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SENATE ENVIRONMENTAL QUALITY COMMITTEE

BOB WIECKOWSKI, CHAIR

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California State Capitol, Room 3191

Oversight Hearing of the Department of Pesticide Regulation: Are Proposed Regulations Protective of Children's Health

BACKGROUND INFORMATION

Introduction

California has the largest agricultural output in the country; it produces over a third of the country's vegetables and two-thirds of the country's fruits and nuts.

California's agricultural industry employs an estimated 350,000 people and brings in around $50 billion annually.

With agriculture, comes the challenge of protecting commodities from the natural threat of pests. Pests are organisms such as weeds, insects, fungi, rodents, etc. that cause damage, economic loss, and/or transmit or produce disease.

By damaging crops and food production, pests can have adverse impacts on agriculture and food access. For example, an infestation of Mediterranean fruit flies, whose larvae feed on a wide variety of fruits, can make a fruit crop unfit for human consumption. The crops potentially affected by Mediterranean fruit flies in California are many and comprise a significant portion of the total agricultural output for the state.

Productive and profitable crop and food production requires effective pest management practices. One such practice employed by the agricultural industry is the use of pesticides.

Pesticides

A pesticide is any substance or mixture of substances that deters, incapacitates, kills, or otherwise discourages pests.

"Pesticide" is an umbrella term that includes many kinds of chemicals – natural and synthetic. Pesticides are often classified by their target: herbicides target plants, insecticides target insects, fungicides target fungi, etc. Pesticides can also be classified by their chemical structure (e.g., organic, inorganic, synthetic) or physical state (e.g., solid, liquid, gas).

Pesticides are used in residential homes and gardens, but the majority of pesticides are used for crop protection in agriculture.

According to the U.S. Environmental Protection Agency (U.S. EPA) an estimated 684 million pounds of pesticide active ingredients were used in U.S. agricultural fields in 2007.

California's agricultural pesticide use scales with its agricultural activities, with approximately 150 to 200 million pounds applied annually.

Such heavy and widespread use of pesticides creates public health and environmental concern; pesticides are toxic by design and deliberately released into nature to harm or deter a target pest. However, pesticides are not specific to a single organism. For example, a pesticide that targets an insect's nervous system is often toxic to animal and human nervous systems as well, though not necessarily in the same way or to the same degree.

Department of Pesticide Regulation

Due to the importance of agriculture and thereby pest control in California the Department of Pesticide Regulation (DPR) was created to properly regulate and monitor the sale, use and effect of pesticides, while ensuring human health and environmental protection.

DPR's mission is to protect human health and the environment by regulating pesticide sales and use, and by fostering reduced-risk pest management. DPR is responsible for 1) pesticide product evaluation and registration; 2) statewide licensing of commercial applicators, dealers, consultants, and other pesticide professionals; 3) evaluation of health impacts of pesticides through illness surveillance and risk assessment; 4) environmental monitoring of air, water, and soil; 5) development of pesticide use policies; 6) field enforcement, in cooperation with county agricultural commissioners (CAC); 7) residue testing of fresh produce; 8) encouraging development and adoption of least-toxic pest management practices through incentives and grants.

Pesticide registration.

One of DPR's main tools for regulating pesticide use is its pesticide registration process. Before a pesticide can be sold and used in California, it must be evaluated by DPR to determine whether or not, when used according to label instructions, the product will cause undue harm to human health or the environment.

Prospective registrants must submit tests and studies that provide data on the chemical properties, product performance, ecological effects, acute and chronic toxicity, environmental fate, and human exposure and/or spray drift potential of the pesticide to DPR to be evaluated.

Once reviews are complete, a decision to register or deny an application is proposed, followed by a 30-day period for public comment. A product is not registered until all concerns brought up by any of DPR's branches are resolved and the Director of DPR has given his/her final approval.

While California's pesticide registration process parallels the federal program in many respects, there are a few differences. For instance, DPR requires efficacy data to be submitted and may require additional or different studies as well. DPR also evaluates pesticide use under environmental and cultural conditions specific to California.

Once registered, DPR must still continue to evaluate whether the legal use of a registered pesticide is posing a significant adverse effect on human health or the environment. Evaluations of pesticide safety can be based on new human health and/or environmental risk assessment data, illness and environmental monitoring data, or actions from other agencies (e.g., the Office of Environmental Health Hazard Assessment or the U.S. EPA).

Pesticide application.

Application or use of pesticides after registration is also regulated. DPR can develop and implement state regulations that are more restrictive than required on the U.S. EPA-approved label (describes the maximum application rate, methods of application, crops that can be treated, safety precautions, and other requirements).

The state has listed certain pesticides in regulation as restricted materials due to the potential hazards they pose to public health, farmworkers, domestic animals, honeybees, the environment, wildlife, or crops other than those being treated.

According to DPR's *Initial Statement of Purpose and Public Report – Pertaining to Pesticide Applications Near Schools*, there are approximately 37 restricted materials currently registered in California. By law, agricultural applications of restricted materials can only be made by or under the supervision of a certified applicator and only after obtaining a site and time specific permit issued by the CAC.

Before issuing a permit, a CAC considers the need for a particular pesticide and whether a safer pesticide or better method of application could be used and still prove effective. If the evaluation shows that the application is likely to pose a significant risk of causing an adverse effect, the CAC may further restrict use beyond the requirements of the label or regulation, or deny the permit. Applicators must provide a notice of intent (NOI), to their CAC at least 24 hours before any application.

CACs across California have instituted their own buffer zone, notification and application time requirements for their counties.

Health Risks of Pesticide Exposure

Exposure to pesticide chemicals can cause both acute and chronic health impacts.

Health risks from acute exposures.

Acute (short-term), higher level exposures to pesticides can result in pesticide poisoning. Symptoms of mild poisoning include headache, nausea, skin and respiratory irritation, fatigue and dizziness. Moderate poisoning can add symptoms such as vomiting, coughing, blurring of vision, muscular incoordination, mental confusion, rapid pulse and constricted throat and chest. Severe poisoning can result in the inability to breathe, chemical burns, loss of reflexes or uncontrollable muscular twitching, unconsciousness and even death. DPR monitors illness from pesticide poisoning through its Pesticide Illness Surveillance Program and designs best use practices to protect agricultural and pest control workers from acute pesticide poisoning.

Health risks from chronic exposures.

The effects of chronic (long-term), lower level exposures to pesticides, especially to multiple different types of pesticides, are less monitored, studied or tracked and therefore, policies are not directed at protecting against long-term impacts of pesticide exposure.

However, it has become increasingly clear, through years of scientific study, that chronic exposure to pesticides has a detrimental impact on human health as well.

The President's Cancer Panel was established in 1971 to monitor the activities of the National Cancer Program and report to the President on the barriers to progress in reducing the burden of cancer. Due to a growing body of evidence linking environmental exposures like pesticides to cancer, the Panel dedicated its 2008-2009 activities to examining the impact of environmental factors on cancer risk. In their annual report, the Panel expressed concern in finding that the "true burden of environmentally induced cancer has been grossly underestimated."

The panel found that exposure to pesticides has been linked to brain/central nervous system (CNS), breast, colon, lung, ovarian (female spouses of agricultural workers), pancreatic, kidney, testicular, and stomach cancers, as well as Hodgkin and non-Hodgkin lymphoma, multiple myeloma, and soft tissue sarcoma.

Pesticide exposure has also been linked to harmful effects on reproductive, respiratory and nervous systems and the development of children. For example, specific reproductive issues associated with pesticide exposure include lower sperm count and quality in men, disruption of menstruation and ovulation, fertility, and menopause in women, and increased rates of miscarriage and premature birth.

Exposure of children to pesticides.

Compared to adults, children interact more heavily with their environment and consume more food, water and air relative to their weight. This increases their exposure to chemicals in their environment. However, children are undergoing rapid development and have fewer biological defense mechanisms than adults.

For children, sources of exposure to pesticides can include: parental exposure prior to conception, *in utero*, dietary (including breast milk), household (including pesticides used at home and "take-home" exposure via parents' clothing and vehicles), and the wider environment (daycare centers, schools, parks and playgrounds).

Children that live and go to school in close proximity to farms are likely to face higher environmental pesticide exposures through pesticide drift, and potential contamination of drinking water sources. Agricultural use of pesticides near residential properties such as homes, schools, daycare centers and playgrounds has been demonstrated to cause pesticide exposure through various studies. Several examples of pesticide exposure studies are summarized below in Table 1 and in greater detail in Appendix 1.

Health risks to children from pesticide exposure.

Childhood health impacts with links to pesticides include altered brain development (e.g., attention deficit/hyperactivity disorder, autism spectrum disorder and lower IQ), certain cancers like leukemia and brain tumors, birth defects, earlier puberty, childhood asthma, obesity, and diabetes. Examples of studies that evaluate the effects of chronic low-level exposures to pesticides on children are also summarized below in Table 2 and in greater detail in Appendix 2.

Table 1: Pesticide Exposure Studies

Study	Author	Year	Measured	Results
Correlating agricultural use of organophosphates with outdoor air concentrations: a particular concern for children	Harnly et al.	2005	Organophosphate (OP) pesticide use Outdoor air concentrations of OP pesticides	Agricultural use within a *3-mile radius* on the monitoring day and *up to 2 days prior* was significantly associated with air concentrations for insecticides chlorpyrifos and diazion and their breakdown products
Pesticides in dust from homes in an agricultural area	Harnly et al.	2009	Indoor dust Agricultural pesticide use within a *9-square-mile* area	Agricultural use of chlorpyrifos, DCPA, and iprodione in the *month or season prior* to sample collection was associated with 83%, 19% and 49% increases, respectively, in dust concentrations for each 2 pounds applied/day
Determinants of agricultural pesticide concentrations in carpet dust	Gunier et al.	2011	Indoor dust Agricultural pesticide use within *1,250 meters*	Residences with agricultural pesticide use nearby had significantly higher concentrations of the pesticides in indoor dust compared to residences without nearby agricultural use (chlorpyrifos, chlorthal-dimethyl iprodione, phosmet, simazine)
Determinants of organophosphorus pesticide urinary metabolite levels in young children living in an agricultural community	Bradman et al.	2011	OP pesticide metabolites in children's urine at 6, 12 and 24 months Possible OP exposure sources: diet, living or attending a childcare facility within 60 meters of an agricultural field, parent occupation, etc.	Higher levels of OP metabolites in children were associated with greater *produce intake, spatial proximity* to agricultural use, and time of sample collection (during a *season* of heavy pesticide use)
***A review* of nonoccupational pathways for pesticide exposure to women living in agricultural areas**	Deziel et al.	2015	35 pesticide exposure studies published from 1995-2013 were examined	10 of 17 studies found associations between agricultural pesticide use nearby and pesticide presence in indoor dust

Table 2: Health Risk to Children from Pesticide Exposure Studies

Study	Author	Year	Measured	Results
Risk of childhood cancers associated with residence in agriculturally intense areas in the United States	Carozza et al.	2008	Agricultural activity in county of residence	Statistically significant increased risk for many types of *childhood cancers* associated with residence in moderate to high levels of agricultural activity counties.
			Cancer rates in children under 15 years old	*Dose-response effect* : increase effect/risk with increase agricultural activity
Neurodevelopmental disorders and prenatal residential proximity to agricultural pesticides: The CHARGE Study	Shelton et al.	2014	Agricultural pesticide use within various distances from participants' homes during pregnancy	Children with ASD were 60% more likely to have had OP pesticides used within 3/4 mile of their mothers' homes during pregnancy than TD children
			Development of participants' children: autism spectrum disorder (ASD), developmental delay (DD), or typical development (TD)	Children with DD were 150% more likely to have had carbamate pesticides used within 3/4 mile of their mothers' homes during pregnancy than TD children
				Both of these associations decreased as buffer zones increased
Association of pyrethroid pesticide exposure with attention-deficit/hyperactivity disorder in a nationally representative sample of U.S. children	Wagner-Schuman et al.	2015	Pyrethroid metabolite concentrations in children's urine	Boys with urinary metabolite levels above the limit of detection were twice as likely to have ADHD compared to boys with levels below the limit of detection
			Presence of attention-deficit/hyperactivity disorder (ADHD) in children 8-15 years old	*Dose-response effect* : hyperactive-impulse and inattentive symptoms increased by 50% for every 10-fold increase in urinary metabolite levels
Decreased lung function in 7-year-old children with early-life organophosphate exposure	Raanan et al.	2016	OP metabolite concentrations in urine at gestation and at 0.5, 1, 2, 3.5, 5 years old	Childhood, not maternal, urinary OP metabolite concentrations were associated with significant decreases in lung function at 7 years of age
			Lung function at 7 years of age	*Dose-response effect:* lung function decreased as urinary metabolite levels increased
Prenatal residential proximity to agricultural pesticide use in IQ in 7-year-old children	Gunier et al.	2016	Pesticide exposure: use within 0.6 miles of maternal residences, maternal urinary OP metabolite concentrations	IQ measurements decreased with increasing exposure to OP, pyrethroid, neonicotinoid and maganese pesticides
			Intelligence Quotient (IQ) in 7-year-olds	*Dose-response effect* : IQ decreased as exposure increased
Neurodevelopmental effects in children associated with exposure to organophosphate pesticides: ***A systematic review***	Munoz-Quezada et al.	2013	27 studies published from 2002-2012 that examined neurodevelopment effects on children from prenatal and early childhood exposures to OP pesticides	All but one study showed some negative effects of pesticides on neurobehavioral development
				A dose-response relationship was found in all but one of the 12 studies that assessed dose-response

California Department of Public Health Evaluation of Agricultural Pesticide Used Near Schools in California

Because children are especially vulnerable to pesticide exposure, the California Environmental Health Tracking Program (CEHTP) within the California Department of Public Health (CDPH) examined the use of agricultural pesticides of public health concern near public schools in the top 15 counties by agricultural pesticide use in California for 2010. CEHTP published the results of this study in April 2014: *Agricultural Pesticide Use Near Public Schools in California*.

Major findings include the following:

1) The top 15 counties with highest pesticide use account for 85% of pesticide use in California and contain over 2,500 public schools and around 1.5 million students.
2) 36% of these schools have agricultural pesticides applied within ¼ mile of their grounds, with a combined total of over 500,000 pounds.
3) The top 5% of schools with pesticides used nearby had amounts between 2,635 to 28,979 pounds of pesticides applied within ¼ mile.
4) Many of the pesticides of public concern applied near schools fall into multiple health hazard categories and are persistent (do not degrade quickly).
5) County with the highest number of schools with nearby pesticide use is Fresno.
6) County with the highest proportion of schools with nearby pesticide use is Tulare.
7) Ventura County had the highest number of schools and students in the top 5% of schools with nearby pesticide application.
8) Monterey County had the highest percentage of schools and students in the top 5% of schools with nearby pesticide application.
9) Hispanic children were 46% more likely than white children to attend schools with pesticides applied nearby and 91% more likely for the highest quartile of pesticide use.
10) Hispanic children were the only racial/ethnic group whose representation in the student population increased as pesticide use did.

The CEHTP study did not attempt to measure school children's exposures to pesticides directly, but states that the amount and type of pesticides being applied and the number of students possibly affected should warrant further study of possible pesticide exposure (e.g., on-site monitoring and biomonitoring) and health effects (epidemiology).

CEHTP also concluded that the study shows a need for:

1. Routine and standardized collection, digitization and reporting of pesticide use, made public on DPR's PUR database and in a GIS compatible format.
2. Accurate, complete and publicly accessible database on pesticide use within school grounds.
3. Accurate, complete and publicly accessible database of school boundaries.
4. Surveillance of pesticide use near schools and other potentially sensitive locations/populations (workers, women of reproductive age, child care centers).

DPR Regulatory Response

Public concern following the release of CEHTP's 2014 report prompted the DPR to reexamine whether regulation of agricultural pesticide use near schools was sufficiently protective of children's health.

Existing regulations for agricultural pesticide use near schools.

Any regulations specific to application of pesticides near schools are set by individual CAC for each county. For the 15 agriculturally-heavy counties in the CEHTP's report, regulations vary on application timing, buffer zones, and notification requirements depending on pesticide category and application type. For example, Sacramento recommends buffers for most types of applications, but does not enforce a specified distance. Imperial, however, prohibits most applications during school or daycare sessions and has implemented buffers of ¼ up to 1 mile.

DPR Draft Regulations: Pertaining to Pesticide Applications Near Schoolsites.

At the end of 2016, DPR released proposed regulations on agricultural pesticide use near schools. According to DPR, the purpose of the new regulations are to address the potential for *short-term acute* exposures by:

1) Providing minimum statewide regulations for agricultural pesticide use near schools and daycare centers.
2) Providing an extra margin of safety for unintended drift scenarios caused by weather changes or equipment failures.
3) Increasing communication between growers and schools/daycare centers.
4) Providing information to assist schools and daycare centers in preparing for and responding to pesticide emergencies.

Information relied upon for draft regulations.

Health and Safety

According to DPR, its evaluation of available data and current requirements indicates that the health risk to children and others is low when pesticides are used in compliance with the relevant regulations and label requirements.

According to DPR's *Initial Statement of Purpose and Public Report*, this conclusion was based off of two sources of information: 1) DPR's Air Monitoring Network (AMN) results and 2) a study by Lee et al. in 2011that estimates the magnitude and incidence of *acute* pesticide poisoning associated with pesticide drift from agricultural applications.

1) The pesticide AMN is a multi-year air monitoring study conducted by DPR. Air monitoring is one method for estimating exposures to pesticides from inhalation. Other sources of exposure to pesticides include entrapment of pesticide chemicals into dust that can then be inhaled or ingested; occupational take home exposures; and dietary residues.

   DPR's AMN monitors a total of 32 pesticides and 5 pesticide breakdown products of potential health risk in three communities (Salinas, Shafter and Ripon). A 24-hour sample is randomly collected once a week at each of these sites.

   AMN results for 2013 show pesticides were detected in less than 10% of samples. Of the 37 chemicals monitored, 24 were detected in at least one sample. Two pesticides, chloropicrin and 1,3-dichloropropene, were found to exceeded DPR's health screening levels at the Salinas and Shafter sites, respectively.

It is important to note that what air monitoring stations detect depends on their location, weather conditions and when a sample is taken. The AMN takes random samples throughout the year, including when pesticides are not being applied. Therefore, a large number of positive samples would not be expected.

Additionally, there are only three AMN monitoring stations and they are not necessarily located in areas that can provide a representative reading of pesticide air concentrations in schools near agricultural fields with heavy pesticide use. Therefore, this data should not be extrapolated to represent pesticide air concentrations for all locations in California.

Finally, DPR's health screening levels represent what DPR considers to be acceptable levels of exposure. However, the Office of Environmental Health Hazard Assessment (OEHHA) has recommended more health protective target regulatory levels for certain pesticides than DPR has set.

2) Lee et al. published a study in 2011 that examined the circumstances behind agricultural drift events that resulted in *acute* illnesses in California and elsewhere.

From the study, DPR concluded that the majority of drift illnesses resulted from aerial applications and fumigations that were not conducted in compliance with regulatory requirements.

However, there are several other relevant findings to the study, including:

a) More than half of drift-related pesticide poisoning cases resulted from non-occupational exposures.

b) Children under the age of 15 make up the largest number of individual non-occupational cases (415 out of 1,565 total, 27%).

c) After fumigation, the pesticide class that contributed the most to non-occupational drift events was insecticides (34%).

d) The two application types that contributed the most to non-occupational drift events were chemigation (34%) and soil injector (27%).

e) Insecticides caused the greatest number of moderate/high severity drift cases (34%).

f) Five of the top 15 pesticides in the moderate/high severity drift cases are on the top 10 list for the CEHTP's 2014 school report - 3 fumigants (metam-sodium, chloropicrin, methyl bromide) and 2 insecticides (chlorpyrifos and malathion).

   i. These five pesticides make up 59% of total cases and 57% of the moderate/high severity drift cases.

g) For over half of the drift events it was unknown or pending as to whether a violation of federal/state pesticide regulations was a contributing factor (344 out of 643 events, though only 361 out of 1,565 non-occupational illness cases).

h) 69% of non-occupational cases (that have data on distance) occurred within ½ mile of application versus 34% within ¼ mile.

In public meetings and correspondence, stakeholders raised concerns about the protectiveness of the proposed and existing buffer zones and suggested that DPR consider a one mile pesticide-free buffer. Stakeholders cited two studies in support of this distance.

DPR states that these two studies "do not provide scientific justification for a one mile distance."

1) CEHTP's 2014 report: *Agricultural Pesticide Use Near Public Schools in California*

   "CDPH relied solely on pesticide use data for its assessment. More importantly, they only looked at pesticide use within one-quarter mile of schools and provided no support for a more extensive buffer. In addition, the study did 'not attempt to measure school children's exposures to pesticides and, therefore, study results cannot be used to predict possible health impact.'"

2) UCD's CHARGE study (summarized in Table 2 and Appendix 2)

   "The UCD study does not provide information on pesticide exposure to children in schools surrounded by agricultural fields, but on the prenatal pesticide exposure to pregnant women, using pesticide use data as a surrogate, and possible correlations to neurological effects.

The way UCD calculated the pesticide use data in relation to the location of the residence in each case does not allow for any conclusions on the relative impact of use at different distances from the residence. Closer evaluation of data analysis shows that the actual sample sizes used were very small, and even with a finding of a significant correlation, the small sample size is a flag that such results may indicate the cases are atypical."

Economic Impact

In order to explore the economic impact of their draft regulations, DPR relied on a report prepared for the California Department of Food and Agriculture by the Department of Agricultural & Resource Economics at UCD (Goodhue et al., 2016). UCD evaluated the potential economic effects of the DPR's draft regulations on 13 major agricultural counties which make up two-thirds of California's total value of crop production.

Taking into account pesticide use data (July 2013 to June 2014) and field, school and daycare center boundaries, UCD's analysis found that the majority of the costs would be for the preparation of the annual plan notification requirement (90% of total notification costs). Total direct costs for the 13 counties were estimated to be approximately $1.78 million for the year.

With the addition of weather data from 1996-2005 and soils data, UCD evaluated the effect of the time window requirement for two prohibited application methods: aerial and air blast. Sprinkler chemigation was excluded because it was assumed that its timing could be altered to comply with the weekday time constraints without any economic impact. UCD found:

1) 58% of aerial and air blast applications would have been prohibited under the regulation.
2) Evening and weekend applications are already being done. 18% were on weekday evenings (after 6 p.m.) and 24% were on weekends.
3) Almonds and grapes were the commodities with the largest number of applications impacted (48% of all prohibited applications).
4) Estimated revenue losses are very small (direct costs of less than $200,000 for the year, for almonds and grapes in the 13 counties examined).
    a) Estimated losses using historical weather data and soils data are dramatically smaller than losses estimated assuming zero applications can be completed under the draft regulation.

b) The simplistic zero application scenario could only occur under highly unlikely weather conditions that allowed daytime weekday applications and also prohibited applications at night and weekends for several weeks in a row.

5) Limitations of the study:

a) Owing to differences in weather, pest conditions and crop mixes over time and space, UCD does not advise the extrapolation of these results to other years and counties.

b) Fumigation was excluded from the analysis due to the additional post-application requirement of 36 hours.

c) This analysis also does not consider the costs of possible strategies for adaptation to the draft regulations.

6) In spite of the limitations, UCD concludes that the majority of growers (and fields) will not be affected and that the impacts will not be uniform across growers, crops or counties.

DPR extrapolated the impacts determined by UCD for the 13 target counties to all counties statewide (Neal and Segawa, 2016). Using pesticide use report data for July 2013 through June 2014, DPR estimated the following would have been affected by the proposed regulation:

1) 3,499 schoolsites one-quarter mile or less from an agricultural field (13 percent of all schoolsites).

2) 4,821 agricultural fields one-quarter mile or less from a schoolsite (10 percent of all fields).

3) 2,519 growers operating these fields (3 percent of all growers).

4) 2,312 small businesses (91.8 percent of the affected growers).

5) 137,483 pesticide applications to these fields (11 percent of all applications).

6) 9,933 acres of almonds (0.9 – 1.2 percent of almond acreage).

7) 10,158 acres of grapes (0.9 – 1.3 percent of all grape acreage).

DPR estimated the cost to make the notifications required by the proposed regulation during this one-year period would have been $3.3 million, and the loss due to the proposed prohibitions would have been $1.2 million. Total grower cost would have been $3.3-$4.5 million for an average cost of $1,328-$1,795 for each affected grower, with the same cost per grower whether or not the grower was a small business.

DPR *assumed* that the indirect costs were the same as the direct costs, for a total economic impact ranging from $7.8-$9.0 million.

Summary of draft regulations.

In brief, the draft regulations provide:

Section 6691. Application Restrictions

1) From Monday through Friday from 6:00 a.m. to 6:00 p.m., there must be a minimum ¼ mile buffer for applications using:
    a) aircraft, airblast sprayer, or sprinkler chemication equipment
    b) dust or power (except soil injection, then no buffer), fumigants
    c) additionally, fumigants may not be applied within 36 hours from when a school or daycare is open.
2) A 25-foot buffer for other less drift-prone applications, like a ground-rig sprayer or field soil injection equipment.
3) No distance restrictions for the least drift-prone applications, such as within an enclosed space, with bait stations or a hand pump sprayer.
4) No distance restrictions when school classes are not scheduled for the entire day, a daycare center is closed for the entire day, or anytime outside of Monday through Friday from 6:00 a.m. to 6:00 p.m.

Section 6692 and 6693. Annual and Application-specific Notification.

1) Annual notification for all pesticide applications expected to be made within ¼ mile of a school or daycare center must be provided to the principal or administrator of that site and the CAC.
2) Application-specific notification of pesticide applications to be made within ¼ mile of a school or daycare center between 6:00 a.m. to 6:00 p.m., Monday through Friday (unless no buffer is required) must be provided at

least 48 hours prior to application. Principals and adminstrators may waive their right to notification.

Questions

Specific questions arise regarding the regulatory package:

1) **What was the developmental process for these draft regulations?** Were the three studies referenced in DPR's *Initial Statement of Purpose and Public Report* (Vidrio et al., 2014a-b, Lee et al., 2011) and the two suggested by public letters (CEHTP's 2014 report and UC Davis' CHARGE study) the only scientific studies and/or reports examined in determining safe distance and timing regulations?

   There are several recent, relevant studies on pesticide exposure pathways and health risk to children from pesticide exposure. If scientific studies beyond the five referenced above were not examined, **what is the justification for not performing a full literature review?**

2) **Were DPR's analyses of the studies relied upon for drafting these regulations submitted for external peer review?** A thorough review of the scientific weight of the CEHTP's 2014 report, UC Davis' CHARGE study and any studies that connect pesticide usage to exposure or exposure to health risks would provide transparency and guidance to drafting sufficiently protective distance and timing regulations.

3) Pesticide application often produces some amount of drift.

   a) **Are the proposed buffer zones sufficient to protect against the majority of drift events that can result in acute exposure health risks to children?**

   b) **Did DPR consider specifically addressing insecticides in addition to fumigants in their draft regulations?**

   c) With the cause of so many drift events unknown or pending, **is it safe to conclude that most drift events are a result of violations of federal or state regulations?**

d) According to the distance data in Lee et al., 2011, increasing a buffer zone from ¼ mile to ½ mile could cut down an extra 35% of acute non-occupational drift cases. As DPR has pointed out however, some fumigant regulations have changed since 2010, making it difficult to estimate the effect of increased distance regulations. **Has DPR examined the effects of these regulations on both fumigant and non-fumigant drift cases before concluding that the protection provided by increasing a buffer zone from ¼ mile to ½ mile no longer applies?**

4) Most pesticides of public health concern used near schools are persistent. Pesticides can persist especially long if present in an environment protected from degradation by sunlight, moisture, or microorganisms. Additionally, some breakdown products are still chemically active and can be even more toxic than original compound. **Are the proposed timing restrictions and buffer distances sufficient to protect against chronic exposure health risks to children? If not, does DPR have plans to address chronic exposure health risk to children in future regulations?**

5) **Can these new regulations be altered to include protection of children attending private schools as well?** These draft regulations pertain to pesticide applications *surrounding* school grounds, not on the school grounds. Why would the regulations be limited to applications around public schools and not include applications around private schools?

6) Even if a perfect study does not exist to address a specific regulatory issue, the President's Cancer Panel urges the need for caution and a proactive, not reactionary role. **Given the following statements from the panel**:

a) "Environmental contamination varies greatly by type and magnitude across the nation, and the lifetime effects of exposure to combinations of chemicals and other agents are largely understudied…Nonetheless, while these diverse effects often are difficult to quantify with existing technologies and research methods, in a great many instances, we know enough to act."

b) "The increasing number of known or suspected environmental carcinogens compels us to action, even though we may currently lack irrefutable proof of harm" – statement by Dr. LaSalle Leffall, Chair of the President's Panel, in 2010.

c) "A precautionary, prevention-oriented approach should replace current reactionary approaches to environmental contaminants in which human harm must be proven before action is taken to reduce or eliminate exposure."

d) "Agencies responsible for promulgating and enforcing regulations related to environmental exposures are failing to carry out their responsibilities."... "A more integrated, coordinated, and transparent system for promulgating and enforcing environmental contaminant policy and regulations, driven by science and free of political or industry influence, must be developed to protect public health."

Do these draft regulations fulfill these recommendations?

Reports and Studies

Harnly, M., McLaughlin, R., Bradman, A., Anderson, M., & Gunier, R. (2005). Correlating Agricultural Use of Organophosphates with Outdoor Air Concentrations: A Particular Concern for Children. *Environmental Health Perspectives*, *113*(9), 1184–1189. http://doi.org/10.1289/ehp.7493

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Appendix 1

Pesticide Exposure Studies

1. *Correlating agricultural use of organophosphates with outdoor air concentrations: a particular concern for children.* (Harnly et al., 2005)

   Authors examined the associations between agricultural organophosphate pesticide (OP) use, via DPR's Pesticide Use Reporting (PUR) database, and measured outdoor air concentrations, collected by California Air Resources Board and analyzed by UC Davis, at different time and distance scales.

   Authors found that agricultural use within a 3-mile radius on the monitoring day and use up to 2 days prior were significantly associated with air concentrations for the insecticides chlorpyrifos and diazinon, and their breakdown chemicals.

   Although the number of samples (12-20 monitoring days) and locations (4 per pesticide) in this study were limited, the results suggest that agricultural applications of OPs are a source of exposure, that significant impacts may be on the order of days, that spatial dispersion may be greater than single-pesticide-application air studies suggest, and that breakdown chemicals (often still toxic) may be equally, if not more, important contributors to air concentrations than parent organophosphate compounds.

2. *Pesticides in dust from homes in an agricultural area.* (Harnly et al., 2009)

   Authors collected and analyzed 504 indoor dust samples from 197 homes in Salinas Valley, CA to compare pesticide concentrations of indoor dust with agricultural pesticide use within a 9-square-mile area of participants' homes. Participants are all part of the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) Study; the longest running longitudinal birth cohort study of pesticides and other environmental exposures among children in a farmworker community.

   Agricultural use of chlorpyrifos, an herbicide DCPA and a fungicide iprodione in the month or season prior to sample collection was associated with 83%, 19% and 49% increases, respectively, in dust concentrations for each kg (2.2 pounds) applied per day. Agricultural use of diazinon and permethrin, however, did not show significant associations with indoor dust levels. Chlorpyrifos, DCPA and iprodione either have very low vapor pressure (more likely to stay in liquid phase), a high log octanol-water partition coefficient (low affinity for water, tend to absorb more readily into organic matter in soils or sediments, higher potential to bio-concentrate in living organisms), or both. Authors conclude that health risk assessments for pesticides that have these physicochemical properties should consider the possibility of their environmental persistence in indoor environments.

3. *Determinants of agricultural pesticide concentrations in carpet dust.* (Gunier et al., 2011)

   Authors collected carpet dust from 89 residences in California and estimated agricultural use of pesticides within 1,250 meters of the residences with DPR's PUR data linked to crop maps. For five of the seven pesticides evaluated (chlorpyrifos, chlorthal-dimethyl iprodione, phosmet, and simazine), residences with agricultural pesticide use nearby had significantly higher concentrations of pesticides in carpet dust compared with residences without nearby agricultural use.

4. *Determinants of organophosphorus pesticide urinary metabolite levels in young children living in an agricultural community.* (Bradman et al., 2011)

   Authors measured OP metabolites in urine samples collected from approximately 400 CHAMACOs cohort children in Salinas Valley, CA when they were 6, 12, and 24 months old. In general, authors found that higher levels of OP metabolites in children were associated with produce intake, time of sample collection (seasons when pesticides are applied) and spatial proximity to agricultural use (living or attending a childcare facility within 60 meters from an agricultural field).

5. *A review of nonoccupational pathways for pesticide exposure to women living in agricultural areas.* (Deziel et al., 2015)

   Authors reexamined 35 pesticide exposure studies published from 1995-2013. 10 out of 17 studies found associations between agricultural pesticide use nearby and pesticide presence in indoor dust. Generally, when additional information beyond distance metrics is incorporated, such as crop acreage, amount of pesticide applied and wind direction, the association between pesticide use and pesticide presence in dust is stronger.

   Five publications examining the influence of agricultural drift on pesticide biomarker levels in women observed no associations. Authors believe this is because pesticide biomarkers mainly reflect recent high-exposure events.

Authors state, "We observed some inconsistent relationships between environmental and biological measurements, which may reflect different windows of exposure." The two different types of measurements, biological and environmental, could provide complementary information, high-acute exposures from spray drift and low-chronic exposures from volatilization drift, respectively. Further study is needed to fully understand the relationship between the two.

Appendix 2

Health Risks to Children from Pesticide Exposure Studies

1. *Risk of childhood cancers associated with residence in agriculturally intense areas in the United States.* (Carozza et al., 2008)

   Authors evaluated whether residence in a county with greater agricultural activity was associated with risk of developing cancer in children under 15 years old. Authors found statistically significant increased risk estimates for many types of childhood cancers associated with residence in moderate (20-60% cropland) to high (60% and up cropland) levels of agricultural activity counties. They also found a remarkably consistent dose-response effect where the odds ratio for most of these childhood cancers increased going from medium to high crop usage counties.

2. *Decreased lung function in 7-year-old children with early-life organophosphate exposure.* (Raanan et al., 2016)

   In this study, authors evaluated whether prolonged early-life exposure to OPs have an adverse effect on lung function of CHAMACOS children. To assess OP exposure, urinary OP metabolite concentrations were measured twice during gestation and at 0.5, 1, 2, 3.5, 5 years old. Lung function was assessed by spirometry (maximum expiratory flow volume tests) at age 7.

   Childhood, but not maternal, urinary OP metabolite concentrations were associated with significant decreases in lung function at age 7. Each 10-fold increase in concentrations of OP metabolites measured through early childhood (0.5-5 years of old) was associated with a 159 mL/s decrease in FEV1 in 7-year-old children. In comparison, passive pediatric exposure to maternal cigarette smoke was found to be associated with a decrease in FEV1 of 101 mL/s after 5 years of exposure.

3. *Neurodevelopmental disorders and prenatal residential proximity to agricultural pesticides: The CHARGE Study.* (Shelton et al., 2014)

   The Childhood Autism Risks from Genetics and Environment (CHARGE) study is an ongoing population-based case-control study that aims to uncover a broad array of factors contributing to autism and developmental delay. As part of the CHARGE study, authors of this paper set out to explore the relationship between exposure of CHARGE mothers to agricultural pesticides during pregnancy and neurodevelopmental outcomes of CHARGE children. Within the CHARGE cohort, authors identified 486 children with Autism Spectrum Disorder (ASD), 168 children with developmental delay (DD) and 316 children with typical development (TD). PUR data linked to participant's homes during pregnancy were used to determine if pesticides were applied within various distances (~ ¾ mile to a little over 1 mile) from participants' homes during pregnancy.

Authors found that approximately one third of CHARGE mothers lived within 1 mile of pesticide applications during pregnancy; two-thirds of which were exposed to multiple pesticides over their pregnancy. Children with ASD were 60% more likely to have had OPs used within ¾ mile of their mothers' homes during their gestation than TD children. Children with DD were 150% more likely to have had carbamate pesticides used within ¾ mile of their mothers' homes during their gestation than TD children. Both of these associations lessened as buffer zones increased. Also, each 100 pound increase in chlorpyrifos applied within 1 mile of homes during gestation increased the prevalence of ASD by 14%. Authors conclude that prenatal exposure to organophosphate and pyrethroid pesticides may increase the prevalence of neurodevelopmental disorders and that this effect may be governed by a positive dose-response relationship.

4. *Prenatal residential proximity to agricultural pesticide use and IQ in 7-year-old children* (Gunier et al., 2016)

Authors evaluated the relationship between pre-natal exposure to potentially neurotoxic agricultural pesticides and neurodevelopment in 7-year-old children. Pesticide exposure within 0.6 miles of maternal residences was estimated using PUR data and a geographic information system (GIS) for 283 CHAMACOS cohort participants. Maternal urinary OP metabolite concentrations were also measured.

Authors observed a general decrease in all intelligence quotient (IQ) measurements with increasing use of organophosphate, pyrethroid, neonicotinoid and maganese pesticides within 0.6 miles of the maternal residence during pregnancy. Each standard deviation in toxicity-weighted OP use during pregnancy was associated with an estimated 2.2 point decrease in IQ and a 2.9 point decrease in Verbal Comprehension scores. Importantly, effect estimates on IQ of nearby OP use and maternal urinary OP metabolite concentrations were similar. This again suggests that environmental and biological measurements of OPs could be assessing different exposure pathways and that measuring both could provide a more complete characterization of exposure.

5. *Association of pyrethroid pesticide exposure with attention-deficit/hyperactivity disorder in a nationally representative sample of U.S. children.* (Wagner-Schuman, 2015)

   Authors examined the association between pyrethroid pesticide exposure, as measured by the presence of a urinary pyrethroid metabolite, and ADHD in a nationally representative sample of 687 U.S. children from 8-15 years old (2001-2002 National Health and Nutrition Examination Survey). Data showed that boys with urinary metabolite levels above the limit of detection were twice as likely to have ADHD compared to boys with levels below the limit of detection. Additionally, hyperactive-impulse and inattentive symptoms increased by ~50% for every 10-fold increase in urinary metabolite levels in boys.

6. *Neurodevelopmental effects in children associated with exposure to organophosphate pesticides: A systematic review.* (Munoz-Quezada et al., 2013)

   Authors reviewed findings from 27 studies published from 2002-2012 that examined neurodevelopmental effects on children from prenatal and early childhood exposures to OPs. All but one showed some negative effects of pesticides on neurobehavioral development. A positive dose-response relationship between OP exposure and neurodevelopmental outcomes was found in all but one of the 12 studies that assessed dose-response. On strength of evidence, 11 studies were rated high, 14 studies rated intermediate and 2 studies rated low.