other types of plants, including those traditionally considered weeds, such as broadleafs, but also all other species and varieties of grass. This includes any dormant, volunteer seed from a previous crop in the same field. Field burning has been utilized extensively, in the past, to eradicate weed seed, and prevent them from germinating. However, with current air quality and safety concerns, burning has been reduced to a nominal level. This has led to an increase in the use of chemical herbicides in grass seed fields. In addition to herbicides, fungicides are regularly applied to perennial crops which tend to be vulnerable to fungal infestations that prevent plants from seeding. Maintenance of a vigorous grass crop, and production of dense seed heads also requires the use of fertilizers.

Many farmers increase their income by allowing livestock grazing, particularly sheep, during the winter months. This is of interest because many chemical pesticides have grazing restrictions. Thus, grazing probably reduces the use of certain chemical compounds. However, it is recommended that additional fertilizer be applied to grass crops if grazing is going to be commenced. Another consideration is that many grass seed farmers sell hay or seed screenings, material left after seed is harvested, cleaned and bagged, to livestock growers or companies producing livestock feed pellets. Many chemicals have restrictions on whether or crops that have be treated can subsequenly be used for animal feed. There is, therefore, an economic incentive to use chemicals that do not have feeding restrictions. Finally, it should be recognized that chemicals represent a major expense to farming operation. Farmers generally attempt to apply chemicals when they will be most effective, which may limit somewhat the amount of chemical entering waterways as contaminants.

Annual Ryegrass -

If soil tests indicate that lime is needed (pH □4.7), lime is applied during seedbed preparation (late August -early September). Seedbed preparation occasionally includes a herbicide application, usually glyphosate (Round-up). Annual ryegrass is planted by drilling in August or

early September, a complete fertilizer (N-P-K /15-15-15) is generally drilled with the seed. A selective grass herbicide is applied in the fall (late Sept. - early Oct.), usually ethofumesate (Nortron). Also, slug control occurs in the fall. Metaldhyde bait (4-7.5 % ai) is employed in areas experiencing slug damage. Slug bait is gennerally not approved for use on refuge lands, except under severe infestations causing irreprrable damage toforage crops. In the late winter/early spring, fertilizer is applied again, some form of nitrogen with sulfate, urea-sul or ammonium sulfate (34-0-7). Two applications are generally applied, early March and mid-April, generally providing about 80-100 lbs of nitrogen per acre. This is followed by an herbicide treatment for broadleaf weeds, generally 2, 4-D (or MCPA) combined with dicamba (Banvel), in late March or early April. Other herbicides that may be used either fall or spring, but not on refuge lands include, tribenuron methyl (Express), bromoxynil (Buctril), clopyralid (Stinger), clopyralid +2,4-D (Curtail) or clopyralid + MCPA (Curtail M). Formulations containing clopyralid are generally expensive in relation to other herbicides, and may be somewhat cost prohibitive to apply. Paraquat (Gramoxone extra) is sometimes employed during seedbed preparation, but paraquat is a restricted use chemical, and requires a state licenced applicator for it's use.

Perennial Ryegrass -

Perennial ryegrass crops generally produce seed over a 4-5 year period, the crop is rotated into a new crop of perennial ryegrass following this production phase. During the first year, the establishment period, the crop is treated slightly differently than after it becomes established. On the refuges new stands of perennial grass are spring planted, whereas off refuge fields are often be fall planted. The refuge requires spring planting to ensure a better established crop during the winter, and to reduce soil erosion. If lime is needed in the soil (pH□ 4.7), as determined through a soil testing process, it is applied during seedbed preparation at about 1 ton per acre. In late August or early September, perennial grass is seeded in rows, using an activated carbon band/fertilizer (N-P-K / 15-15-15) solution over the seed. Two preemergence herbicide sprays are used for seedling and broadleaf weed control. A "sprout-spray" is done with either glyphosate (Round-up), or in some cases paraquat (Gramoxone extra), followed by an application of diuron (Karmex). Then one post-emergence application is applied, usually, ethofumesate (Nortron). Then, if needed, slug bait (metaldehyde) is placed in areas where slug damage is occurring. In the spring (late Feb.-April), the crop is fertilized twice, using ammonium sulfate (33-0-0-12), followed by urea (45-0-0). Total applied nitrogen for spring should equal about 80-100 lbs of N per acre. In March, a broadleaf weed herbicide is applied, 2,4-D combined with dicamba (Banvel). This combination may be applied with liquid fertilizer (which would substitute for one of the above fertilizer applications). Later in the spring (April), a spot-spray is conducted for rouge weed control using glyphosate (Round-up) and a backpack sprayer. In mid-May to late June, fungicide is boom sprayed or aerial applied to control rust infestations. Propiconazole (Tilt) is used, usually twice with 18 days between applications.

Established perennial ryegrass is fertilized in the fall post-harvest with a complete fertilizer (N-P-K, 14-14-14). A border spray using glyphosate (Round-up), and a hand nozzle from a spray buggy, is done around field edges. Then, three separate herbicide treatments are applied to control noxious weeds and seedling sprouts (Oct-Dec), first an application of metolachlor (Dual), then diuron (Karmex) combined with metribuzin (Sencor or Lexone), and finally oxyfluorfen (Goal). On refuge land, Karmex alone or Karmex/Sencor are the approved chemicals that are used, and

applications are usually completed by November 1. In the spring (late Feb.-April), the crop is fertilized twice, using ammonium sulfate (33-0-0-12), followed by urea (45-0-0). Total applied nitrogen for spring should equal about 80-100 lbs of N per acre. In March, a broadleaf weed herbicide is applied, 2,4-D combined with dicamba (Banvel), if other "weed" grasses are also a problem fenoxaprop (Horizon) may be applied. This combination may be applied with liquid fertilizer (which would substitute for one of the above fertilizer applications). Later in the spring (April), a spot-spray is conducted for rouge weed control using glyphosate (Round-up) and a backpack sprayer. Finally, in mid-May to late June, fungicide is aerial applied to control rust infestations. Propiconazole (Tilt) is used, it may be applied from 1 to 4 times depending on the severity of the fungal infection, but typically twice with 18 days between applications is sufficent.

Fescue -

Perennial fescue crops are similar to perennial ryegrass in that they must go through an establishment phase, and then will be in production for 4-5 years. Spring planting is standard for fescue. During the fall (Nov), the season before a new planting, an herbicide treatment is usually applied to the seedbed, using glyphosate (Round-up) or diuron (Karmex). Immediately prior to planting (Feb) a seedling weed control is applied, again using glyphosate (Round-up). The crop is fertilized when it is seeded, with nitrogen/sulfate (40-0-0-6). Then, (March) a broadleaf herbicide is applied 2,4-D (or a derivative of 2,4-D). The following fall (Oct-Nov), the crop is considered established, the herbicides metolachlor (Dual), followed by diuron (Karmex) combined with metribuzin (Sencor or Lexone) or oxyfluorfen (Goal) are applied. A complete fertilizer (N-P-K/14-14-14) is applied in the fall, as well. In spring, a broadleaf herbicide 2,4-D combined with dicamba (Banvel) is applied. The crop is fertilized twice with ammonium sulfate (33-0-0-12). Finally, in mid-May to late June, fungicide is boom sprayed or aerial applied to control rust infestations. Propiconazole (Tilt) is used, usually twice with 18 days between applications.

Pasture/grass clover mix -

Established pasture is usually maintained by applying fertilizers both fall (Oct) and spring (Mar). Pasture rarely requires any application of herbicide or pesticide. Weed control is usually focused on invasive shrub species such as blackberry, or individual plants such as thistle, and they are sprayed individually and selectively using a backpack sprayer and glyphosate (Round-up). If an unusual amount of weeds are present the pasture may be sprayed using 2,4-D or MCPA, in the spring (March). When cattle are present on pasture lands there is obviously inputs of organic nitrogen (nitrate nitrogen) and depending upon the number of animals, manure may be a potential problem. However, this is of greater concern on dairy lands (see below).

C. *Vegetable Row Crops*

Corn -Sweet (for processing) and Field (Dairy feed corn)

Table 3 summarizes agricultural chemicals used on corn crops.
During spring (Feb-Mar) the field is prepared for planting. Herbicides are employed in the seedbed preparation, typically atrazine is employed for field corn, and metolachlor (Dual) is

applied to sweet corn. Occasionally, atrazine and metolachlor are combined together. These chemicals are usually incorporated into the soil prior to planting, or activated through irrigation. Other chemicals that are used for preplant incorporated weed control are cyanazine (Bladex), alachlor (Lasso or Partner), propachlor (Ramrod), EPTC with safener (Eradicane), Butylate with safener (Sutan Plus), dimethenamid (Frontier), pendimethalin (Prowl), or acetochlor (Harness or Surpass). All of these herbicides, except for Prowl, can be combined with atrazine or cyanazine to increase their effectiveness. Seed corn used for planting both sweet and field corn, is usually treated with fungicide. Seeds are coated with chemical prior to planting. Fungicides such as, thiram (Thiram 50 WP dyed) at 3 ounces per 100 pounds of seed, are used to control seed rot and seedling blight, others such as triadimenol (Baytan 30) may be used at a rate of approximately 3 fluid ounces per 100 pounds of seed, to control corn head smut. However, environmental contamination from this source seems unlikely because the fungicide is designed to stay with the seed through germination and growth. Additionally, during planting insecticide may be applied to control the garden symphylan, a soil borne pest, and to arrest potential outbreaks of black cutworm, which are the most common pests of corn crops. Typical control includes banding the seed row at planting with ethoprop (MOCAP), or using chlorpyrifos (Lorsban 4E or Lorsban 15G), or fonofos (Dyfonate 4E), and incorporating into the top few inches of soil. Occasionally, diazinon may also be used for this purpose, however, under western Oregon conditions it may not be as effective as insecticides listed above.

Following the initial planting, many other herbicides may be used to control weeds within the corn crop. This is usually done if there is a weed problem noticed in the field, and is dependant on the growth stage of both the corn crop and the species and growth stage of weed plants. It is important to control weeds in field corn used for feed, because many weed plants may be toxic to livestock. Herbicides that may be applied during early post emergence of corn (May-June) include 2,4-D, atrazine, pendimethalin (Prowl), bentazon (Basagran), pyridate (Tough), or halosulfuron (Permit) for sweet corn or field corn. In addition, other products may be used on field corn only, and they include dicamba (Banvel), bromoxynil (Buctril), clopyralid (Stinger), a combination of atrazine and bentazon (Laddok), nicrosulfuron (Accent), and primisulfuron (Beacon). If a weed problem appears later in the stage of corn growth or was not controlled by the previous treatment, paraquat (Gramoxone extra), or a combination of paraquat and atrazine may be used as a directed spray, it is particularly critical to use a method of applying this herbicide that places the chemical toward the bottom few inches of the corn plants, so the chemical does not damage the plant. Finally (July), a spot treatment on individual weed plants may be conducted, using glyphosate (Round up). Corn is then harvested in August or early September. Cover crops, such as, ryegrass, alfalfa, or clover are sometimes planted post harvest in fields used for corn production. These crops remain over the winter to anchor soil, but are usually not intensively managed for a harvestable crop.

Hunting Clubs -

There are several areas of land adjacent to the refuge that are managed as private hunting clubs. The goal of land management in these areas is not to produce a harvestable crop, but to grow crops that attract "harvestable" wildlife, such as waterfowl. Typically these areas contain corn. The corn is grown to maturity as described above, however, it is not harvested. The corn is left in the field so that ducks and geese may forage on the "waste grain". Other crops that may be

grown in hunt club areas include wild rice, or millet. These later crops do not generally require the use of many chemicals and are in such limited acreage that they are not explored in detail for this report.

D. ***Cereal grains***

Oats

Table 4 summarizes chemicals applied to oat crops.
Oats may be planted in either fall or spring in the Willamette Valley. However, many treatments with agricultural chemicals follow the phenology of the crop, so the same chemical may be applied at different times of the year. Oats are generally treated with diuron (Karmex) early after planting (Sept, Feb), to reduce competition with emerging grasses. Then (Oct, Mar), other herbicides may be used to control broadleaf weeds, these include 2,4-D or MCPA, clopyralid (Stinger), chlorsulfuron (Glean) (*Note: it is recommended that Glean be combined with another herbicide with a different mode of action.), dicamba (Banvel) or MCP Amine combined with dicamba (Banvel). The crop is monitored for any potential insect pests throughout the growing season. The most common insect pests are aphids, and several species can cause crop damage. Recommended control methods include an aerial application of malathion or an application of Penncap M (encapsulated methyl parathion), when aphids become a problem. Generally, oats ripen in April (Fall planted) or August and are harvested then.

E. ***Dairy farms***

The largest concern with dairy farms is the potential for surface runoff of animal waste. Dairy farms must comply with Oregon Department of Agriculture (ODA) regulations and maintain a current confined animal permit, as well as a manure management plan. Under these regulations a zero percent (0 %) discharge is assumed. However, during heavy rains (Sept-Dec) high amounts of nitrate nitrogen may be mobilized, because soils are saturated and settling ponds or lagoons may overflow. During summer, water from settling ponds may be used to irrigate crops, particularly corn and alfalfa. If soils are highly compacted, or too dry to absorb all of the irrigation, run-off untreated waters containing manure may become again become a problem. Another potential contaminant from dairy farms is fecal-coliform bacteria. A note however, is that fecal-coliform bacteria from cattle cannot be distinguished from that from other sources (such as wildlife).

F. ***Christmas tree farms***

Table 5 summarizes agricultural chemicals applied to Christmas trees.
A major difference between Christmas (x-mas) trees and other agricultural crops is that the trees are allowed to grow for 6-8 years before they are harvested. Trees are treated differently when they are initially planted, for about 1-3 years, than when they are older and approaching harvestable age/size. Early in tree growth and establishment, controlling weeds in order to reduce competition for water and nutrients is important, later it is desirable to maintain some ground cover between rows so that soil erosion is reduced and so that trees do not get muddy as they are

harvested. Also, when trees are young, chemicals may be applied over the tops of trees using a tractor or ATV with a boom spray-rig; however, as trees mature aerial spraying may often be the preferred method of application. Fungicide and fertilizer are generally only used during the final two to three years of tree growth to improve foliage condition and color. Insecticide is used if and when insect pests or crop damage are noticed. However, during the final season before harvest trees are generally treated with insecticide as a matter of course, due to Oregon Department of Agriculture regulations. In order for trees to be shipped out of state, they must be inspected and be free of insect pest species. A "rule of thumb" for established x-mas tree crop management is one-of-each (herbicide, insecticide and fungicide) will be applied annually.

Site preparation, prior to planting new seedlings, involves the use of herbicides. (*Note: I have concentrated on site preparation in areas that previously had trees. If a field is being converted from another crop into x-mas trees this may be slightly different). In early spring (Feb), glyphosate (Round-up, Accord, or Honcho with a nonionic surfactant), fluazifop (Fusilade DX), sethoxydim (Vantage), or sulfosate (Touchdown) are used depending on which weeds are present at the site. Later in the summer or early fall (August-Oct), isoxaben (Gallery), isoxaben combined with trifluralin (Snapshot 2.5), oryzalin (Surflan), or prodiamine (Factor) may be employed just prior to planting. Oxyflourfen (Goal), is used just after transplanting seedlings, which is usually done in the fall. During the spring following planting (Mar-Apr), atrazine, simazine, or hexazinone (Velpar L) may be used as preemergent weed control.

Established plantings can be managed using a soil active herbicide when trees are dormant, in the late fall (Oct-Nov) or during late winter (Feb). Soil active herbicides include many of the previously mentioned chemicals (atrazine, simazine, hexazinone, isoxaben, isoxaben+trifluralin, prodiamine, and oxyfluorfen), and others including, pronamide (Kerb) or a combination of simazine and oryzalin (Surflan + Princep). Herbicides may also be applied using either a carefully directed spray, or a broadcast spray at a low rate, on established stands of trees. Common directed spray treatments include fluazifop (Fusilade DX), sethoxydim (Vantage), clethodim (Prism) for control of grasses, glyphosate, paraquat (Gramoxone extra), or triclopyr (Redeem) for other weed types. Clopyralid (Stinger) or 2,4-D may be used as broadcast treatments.

Treatment for common insect pests, including; conifer aphid, Douglas fir needle midge, European pine shoot moth and spruce budworm, involves an aerial application of chlorpyrifos (Lorsban 4E). This usually occurs during spring, late April or May. Fungicide treatment is usually applied during May or June to control Swiss needle cast, this treatment is initiated three years prior to harvest. Chlorothalonil (Bravo 720), benomyl (Benlate 50 WP), mancozeb (Fore) are the common treatments. During the final two years before harvest, fertilizer is applied during February or March. Trees are fertilized if foliar nitrogen levels are less than 2 %. If trees are less than 3 feet tall, 0.7 oz of nitrogen per tree is applied, whereas if trees are over 3 feet in height 2.0 oz per tree is applied. Urea and ammonium sulfate are the most widely used fertilizers.

G. *Commercial Forestry / Timberlands*

Table 6 indicates chemicals used in commercial forestry.
Chemicals applied to commercial forest lands are often herbicides; insecticides and fungicides are rarely used. Weed or brush control in commercial forests is a common practice because undesirable woody and herbaceous plants can compete with commercially desirable tree species. Reforestation and establishment of new forest stands often depends heavily on the use of

herbicides to remove unwanted brush. Once stands become established (after 3-5 years), however, forests do not generally require any chemical treatments. Virtually all brush and weed control in forests is done with 2,4-D, glyphosate, imazapyr, picloram, dicamba or triclopyr, as dormant or foliage sprays, injections, or cut surface applications. Atrazine, pronamide, 2,4-D, sulfometuron, and hexazinone, are used to control herbaceous weeds in plantations. Soil active herbicides are seldom used for selective brush control in established plantations, because of their tendency to injure conifers, however, they are used during site preparation. Glyphosate is highly effective on deciduous and herbaceous species, when applied in the fall. Imazapyr is active on maple, alder and other brush as a growth inhibitor, and is well adapted for trunk injection or spot treatments. Triclopyr is used for site preparation and release, the amine salt is also used for trunk injection. Two sulfonylurea products, metsulfuron and sulfometuron, have been recently registered for use in forestry. Metsulfuron is used as a site preparation treatment only, and trees should be planted months after application. Sulfometuron is used for grass and general herb weed control in reforestation areas. In general, if the application is made in the fall there is less chance for injury to young seedlings. However, spring applications may be made on plantings that are older than 1 year.

Methods of applying chemicals in forest stands vary depending upon the species composition (of both weed plants and seedling trees), proximity of other crops, degree of control required, and available equipment. In general, when initial brush problems occur (most stems less than 2 inches in diameter) aircraft is the preferred method of application. Foliage spraying is used extensively, especially on fields or units that are to be converted to conifer stands, however it lacks selectivity for conifers (e.g. conifer trees may be damaged if spray is extensive). Other methods may be used if circumstances are favorable; small units and/or even terrain the "waving wand" method (a laborer using a backpack sprayer) can be effective, spot brush control can be done using hand or tractor-mounted ground rigs, herbicide injection is the most economically favorable way to treat weed trees over 1.5 -2 inches in diameter.The optimum season is usually mid-summer in terms of target species control, but that is when many conifers are most sensitive. Applying earlier or later than mid-summer depends upon which chemical/s are to be used. The choice of whether to spray from the ground or from the air depends upon the size of the job and the equipment available. A backpack sprayer with adjustable nozzles can apply sprays at 3- 10 gal/A quite uniformly on weeds and brush less than 8 feet tall (the "waving-wand" method), however the labor requirement to use this technique is often excessive on jobs of more than 40 acres. Aerial application becomes more economical when larger areas are to be treated. 2,4-D, dichlorprop, triclopyr, imazapyr, glyphosate, metsulfuron, dicamba, and picloram are the herbicides used for foliage applications, and they are generally mixed only with water. However, release of young conifers from brush during the dormant season (early summer) often requires an application by helicopter of herbicide mixed with oil as a carrier. Phenoxy herbicides and triclopyr ester are applied with this method at low volumes, typically during early summer, however vine maple requires application during March or April. Basal applications may be used if selective treatment of plants is desired. This also requires oil (diesel or stove oil) as a carrier. This can be done February through November by using a backpack sprayer to apply a soaking spray on the lower 15 inches of a tree trunk or brush stem. Triclopyr is the most commonly used herbicide, but 2,4-D (low-volatile ester), or dichlorprop can also be used in this manner. Another method of selective treatment is to used a cut-surface or stump treatment. This requires the trunk of the weed tree to be hacked with and axe and then treated with a concentrated amine-

formulated herbicide, or the stump of a recently cut tree to be squirted with concentrated herbicide. Cut surface (hack and squirt) applications are most effective during June through November. Tree injectors can also be used to apply chemicals directly into the tree itself, for both weed control, or to thin dense stands of young plantation trees. Two applications of herbicide are generally desired for full plantation establishment, these should ideally be timed so that most species are controlled prior to planting. Risk of injury to seedling trees increases after planting and requires more careful planning of chemical types, rates and timing.

H. ***Other concerns***

During the spring of 1997, it was observed that a "sludge" that had a very strong putrid odor was entering the drainage ditch at Baskett Slough NWR. Later it was determined that a fruit processing operation was dumping effluent into the ditch which allowed the effluent onto refuge land and waterways. Water samples were collected by Department of Environmental Quality at the request of refuge personnel. These test revealed an extremely high level of biochemical oxygen demand. The fruit processing plant was then closed down by DEQ until an alternative method of disposing of the waste water could be found. The plant then began irrigating an alfalfa field with their waste water, as a solution to the run-off problem.

V. Conclusions:

There is potential for contamination from agricultural chemicals on the Willamette Valley Refuges. Land uses surrounding the refuges are intensively managed agricultural commodities, which regularly require the application of chemicals .The second phase of this project, collection and analysis of water samples, will reveal which chemical compounds are reaching the refuge waterways, and to what extent. Information from water testing will then allow for futher investigation of the effects contaminants on wildlife populations.

Summary: Agricultural Chemicals Applied Within and Around Willamette Valley Refuges (OSU Extention Service I

Crop	Type	Common name	Trade name	Rate	Method	Dates	Timing	#
Corn (Field,Sweet,	Herbicide	**atrazine**	many	1.6- 2.4 lb ai/A	spray??	April-June	preplant or preemergence	1
Silage,Seed)								
Preplant Incorporated								
or Preemergence		cyanazine	Bladex	label	spray	April-June	preplant or preemergence	1
		alachlor	Lasso or	2-4 lb ai/A	spray	April-June	preplant or preemergence	1
			Partner					
		propachlor	Ramrod	4-6 lb ai/A	spray	April-June	preplant or preemergence	1
		metolachlor	Dual	1.5-3 lb ai/A	spray	April-June	preplant or preemergence	1
		butylate w/safener	Sutan Plus	4-6 lb ai/A	spray	April-June	preplant w/in 14 days of planting	1
		EPTC w/safener	Eradicane	3.14-6.14 lb ai/A	spray	April-June	preplant w/in 14 days of planting	1
		dimethenamid	Frontier	0.76-1.46 lb ai/A	spray	April-June	preplant or preemergence	1
		pendimethalin	Prowl	0.75-2 lb. ai/A	spray	April-June	after plant but before emergence	1
		acetochlor	Harness or	0.8-3 lb ai/A	spray	April-June	preplant or preemergence	1
			Surpass					
Postemergence	herbicide	2,4-D	many	0.5-1.2 lb ae/A	spray	May-June	when corn is actively growing	1
		dicamba	Banvel	0.25 lb ai/A	spray	May-June	when corn is actively growing	1
		bromoxynil	Buctril	0.25-0.375 lb ai/A		May-June	when corn is 3 or 4 leaf stage	1
		bromoxynil	Buctril	0.25-0.375 lb ai/A				
	combo<							
		atrazine	many	0.5-1.2 lb ai/A		May-June	between 4 and 8 leaf stage corn	1
		pendimethalin	Prowl	0.75-2 lb. ai/A		May-June	2-4 leaf stage of corn	1
		clopyralid	Stinger	0.063-0.25 lb ae/A		May-June	apply to actively growing broadleaf w	1
		nicrosulfuron	Accent	0.5 oz ai/A		May-June	apply before corn is in 10 collar grow	1
		primisulfuron	Beacon	0.57 oz ai/A		May-June	when corn is 4-20 in tall	1
				0.76 oz product/A				
		bentazon	Basagran	0.75-1 lb ai/A		May-June	post emergence of annual braodleaf w	1
		bentazon						
	combo<		Laddok	2-3.5 pts./A prod		May-June	postemergence, when weeds are acti	1
		atrazine						
		pyridate	Tough	0.47-0.94 lb ai/A		May-June	weeds at 2-4 leaf stage/corn is activ	1
				1-2 pt prod				
		halosulfuron	Permit	0.50-1 oz ai/A		May-June	post emerg.from spike through layby	1
				0.66-1.33 oz prod				
Postemergence		paraquat	Gramoxone	0.47 lb ai/A (1.5 pt)		June-July	corn at least 10 in high/apply only to	1
Directed Spray			Extra					
		paraquat	Gramoxone Ex	0.47 lb ai/A (1.5 pt)				
	combo<		Extra			June-July	corn at least 10 in high/apply only to	1
		atrazine	many	0.5-1.0 lb ai/A				
Perrenial Weeds		glyphosate	Round up	2.25-3.75 lb ae/A		April-June	apply to weed s before crop emerger	1
Spot treatment		glyphosate	Round up	2.25-3.75 lb ae/A		April-June	actively growing weeds before silking	1
	Insecticide	ethoprop	MOCAP	75 lb/ai 1000 row f	band	April	from planting until lay-by stage	1
		chlorpyrifos	Lorsban 15G	0.075 - 0.1 lb ai/ 1,	band	Mar-April	at planting	1
		chlorpyrifos	Lorsban 4E	1-2 lbs	broadcas	Mar-April	preplant incorporate/or post-emergen	1
		fonofos	Dyfonate 4E	1-2 lb	spray (bi	Mar-April	preplant incorporate	1

Summary: Agricultural Chemicals Applied Within and Around Willamette Valley Refuges (OSU Extention S								
Crop	Method	Type	Common name	Trade name	Rate *	date	Timing	# ap
Commercial Forestry	Direct Spot Spray	Herbicide	2,4-D	many	2 lb ae		Spring/Fall	1
	Tree injection				(per 100 gal sol.)			
	Basal Bark treatment		picloram	Tordon 22K	1 gal (0.54)		Spring/Fall	1
	*extremely localized	combo<						
	less chance of spread or		2,4-D		2 lb			
	drift--however usually							
	higer concentrations are used							
			dicamba	Banvel	1 lb		Spring/Fall	1
		combo<						
			2,4-D		2 lb			
			triclopyr ester	Garlon 3A	3 lb.		Midsummer	1
			triclopyr ester	Garlon 3A	4 - 8 lb undiluted		any season	1
			triclopyr amine	Garlon 4	3 lb		midsummer	1
			glyphosate	Accord	3 lb/ae	July	Midsummer	1
			imazapyr	Arsenal	1 lb.			1
					10 lb (2.5%)			
						June	midsummer	1
						Aug		
			metsulfuron	Escort	2 oz		spring/summer	1
			dichlorprop	Weedone	2 lb			1
	Area Spraying using	herbicide	2,4-D	many	2 lb (10 gal spray)	Feb.-	Spring (late dormant season)	1
	Boomless ground Equipment					Mar.		
	or Aircraft		2,4-D	many	2 lb (10 gal spray)	Feb.-Mar.	Spring (late dormant season)	1
			2,4-D	many	2 lb (10 gal spray)		any	1
		combo<						
			picloram	Tordon 22K	0.5 lb			
			2,4-D	many	2 lb		spring/late summer	1
		combo<						
			triclopyr ester	Garlon 3A	1 lb			
			2,4-D	many	2 lb			1
		combo<						
			dicamba	Banvel	1 lb			
			2,4-D	many	1.8 lb		spring	1
		combo<						
			dichlorprop	Weedone	1.8 lb			1
			glyphosate	Accord	0.75-1.5 lb ae	June, Aug	late summer	1
			glyphosate	Accord	1.5 -2 lbs.			1
		combo<						
			imazapyr	Arsenal	4-6 fl.oz.			1
			tricolpyr amine	Garlon 4	6-9 lb.		midsummer	1
			triclopyr ester	Garlon 3A	1.25-2 lb.			1
			triclopyr ester	Garlon 3A	1-2 lb			1
		combo<						
			picloram	Tordon 22K	1 lb			1
			dichlorprop	Weedone	2-3 lb			1
			metasulfuron	Escort	0.5 oz ai			1
			imazapyr	Arsenal	0.2-0.25 lb ai			1

Summary: Agricultural Chemicals Applied Within and Around Willamette Valley Refuges (OSU Extention Service Information)

Crop	Type	Common name	Trade name	Rate	Method	Appox. Dates	Timing	# applications
Annual Ryegrass	Herbicide	Glyphosate	Round-up	0.5-1.5 lb.ae/A	Ground / boom spray	Sept	Fall (post-planting but pre-emergence of Crop)	1
		OR						
		Gramoxone extra	Paraquat	0.5 lb. ai/A	Ground / boom spray	Nov.-Dec.	Late Fall	1
		Ethofumesate	Nortron	0.75-1.9 lb. ai/A	Ground / boom spray	Sept-Nov	Fall (After planting but no later than 4-leaf stage of	1
		bromoxynil	Buctril	0.25-0.5 lb ai/A	Ground / boom spray	Oct-Nov	Fall (post emergence but before weeds have 4 leave	1
		OR						
		MCPA	MCPA	0.5-1 lb ae/A	Ground / boom spray	Oct-Nov	Fall (after 2 leaf stage of crop)	1
		tribenuron methyl	Express	0.17 - 0.25 oz ai/A	Ground / boom spray	Sept-Nov, Mar-Apr	Fall or Spring (when weeds are actively growing)	1
		clopyralid + 2,4-D	Curtail	2-4 pt/A product	Ground / boom spray /aeri	Mar-May, Sept-Nov	Spring (before boot stage), Fall (postharvest treatm	1
		clopyralid + MCPA	Curtail M	1.75-3 pts/A produc	Ground / boom spray /aeri	Mar-May, Sept-Nov	Spring (before boot stage), Fall (postharvest treatm	1
		clopyralid	Stinger	0.25-0.66 pt/A prod	Ground / boom spray /aeri	Mar-May, Sept-Nov	Spring (before boot stage), Fall (postharvest treatm	1
		dicamba	Banvel	0.25-1 lb.ae/A	Ground / boom spray	March-April	Spring (apply before jointing stage)	1
	* used in combination <	2,4-D or MCPA	many	0.5 - 1.5 lb.ae/A	Ground / boom spray	March-April	Spring (apply before jointing stage)	1
	Fertilizer	N-P-K	Triple 16	150-175 lbs/A	Ground / boom spray	Sept.-Oct.	Fall	1
		nitrogen		20 lbs nit				
	Fertilizer	Nitrogen	Urea-Sul/ammonium sulfate	40-50 lbs nit (80- 100 lbs nit)		March-April	Spring	2 x
Perennial Ryegrass Establishment Phase	Herbicide	Glyphosate	Round-up	0.5-1.5 lb.ae/A	Ground / boom spray	Sept	Fall (post-planting but pre-emergence of Crop)	1
		OR						
		Gramoxone extra	Paraquat	0.5 lb. ai/A	Ground / boom spray	Nov.-Dec.	Late Fall	1
		diuron	Karmex	2-2.4 lb. ai/A	Ground / boom spray	Sept-Oct.	Fall (immediately after planting using active carbon t	1
		Ethofumesate	Nortron	0.75-1.9 lb. ai/A	Ground / boom spray	Sept-Nov	Fall (post-emergence)	1
	Insecticide*	Metaldehyde	Deadline	appox. 20-40 lbs/A	Ground	Sept.	Fall (after first rain, but during dry weather)	1
	Herbicide	tribenuron methyl	Express	0.17 - 0.25 oz ai/A	Ground / boom spray	Sept-Nov, Mar-Apr	Fall or Spring (when weeds are actively growing)	1
		bromoxynil	Buctril	0.25-0.5 lb ai/A	Ground / boom spray	Oct-Nov	Fall (post emergence but before weeds have 4 leave	1
		OR						
		MCPA	MCPA	0.5-1 lb ae/A	Ground / boom spray	Oct-Nov	Fall (after 2 leaf stage of crop)	1
	Fertilizer	N-P-K	Triple 14/15/or 16	150-175 lbs/A	Ground / boom spray	Sept.-Oct.	Fall	1
		nitrogen		20-30 lbs nit				
	Fertilizer	nitrogen	Ammonium Sulfate	40-50 lbs. nit	Ground / boom spray	March 15 -April 15	Spring	1
		nitrogen	Urea	40-50 lbs nit.	Ground / boom spray	March 15 -April 15	Spring	1
	Herbicide	dicamba	Banvel	0.25-1 lb.ae/A	Ground / boom spray	March-April	Spring (apply before jointing stage)	1
	* used in combination <	2,4-D OR MCPA	many	0.5 - 1.5 lb.ae/A	Ground / boom spray	March-April	Spring (apply before jointing stage)	1
		clopyralid + 2,4-D	Curtail	2-4 pt/A product	Ground / boom spray /aeri	Mar-May, Sept-Nov	Spring (before boot stage), Fall (postharvest treatm	1
		clopyralid + MCPA	Curtail M	1.75-3 pts/A produc	Ground / boom spray /aeri	Mar-May, Sept-Nov	Spring (before boot stage), Fall (postharvest treatm	1
		clopyralid	Stinger	0.25-0.66 pt/A prod	Ground / boom spray /aeri	Mar-May, Sept-Nov	Spring (before boot stage), Fall (postharvest treatm	1
		Glyphosate	Round-up	3 lb.ae/A	Spot spray / Backpack	March- April	Spring	1 (as needed)
	Fungicide	Propiconazole	Tilt	4-8 oz./A	Ground / boom spray	April-May	Spring	1 to 4 (2 aver
	Herbicide	Glyphosate OR diuron	Round-up OR Karmex	3 lb. ae/A	Border Spray	Sept	Fall (post-harvest)	4
Perennial Ryegrass Production Phase (4-5 years)	Herbicide	metolachlor	Dual	1.5 pt/A	Ground / boom spray	Oct.	Fall (seeding weed control)	1

Perennial Ryegrass Production Phase (4-5 years)	Herbicide	metolachlor	Dual	1.5 pt/A	Ground / boom spray	Oct.	Fall (seedling weed control)	1
		oxyfluorfen	Goal	1 pt. /A	Ground / boom spray	Nov.	Fall (seedling weed control)	1
	Fertilizer	N-P-K	14-14-14	20-30 lbs nit		Sept-Nov	fall	1
	Herbicide	diuron	Karmex	0.8 -1.6 lb ai/A	Ground / boom spray	Nov.	Fall (seedling weed control)	1
	used in comb. <	metribuzin	Lexone or Sencor DF	0.24-0.56 lb ai/A				
		tribenuron methyl	Express	0.17 - 0.25 oz ai/A	Ground / boom spray	Sept-Nov, Mar-Apr	Fall or Spring (when weeds are actively growing)	1
		bromoxynil	Buctril	0.25-0.5 lb ai/A	Ground / boom spray	Oct-Nov	Fall (post emergence but before weeds have 4 leave	1
		OR						
		MCPA	MCPA	0.5-1 lb ae/A	Ground / boom spray	Oct-Nov	Fall (after 2 leaf stage of crop)	1
		clopyralid + 2,4-D	Curtail	2-4 pt/A product	Ground / boom spray /aeri	Mar-May, Sept-Nov	Spring (before boot stage), Fall (postharvest treatm	1
		clopyralid + MCPA	Curtail M	1.75-3 pts/A produc	Ground / boom spray /aeri	Mar-May, Sept-Nov	Spring (before boot stage), Fall (postharvest treatm	1
		clopyralid	Stinger	0.25-0.66 pt/A prod	Ground / boom spray /aeri	Mar-May, Sept-Nov	Spring (before boot stage), Fall (postharvest treatm	1
		diuron	Karmex	2-2.4 lb. ai/A	Ground / boom spray	Dec.	Fall (seedling control Fall)	1
	Fertilizer	nitrogen	Ammonium sulfate/Uera-sul	40-50 lbs nit		March-april	Spring	1
	Fertilizer	nitrogen	Urea	40-50 lbs nit		March april	Spring	1
	Herbicide	dicamba	Banvel	0.25-1 lb.ae/A	Ground / boom spray	March-April	Spring (apply before jointing stage)	1
	* used in combination <	2,4-D OR MCPA	many	0.5 - 1.5 lb.ae/A	Ground / boom spray	March-April	Spring (apply before jointing stage)	1
	OR	fenoxaprop	Horizon	0.15-0.25 lb ai/A	Ground / boom spray	March	Spring (apply after crop has been established for at	1
		Glyphosate	Round-up	3 lb.ae/A	Spot spray / Backpack	March- April	Spring	1 (as needed)
	Fungicide	Propiconazole	Tilt	4-8 oz./A	Ground / boom spray	April-May	Spring	1 to 4 (2 aver
	Herbicide	Glyphosate OR diuron	Round-up OR Karmex	3 lb. ae/A	Border Spray	Sept	Fall (post-harvest)	1 (as needed)
Fescue (Tall) Establishment Phase	Hebicide	Glyphosate	Round-up	0.5-1.5 lb.ae/A	Ground / boom spray	Nov	Fall (when rain starts the germination of weed seeds	1
		OR					Seedbed preparation	
		diuron	Karmex	1.6 lb ai/A or less	Ground / boom spray	Nov	Fall (when rain starts the germination of weed seeds	1
							Seedbed preparation	
		Glyphosate	Round-up	0.5-1.5 lb.ae/A	Ground / boom spray	Feb	Spring (pre-planting)	1
	Fertilizer	nitrogen	Urea-sul	80-100 lbs.		March -April	Spring	1
	Herbicide	2,4-D	many	0.5 - 1.5 lb.ae/A	Ground / boom spray	March	Spring (Broadleaf control)	1
	others possible	Ethofumesate	Nortron	0.75 - 1.9 lb ai/A	Ground / boom spray	Feb-Mar	Spring (early post-emergence of crop)	1
		fenoxaprop	Horizon	0.15-0.25 lb ai/A	Ground / boom spray	March	Spring (after crop has been established at least 1 m	1
				1.2-2 pt product				
Fescue (Tall) Production Phase	Fertilizer	N-P-K	14-14-14	20- 30 lbs nit/A		Sept-Nov	Fall	1
	Herbicide	metolachlor	Dual	2 pt. product/A	Ground / boom spray	Oct	Fall (Seedling weed control)	1
		diuron	Karmex	1.6-3.2 lb ai/A	Ground / boom spray	Oct	Fall (Seedling weed control)	1
	used in comb. <	metribuzin	Lexone or Sencor DF	0.24-0.56 lb ai/A				
		oxyfluorfen	Goal	1 pt. /A	Ground / boom spray	Nov.	Fall (seedling weed control)	1
		tribenuron methyl	Express	0.17 - 0.25 oz ai/A	Ground / boom spray	Sept-Nov, Mar-Apr	Fall or Spring (when weeds are actively growing)	1
	Fertilizer	nitrogen	Urea-sul	40-50 lbs nit		March-april	Spring	2
	Herbicide	dicamba	Banvel	0.25-1 lb.ae/A	Ground / boom spray	March-April	Spring (Broadleaf weed control)	1
	* used in combination <	2,4-D OR MCPA	many	0.5 - 1.5 lb.ae/A	Ground / boom spray	March-April	Spring (Broadleaf weed control)	1
	Fungicide	Propiconazole	Tilt	4-8 oz./A	Ariel	April	Spring (Rust control)	1

Crop	Type	Common name	Trade name	Rate	Method	Appox. Dates	ming	#
X-mas trees							llowing harvest of x-mas tree crop/could be different	
site prep	herbicide	glyphosate	Round up	label rate	spray	fall	r new plantings in grass fields etc.	
			Honcho +					
			Accord					
		fluazifop	fusilade DX	2 lb gal/conc	spray	early spring		
				label				
		sethoxydim	Vantage	0.28-0.47 lb al/A	spray			
		sulfosate	Touchdown	label	spray			
new plantings	herbicide	atrazine	many	2-4 lb al/A	spray	March or April		
		simazine					reemergence of weed	
		hexazinone	Velpar L	label	spray	March or April		
		isoxaben	Gallery	0.495-0.998 lb al/A	spray	late summer/early fall	efore weed emergence	
							replanting	
		isoxaben						
	combo<	>	Snapshot 2.5 TG	200 lb/A product	spray	late summer/early fall	replanting	1
		trifluralin						
		oryzalin	Surflan	2-4 qt / A product	spray	late summer/early fall	replanting	
		prodiamine	Factor	label	spray	late summer/early fall	replanting	1
		fluazifop	Fusilade DX	label	spray	early spring	o active growing weeds	1
		sethoxydim	Vantage	0.28-0.47 lb al/A	spray	early spring	ptimum growth stage of weeds	
		oxyfluorfen	Goal	1-2 lb al/A	spray	early spring	mmediately after transplanting but prior to bud break	
		sulfosate	Touchdown	label	spray	early spring	ctively growing weeds	1
established plantings	herbicide	atrazine	many	2-4 lb al/A	spray	feb-march	while trees are dormant	1
winter applications		simazine						
that persist in soil								
		hexazinone	Velpar L	1-2 lbal/A	spray	march-April	efore bud break	1
		isoxaben	Gallery	0.495-0.998 lb al/A	spray	late summer/early fall	an be used post cultivation (as above)	1
						or early spring		
		isoxaben						
	combo<	>	Snapshot 2.5 TG	200 lb/A product	spray	winter		1
		trifluralin						
		prodiamine	Factor	label	spray	winter		1
		pronamide	Kerb	1-2 al /A	spray	fall before freezing weather		1
		oryzalin	Surflan	2-4 lb al/A prod	spray	spring	after transplanting	1
	combo<							
		simazine	Princep	2-4 lb al/A prod				
		oxyfluorfen	Goal	1-2 lb. prod	spray	any	except when buds are not yet hardened off	1
established plantings	herbicide	asulam	Asulox	3.34 lb al/A	spray		after buds mature on trees/on expanded fern fronds	1
broadcast or directed								
application		fluazifop	Fusilade DX	label	spray	early spring	actively growing weeds	1
		sethoxydim	Vantage	0.29-0.478 lb al/A	spray	spring	optimum growth stage of weed grasses	1
		clethodim	Prism	label	spray	spring	postemergence of weeds	1
		clopyralid	Stinger	0.063-0.25 lb al/A	spray	spring	actively growing weeds	1
		2,4-D	Clean Crop LV 6	label	spray	spring/fall	before bud break or after bud set	1
		glyphosate	Round-up	label	spray	spring/fall		1
			or					
			Honcho					1
		glyphosate	Accord	33% sol.	wiper	spring/fall	dependant on specific weed target	1
		paraquat	Gramoxone Extra	0.625-0.94 lb al/A	spray	spring/fall	annual weeds < 6 in tall	1
		triclopyr	Redeem	0.5-0.9 lb al/A	spray			1
	insecticide		Lorsban 4E	label (1 pt/A)	spray	May	for conifer aphid,douglas fir needle midge,spruce budworm	1
	fungicide		Benlate 50 WP	1 lb/A	spray	May	to control swiss needle cast	1
		or					*needed to gain a shipping permit from department of ag.	
		chlorothalonil	Bravo 720	2.75-5.5 pt /A	spray			1
		or						

Summary: Agricultural Chemicals Applied Within and Around Willamette Valley Refuges (OSU Extention Service								
Crop	Type	Common name	Trade name	Rate	Method	Appox. Dates	Timing	# app
Oats	Herbicide	diuron	Karmex	0.8-1.2 lb ai/A	spray	Fall	after planting but before oats emerge	1
			Direx					1
		2,4-D		0.25-0.5 lb ae/A	spray		before plant stems begin to joint	1
		or						
		MCPA		0.25-0.5 lb ae/A				
		clopyralid	Stinger	0.094-0.125 lb ae/A	spray		3 leaf to earlyboot/activly growing weed	1
				(0.25-0.33 pt/A)				
		chlorsulfuron	Glean	0.12-0.25 oz ai/A	spray	spring	postemergence at 2-3 leaf stage	1
							before weeds are 2 in tall	
		dicamba	Banvel	0.12 lb ae/A	spray	spring	2-5 leaf stage	1
		MCPA amine		0.25-0.375 lb ae/A	spray	fall/spring	prior to jointing	1
	combo<							
		dicamba	Banvel	0.12 lb ae/A				
	Insecticide	Malathion spray		1-1.25 lb	aerial	spring	for aphid damage	1
		methyl parathion	Penncap M	0.25-0.5 lb	spray	spring	for aphid damage	1
	fungicide		Baytan	1.5 fl/oz./100 lb seed	powder	spring	before planting	1

Summary: Agricultural Chemicals Applied Within and Around Willamette Valley Refuges (OSU Extention Service information)								
Crop	Type	Common name	Trade name	Rate	Method	Appox. Dates	Timing	# app
Hybrid Cottonwoods	Herbicide	glyphosate	Accord	1.5-3.75 lb ae/A	spray		prior to planting	1
Pulp Prod.	New plantings		Round-up					
		trifluralin	Treflan MTF.	0.5-1 lb ai/A	spray		prior to planting	1
		oxyfluorfen	Goal	1-2 lb ai/A	spray		prior to bud break	1
							preemergence of weeds	
		2,4-D amine	Wilbur-Ellis Amine 4		spray		prior or after planting	1
			or Weedestroy AM-40				actively growing weeds	
			amine salt					
	Established							
	Plantings	oxyfluorfen	Goal	1-2 lb ai/A	spray		prior to bud break	1
		oryzalin	Surflan AS	2-4 lb ai/A	spray			1
		diuron	Karmex DF	1.6-3.2 lb ai/A	spray			1
		terbacil	Sinbar	0.8-1.6 lb ai/A	spray	late winter	preemergence of weeds	1
						early spring		
		trifluralin	Treflan MTF.	1-2 lb ai/A	spray		preemergence of weeds	1
		2,4-D amine	Wilbur-Ellis Amine 4	0.24-1.43 lb ae/A	spray		actively growing weeds	1 +
			or Weedestroy AM-40	(0.5-3 pt/A)				
			amine salt					
		dichlobenil	Casoron 4G	2-4 lb ai/A	spray	Nov-Feb		1
		sulfometuron	Oust	0.375-0.94 oz ai/A	spray			1
				(0.5-1.25 oz/A prod)				