PESTICIDE USE IN GRASS SEED PRODUCTION

"DISPELLING THE FIELD BURNING MYTH"

A REPORT BY OREGON TOXICS ALLIANCE

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Oregon Toxics Alliance (OTA) is a statewide non-profit organization working for all Oregonians to expose root causes of toxic pollution and help communities find solutions that protect human and environmental health.

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INTRODUCTION

This report reviews the historical uses of pesticides in grass seed production in Oregon, the purpose for their use, the types of pesticides that are commonly used, and the environmental fate of these pesticides.

Pesticides have been used on Oregon's grass seed fields since the mid-twentieth century.[1] The application of pesticides is a farming practice used to control broadleaf weeds, field rodents, competing grasses and plant disease. As research protocols and the sensitivity of measurement tools improve, scientific studies provide more information about environmental harm resulting from pesticides.

Pesticides do not necessarily degrade quickly after they are applied on crops, resulting in environmental persistence. Many pesticides are known to transport off-site through water and in soil.

Government agencies conducting water sampling in Oregon have published data confirming that pesticides are detectable in rivers, sometimes at levels exceeding federal standards for aquatic health.[2] The Oregon Department of Environmental Quality has collected data suggesting that over 50% of the wells in the Willamette Valley are contaminated with pesticides from agricultural uses. In general, pesticides that are used on grass seed crops have the largest total application in the Willamette Valley. Of the 10 most heavily used pesticides (7 herbicides, 3 insecticides), 6 were used to some extent on grass seed crops; these include, in descending order, diuron, 2,4-D, MCPA, chlorpyrifos, dicamba, and atrazine.[3]

A total of approximately 56 different types of herbicides were used on Oregon grass seed fields in 2007-2008. These pesticides were applied on fields both before and after field burning. Pesticide residues that are incinerated in the process of flaming and field burning contribute to an entirely different set of environmental hazards, namely the creation and spread of dioxin, and other harmful combustion products such as particulates, phosphorus pentoxide from phosphorus-based pesticides, hydrogen chloride from chlorinated hydrocarbons, cyanide from nitrogen-containing organics, and sulfur dioxide.[4]

A BRIEF HISTORY OF GRASS SEED PRODUCTION IN THE WILLAMETTE VALLEY

Originally, Oregon's Willamette Valley produced cereal crops and wheat. In 1899, grains accounted for 43% of the entire value of all crops. By 1957 farmers were capable of producing an average wheat yield of 36 bushel/acre. In addition to grain production**,** native annual and perennial ryegrass grew in the area. The first commercial planting of ryegrass took place in Linn County by a farmer named Forest Jenks in 1921.[5] In the 1930's, grass seed farming began to replace other activities on the land. Farmers raised ryegrasses and fescues that were common to the area.[6] By 1939, grass seed production acreage jumped to almost 5,000 acres as more farmers, such as the Kropf and Evans enterprises, invested in the commercial planting of ryegrass.

Oregon grew an "ecoytope" variety of ryegrass that, according to Oregon State University agriculturalist Donald Brewer, was "formed by ecological conditions."[7] Many times a native grass type was **"**fought off" as a weed until someone started to cultivate it as a crop. If the grass type proved to be successful, the farmer applied for a registration and seed certification in order to increase the marketability of his variety. Certification insures the buyer that the seed has a high degree of purity and a low percentage of seeds from weeds or other varieties of grass. Seed certification is a necessary marketing strategy since only certified seeds can be used to produce all the next generations of registered seed stocks. In order to sell to Europe's more competitive markets, Oregon grass seed farmers sought to verify the purity of perennial ryegrass seed through a program of seed certification. In a reversal of roles, native grasses became the interlopers and imported stocks and registered varieties were exclusively cultivated. Eventually, all native perennial and annual grasses were pushed out of the market in favor of producing only "certified seed."[8]

Oregon adopted a set of standards for certifying perennial ryegrass by 1941. By the second and third years of planting a new variety, through "the appropriate use of herbicides," the seed was sufficient to meet certification standards.[9]

Over the next five decades, as a result of Oregon's Seed Certification program, growers competed for exclusive rights to produce grass seed that was more *pure* and less prone to be mixed or "contaminated" with native varieties. Establishing the seed purity or the distinctiveness from another farmer's crop increases the value of a particular grass seed crop.

By placing a high value on the newest variety and purest grass seed, the industry generates competitiveness in the market. Herbicides contribute to these objectives by helping grass seed farmers eliminate crop competition in order to grow a mono-culture crop.[10]

Open field burning and pesticide uses were developed to help the grass seed industry expand and foster seed purity and eliminate weeds and competing grasses. However, both practices result in significant environmental health problems – smoke as an air pollutant during the burning season and pesticides as a water contaminate in the Willamette Valley.

PESTICIDES APPLIED ON GRASS SEED CROPS

According to a publication produced by the Oregon Seed Council, "herbicides are applied to control all competitive plant growth" and "careful records are kept of chemical applications, plus other materials and procedures used for each crop."[11] Despite the careful record keeping, the public does not have access to these records – nor is the information released to State legislators who requested it. Information about pesticide uses in the State of Oregon is reported to the Department of Agriculture through Oregon's Pesticide Use Reporting System (PURS).

PURS tracks pesticides by water basin. The system does not provide information about pesticide use by crop type nor for geographic areas smaller than an entire water basin. The 2007 PURS Annual Report calculates that nearly three million pounds of herbicides were used on seed crops.[12] However, that number doesn't distinguish between grass seed crops and other possible seed crops.

General data on pesticide use by crop type can be accessed through Washington State University's Pesticide Information Center On Line (PICOL).[13] The databank lists 55 pesticides for grass seed crop in Oregon for the year 2008. It does not provide information about how many pounds of pesticide are used. This report is unable quantify how many pounds of pesticides are used annually in grass seed production because that information is not available to the public.

These are the pesticides listed by PICOL that were used on grass seed crops in Oregon in 2008:

- 2,4-D
- 2,4-D DIMETHYLAMINE
- 2,4-D ISOPROPYLAMINE
- AZOXYSTROBIN
- BACILLUS PUMILUS STRAIN QST 2808
- BACILLUS THURINGIENSIS SSP. KURSTAKI 1
- BETA-CYFLUTHRIN
- BROMOXYNIL
- CAPTAN
- CARBARYL (CARBAMATE)
- CARBOXIN
- CARFENTRAZONE-ETHYL
- CHLOROTHALONIL
- CLOPYRALID
- CYFLUTHRIN
- CYTOKININS
- DICAMBA
- DICOFOL
- DIMETHENAMID
- DIMETHOATE (ORGANOPHOSPHATE)
- DIQUAT DIBROMIDE
- DIURON
- FLUFENACET
- FLUROXYPYR
- GIBBERELLIC ACID
- GLUFOSINATE-AMMONIUM
- GLYPHOSATE
- GLYPHOSATE, AMMONIUM SALT
- GLYPHOSATE, ISOPROPYLAMINE SALT
- GLYPHOSATE, POTASSIUM SALT
- HARPIN PROTEIN
- HYDROGEN PEROXIDE (DIOXIDE)
- INDOLE BUTYRIC ACID (IBA)
- IRON PHOSPHATE (FEPO4)
- LAMBDA-CYHALOTHRIN
- MCPA
- METALDEHYDE
- MINERAL OIL, PETROLEUM DISTILLATES, SOLVENT REFINED LIGHT

- MONOCARBAMIDE DIHYDROGENSULFATE
- PARAQUAT
- PHOSPHOROUS ACID, MONO- AND DI-POTASSIUM SALTS OF
- PROHEXADIONE CALCIUM
- PRONAMIDE (PROPYZAMIDE)
- PROPICONAZOLE
- PYRACLOSTROBIN
- QUINCLORAC
- SETHOXYDIM
- SIDURON (TUPERSAN)
- SULFUR
- TEBUCONAZOLE
- THIRAM
- TRIBENURON METHYL
- TRICLOPYR
- TRIFLOXYSTROBIN
- ZETA-CYPERMETHRIN
- ZINC PHOSPHIDE

These pesticides act as herbicides, fungicides, plant growth inhibitors, growth hormones, miticides, rodenticides, insecticides, and insect repellants. Pesticides are applied at least twice a year, in both the spring and the fall.[14]
Examples of pesticides and their purpose include:

1. **Growth Hormones:** 2,4-D, MCPA, Banvel 2, Apogee, Palisade, Lorsban 4E and Stinger

2. **Pre-emergents:** Prowl, Dicamba, MCPA acetic acid, Dual, Axiom DF, Metri DF and Frontier

3. **Post-emergents:** Paraquat, Glyphosate, Oxyfluorfen, Atrazine, Diuron, Metribuzin, Terbacil

Close scrutiny of the PICOL database and the Oregon PURS system strongly suggests that there are closer to 85 different pesticide products used in Oregon grass seed production, depending on the year, the type of grass seed crop and the pest problem that is being treated. Suggested management techniques warn that the development of herbicide-resistant weed populations is strongly linked to repeated use of the same herbicide or applications of herbicides with the same site of action in monoculture cropping systems.[15] Growers will likely have an arsenal of products that they can rotate for use.

It should be noted that the development of pesticide-resistant weed species does not make a case for the approval of yet more pesticides for registration in Oregon. Chemical manufacturers have introduced a plethora of pesticide products to take the place of the ones that have been banned or have proven ineffective. This creates an endless cycle of chemical pesticides that are registered, used and eventually abandoned.

There are several reasons that the grass seed industry uses herbicides according to researchers in the Crop and Soil Sciences Department at Oregon State University.[16] These include seed quality, plant disease and plant competition. Herbicides can also be a liability because grass seed crops are often damaged by herbicides due to the limited selectivity between the crop and the volunteer plants. This may result in premature crop losses.

Pesticides are applied in conjunction with field burning because the two agricultural practices serve difference purposes. Pesticides are used to control competitive plant growth and disease. Field burning has been use for field sanitization and residue management. There is every indication from the industry that pesticides will continue to be used in grass seed production, with or without field burning. However, the claim that banning field burning will significantly increase pesticide use is not borne out by the historical uses of pesticides and the published literature on their efficacy.

The claim that there is an inverse relationship between field burning and pesticide use (i.e. less field burning amounts to more pesticides) is a smoke screen for the more important question: Why increase the reliance on pesticides?

Pesticides and field burning are not the only practices that a grass seed farmer can use to produce a marketable seed crop. Crop and soil scientists recommend a broader range of strategies for controlling volunteer grass crops, weeds and plant diseases. [17] These integrated crop management practices should also include:

- Good crop management where the grower maintains a vigorous, competitive crop growth to aid in the suppression of weeds;
- Nutrient and irrigation management are important aspects of general crop management that assist other methods of weed control;
- Crop rotation can be an effective weed management tool where suitable rotation crops are available;
- Adequate tillage and mechanical controls can suppress weeds.

There is a strong case for prioritizing the development of best crop management techniques that, in addition to increasing profits and marketability, also promote better soil, air and water quality as well as consider impacts to human health and sustainability goals.

The current efforts to eliminate field burning are based on the overwhelming evidence of public health harm from exposure to smoke. Within the grass seed industry, there has been a paucity of research and discussion about the relationship between burning fields and the incineration of pesticide residues during a field burn.

Field burning significantly multiplies the health risks of pesticides. The toxic chemical by-products of pesticides that are entrained in field burning smoke pose an enormous risk of human health and environmental harm as a result of their chemical transformation during the process of combustion.

PESTICIDES AS PRODUCTS OF COMBUSTION

It has already been noted that pesticides pose serious and identifiable environmental hazards. However, when used in conjunction with field burning, pesticides become combustion products, and as such, present a new set of toxic properties.

Researchers are investigating the atmospheric and ecosystem transport of pesticides after any type of incineration process such as a forest fire or field burn. Genualdi's 2009 research confirms that previously deposited semi-volatile organic compounds such as pesticides re-volatilize to the atmosphere and/or degrade from soils and vegetation during the burning process.[18] Depending on the chemical composition of the pesticide, differing toxic compounds are emitted to the air. A non-exhaustive list of examples of emissions of air toxics from incineration of pesticides includes particulates, phosphorus pentoxide from phosphorus-based pesticides, hydrogen chloride from chlorinated hydrocarbons, cyanide from nitrogen-containing organics and sulfur dioxide.[19]

An information profile produced by the USDA Forest Service in 1996 cites DowElanco's own reports that the by-products from burning vegetation treated with Triclopyr, a formulation of a commonly used herbicide, includes irritating vapors, nitrogen oxides, hydrogen chloride, and phosgene gas, carbon monoxide, and aldehydes.[20] The same conclusions were reached by authors in another study supported by USDA. Authors stated that when pesticide formulations were incinerated, "(A)nalyses of the volatile products revealed that at least four hazardous gases (chlorine, hydrogen chloride, hydrogensulfide, and nitric acid) were produced." [21]

A number of studies have found that pesticides that are transformed into small particulate and airborne compounds can be carried far distances via atmospheric transport.[22] A 1991 study published in *Environmental Science & Technology* found mutagenic emissions from the incineration of certain pesticides. The authors concluded that, "One component of emissions that poses potential health effects is the vapor and particulate phase . . . of incomplete combustion. These organics . . . have been found to be carcinogenic in humans and rodents."[23] The gaseous combustion products associated with pesticides are the most dangerous to the nearby residents.[24]

Pesticides that are chlorpyrifos or chloro-phenoxyacetic acid herbicides, or any pesticide product containing chlorine, can also produce dioxin as a by-product of burning. The dioxin is produced when compounds containing chlorine atoms are incinerated. The use of chlorinated pesticides – such as 2, 4-D and chlorothalonil – on fields cultivated for grass seed raises serious concerns over the formation and release of dioxin if those fields should be burned or flamed.

Dioxins and other chlorinated compounds may be similarly released if the slash has been treated with chlorinated herbicides. The known effects of these compounds on human respiratory systems warrant concern for citizens subjected to the smoke from slash burning incidents.[25]

A draft report released in 1994 by the US Environmental Protection Agency clearly describes dioxin as a serious public health threat. Much of the scientific concern centers on the fact that these compounds are extremely potent in producing a variety of effects in experimental animals at levels hundreds or thousands of times lower than most chemicals of environmental interest. In addition, human studies demonstrate that exposure to dioxin and related compounds is associated with subtle biochemical and biological changes that are suspected of disrupting genetic processes, and with chloracne, a serious skin condition. Laboratory studies suggest the probability that exposure to dioxin-like compounds may be associated with other serious health effects including cancer.[26]

Under experimental conditions where chlorinated pesticides were incinerated, TCDD, a toxic variety of dioxin (2,3,7, B-tetrachlorodibenzo-p-dioxin) has been observed in temperature ranges of 350-800 degrees.[27]

The formation of dioxin, toxic gases, and hazardous particulates are of obvious concern to human health and are additionally significant because they act as environmental pollutants. Dioxins build up primarily in fatty tissues over time so even small exposures may eventually reach dangerous levels. In 1994, the US EPA reported that dioxins are a probable carcinogen, but noted that non-cancer effects (reproduction and sexual development, immune system) may pose an even greater threat to human health. [28]

The take-away point is that burning of organic matter such as grass stubble or agricultural and forest slash that have been previously treated with pesticides produces emissions of highly toxic vapors, gases and compounds that adversely affect nearby residents and can also travel for substantial distances on wind currents to harm people living downwind.

THE PROBLEM OF GRASS SEED PESTICIDES DRIFTING OFF-SITE

The Oregon Department of Agriculture (ODA) receives and investigates complaints of adverse human health and plant damage from the uses of pesticides. Oregon Toxics Alliance evaluated only a small sample of pesticide complaints that resulted from the use of pesticides on grass seed fields. We found a number of complaints that resulted in allegations of human health effects, drift onto school grounds and private property, and damage to ornamental and edible plants. Cases requiring investigation that resulted in evidence of drift occurred as recently as 2006.

For example, a 2001 investigation conducted by ODA involved an application of herbicides on a grass field that drifted onto school grounds resulting in the closure of two schools in Yamhill County.[29] In a second case, an aerial application of herbicides to a grass seed field in Lane County drifted onto students waiting at a school bus stop.[30]

These two examples point to the existing problem of pesticide applications on grass seed fields that result in human exposures to off-target drift.[31] The grass seed industry must seek to employ integrated vegetation management techniques that reduces the use of chemical pesticides through the use of a diversified application of biological, mechanical, modified land management, and cultural practices, selected and applied in a manner that minimizes risks to human health.

CONCLUSION

Field burning poses a significant health hazard for Oregonians. The smoke from field burning contains small particles (fine particulate matter) that penetrate deep into our lungs and cannot be filtered out. The American Medical Association has found that even short-term exposure to these particles increases the risk for cardiovascular and respiratory diseases including diabetes, arrhythmia, asthma, heart failure, and cardiac arrest.

Additionally, field stubble that is burned after seasons of pesticide applications puts both nearby rural and downwind urban Oregonians at high risk of exposure to irritating vapors, nitrogen oxides, hydrogen chloride, phosgene gas, carbon monoxide, polycyclic aromatic hydrocarbons and aldehydes. These toxic gases and chemical particles also contribute to the spread of dioxin on wind currents or through particle deposition. Dioxins, produced in small concentrations when organic material is burned in the presence of chlorinated compounds, amplify the health hazards of field burning because dioxins have been shown to bio-accumulate in humans and wildlife due to their fat-soluable properties, and are known to cause birth defects, act as mutagens, and are suspected human carcinogens.

Economical, clean, non-thermal management of grass seed fields in Oregon is possible through straw removal and baling, chopping and returning stubble to the soil as a soil amendment, as well as the promise of the burgeoning biofuels industry. It is time to make the transition from a program of managed field burning to its complete cessation.

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[29] ODA Case # 022137

[30] ODA Case # 054434

[31] Additional information on the topic of pesticide drift and evidence of reoccurring pesticide exposures for Oregon school children can be found in the report Warning! Hazards to Children: Pesticides in our Schools, located on the Oregon Toxics Alliance website (**www.oregontoxics.org**)