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Guidelines Needed for EPA's Tolerance Assessments of Pesticide Residues in Food

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Before the
Subcommittee on Health and the Environment
Committee on Energy and Commerce
House of Representatives

Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to testify about two aspects of the Environmental Protection Agency's (EPA) methods for assessing potential risks of pesticide residues in food. As you know, pesticides used in agriculture may leave residues which persist from the farm gate to the dinner plate. Consumer concern about the safety of pesticide residues in food is high, as shown in recent reactions to news about daminozide residues in apples and apple products. While scientific ability to assess potential health risks related to pesticide residues has increased, some consumers question whether the federal government is regulating pesticide use in a manner that protects public health. H.R. 1725, which the Subcommittee is considering today, would specify the methods EPA would use in assessing dietary risks of pesticide residues and the standards EPA would apply when deciding whether to establish tolerances for pesticide residues in food.

At the request of Chairman Dingell of the House Oversight and Investigations Subcommittee, who has a long-standing interest in pesticide regulation, we have been reviewing several issues regarding EPA's policies and procedures for assessing dietary risks and making regulatory decisions about pesticide tolerances with respect to population subgroups and anticipated residue data. As you know, a tolerance is a legal limit on the amount of pesticide residue allowed to remain in or on food. EPA uses its automated Tolerance Assessment System (TAS) to estimate dietary exposure to pesticide residues, for the overall population and population subgroups based on age, gender, race, and so forth. To estimate residue levels, TAS can use either tolerance levels or anticipated residue estimates, which are intended to reflect residues in food at the time it is consumed. Anticipated residue data are derived from studies done by pesticide manufacturers, Food and Drug Administration (FDA) sampling and testing of food samples, and other sources. To estimate food consumption, TAS uses

information from a Department of Agriculture (USDA) food consumption survey. The issues we are reviewing include:

-- EPA's progress in considering pesticide exposure of population subgroups and establishing relevant policies and procedures,

-- the status of EPA's efforts to develop and use anticipated residue data, and

-- EPA's plans for updating TAS with results of the new USDA food consumption survey and effects of the survey's reduced sample size on the precision of TAS subgroup data.

We will address the first two issues today. More detailed information on these issues is contained in attachments II and III. We plan to report on USDA's food consumption survey at a later date, since survey information is not yet available for our review. However, preliminary information about the TAS update and USDA survey is included in attachment IV to this statement. Background information about TAS and how EPA uses it and the objectives, scope, and methodology of our review can be found in attachment I. Detailed information on EPA's requirements for toxicology and residue chemistry data is included in attachment V. Let me begin by summarizing our findings on EPA's use of population subgroups and anticipated residue data.

RESULTS IN BRIEF

Although EPA uses TAS data to consider risks to population subgroups for health effects other than cancer, it has not established a policy as to whether, and/or in what circumstances, tolerance levels are to be based on the subgroup with the highest potential exposure to the pesticide. On the other hand, we found that EPA usually develops separate cancer risk estimates only for

the overall U.S. population, even though population subgroups' exposure to pesticide residues may be higher. As a result, officials responsible for establishing tolerances do not have as much information about cancer risks to factor into their decisions as they do about other health effects.

If exposure estimates based on tolerance-level residues indicate potential health concerns, EPA may use anticipated residue data to more precisely estimate residue levels in food when it is consumed. Although EPA used such data in assessments of about 40 pesticides over a 2-year period, this has been done on a case-by-case basis without guidelines for performing anticipated residue studies and using such data in risk assessments. Without comprehensive guidelines including standards for data quality, EPA does not have full assurance that disadvantages associated with such data have been adequately addressed or that data are of acceptable quality.

My testimony contains recommendations dealing with these issues. Now I would like to give you more details on our findings as they relate to the two issues.

POLICY NEEDED CONCERNING POPULATION SUBGROUPS

EPA's Tolerance Assessment System, known as TAS, is a computerized database system which can calculate potential dietary exposure for the overall U.S. population and 22 subgroups. TAS does not provide "yes-or-no" decisions on tolerance proposals. Estimates TAS generates require scientific interpretation, and other types of data are also needed to reach decisions about tolerances. EPA's process for considering population subgroups involves using TAS to generate dietary exposure estimates, and then reaching a regulatory decision through internal discussions.

EPA has been aware for some time that it needed a policy concerning population subgroups. An EPA internal staff paper dated March 1986, recommended that the subgroups with the highest exposure should be used as the basis for regulatory decisions. Except for birth defect and reproductive effects, the subgroups selected for decisions would be infants and children, because they consume more in relation to their body weight than do adults. The recommendation, however, was not adopted because the Office of Pesticide Programs (OPP) wanted to first gain experience with individual cases.

With a few exceptions, EPA has based its decisions for carcinogens on exposure and risk estimates for the overall U.S. population. More importantly, EPA decision makers are not normally provided separate cancer risk estimates for population subgroups. Instead, subgroup exposure estimates are included in the average exposure figures when EPA develops its cancer risk estimate for the overall U.S. population. EPA does, however, consider separately subgroup data on a regular basis when it assesses other health risks such as reproductive system damage.

EPA's review of captan, a fungicide used on a variety of fruits and vegetables, illustrates how subgroup consideration differs for carcinogenic effects. EPA recently completed its special review of captan, canceling over 40 of its 64 food uses in order to reduce cancer risk to a level considered to be outweighed by captan's benefits. While EPA's decision about captan's reproductive effects addressed the most highly exposed subgroup as well as the overall U.S. population, its decision about captan's cancer risks were based on averages for the overall U.S. population. According to captan exposure estimates in the TAS report, the two most highly exposed subgroups are nonnursing infants under 1 year of age and children aged 1 to 6. Estimated captan exposure for nonnursing infants was about 3 times greater than the U.S. population average, and estimated exposure for

children 1 to 6 was about 2 times greater than the U.S. population average.

EPA cited several reasons for not separately estimating carcinogenic risk on exposure estimates for children and other age subgroups. First, cancer studies and models assume lifetime exposure, which is most closely approximated by the exposure estimate for the overall U.S. population. This estimate includes all subgroups in the average. Second, young animals used in the cancer studies eat more in relation to their body weight than mature animals, as do young humans, so cancer studies roughly reflect human eating patterns. Third, EPA believes that other conservative assumptions made in assessing cancer risk are sufficient, and that basing assessments on the most highly exposed subgroup would over-state cancer risk.

EPA has, however, assessed cancer risk to infants and children for three pesticides--EDB, alachlor and daminozide. For these pesticides, EPA had cancer data, other than that routinely required, which indicated young animals developed tumors. For a recent action extending the tolerance for daminozide residues in apples, EPA estimated the cancer risk to children partly because their exposure was much higher than adults' exposure, as they consume greater quantities of apple products. While exposure to infants and young children is 2 to 3 times greater than the average for many pesticides, for daminozide, it was more than 9 times greater than the average exposure for the overall U.S. population.

Congress mandated the National Academy of Sciences (NAS) to study scientific and regulatory issues concerning pesticides in the diets of infants and children, including the issue of how to assess risks and establish tolerances that protect these groups. The study is expected to be completed in the fall of 1990. The study results should help resolve some of the questions about these

subgroups, but EPA is under no obligation to act on any NAS recommendations.

We do not believe that EPA should wait for results of the NAS study before establishing a policy as to whether, and/or in what circumstances, tolerance decisions are to be based on the subgroup which is most highly exposed. This is especially important because the pace of reregistration and tolerance reassessment should accelerate over the next decade as required by the Federal Insecticide, Fungicide, and Rodenticide Act Amendments of 1988. Establishing a policy now would help provide assurance that EPA's decisions about older food-use pesticides protect public health, including the health of population subgroups such as infants and children.

We also believe that EPA could strengthen the assurance it provides consumers that tolerances protect public health, if it were to develop separate cancer risk estimates for highly exposed population subgroups, consider this information in reaching regulatory decisions, and provide the information to the public through the tolerance rule-making process. A compelling reason for estimating cancer risk to highly exposed subgroups and providing this information to decision makers is the recent heightened public concern over pesticide residues in food. The degree of concern was apparent in the recent public outcry over potential cancer risks to infants and children from eating food products containing daminozide-treated apples. In the final analysis, considering all available information on cancer risk in reaching tolerance decisions would increase the credibility of EPA's regulatory decisions on carcinogenic pesticides.

For these reasons, we recommend EPA separately estimate cancer risk for highly exposed subgroups, consider subgroups' risk in its decisions regarding carcinogenic pesticides, and report on the subgroups most at risk in its Federal Register notices for the

establishment or change of a pesticide's tolerances. We also recommend that EPA proceed now to establish a policy concerning whether, and/or in what circumstances, tolerance decisions are to be based on the most highly exposed subgroup(s).

Let me now turn to EPA's use of anticipated residue data in setting pesticide tolerance levels.

GUIDELINES NEEDED FOR ANTICIPATED RESIDUE DATA

EPA has traditionally used tolerance levels in estimating dietary exposure because this approach provides a worst-case exposure estimate. Assessments done in this manner assume that 100 percent of each crop on which a pesticide may be used is treated with the pesticide. They also assume the most strenuous conditions of pesticide use--that is, maximum number of pesticide applications allowed and application as close to harvest as allowed by the pesticide label. Thus, if an exposure estimate based on tolerance-level residues yields an acceptable level of risk, EPA concludes that tolerances protect public health. If, however, the assessment indicates that exposure at the tolerance level might present a health concern, EPA revises its exposure estimates using anticipated residue data to obtain a more realistic exposure estimate. In these cases EPA uses percent-crop-treated data, processing or cooking data, field trial data, FDA monitoring data, and/or registrant monitoring data, to estimate the residue levels consumers are more likely to encounter.

EPA's assessment of captan illustrates how anticipated residue data are used. Its earlier estimate of cancer risk assumed tolerance-level residues and that 100 percent of crops were treated; these assumptions yielded a cancer risk estimate of at least one additional case of cancer for every 10,000 people. Anticipated residue estimates for captan yielded a somewhat lower

cancer risk estimate of at least one additional case of cancer among every 1 million people. EPA considered the lower risk estimate using anticipated residue data and canceled over 40 of the 64 food uses of captan.

Between 1987 and 1989, EPA used anticipated residue data to assess 41 pesticides. Generally, the circumstance that triggered EPA's use of anticipated residue data for assessing these pesticides was that exposure assuming tolerance-level residues exceeded the acceptable daily intake level or other toxicity measure.

One disadvantage of anticipated residue estimates is that they can change over time, but tolerances are not necessarily revised periodically to reflect these changes. For example, the percent of a crop treated with a pesticide can change because of a cancellation of an alternative pesticide, pest infestation, or other factors. Commercial food processing methods can also change in ways that might affect the residue level in processed foods. EPA has also encountered two other major problems: (1) the data necessary are not always available, and (2) the data available are often incapable of being used to precisely estimate residues.

EPA, as early as 1986, recognized the need for guidelines for collecting, standardizing, and evaluating anticipated residue data from registrants, but has been slow to develop this guidance. We found that although work on anticipated residue guidelines has been proposed since at least 1986, EPA did not begin extensive work on guidelines until March 1989. At that time, EPA formed a work group of agency staff and expects to have guidelines finalized by about mid-1990.

We are encouraged that EPA has taken positive steps in the past 2 months with regard to developing guidelines for anticipated residue data. However, we have some concerns about how

comprehensive the guidelines will be, how quickly they will be developed, and whether EPA would use the guidelines to review regulatory decisions made in the interim which were based on anticipated residue data.

Although EPA is aware of the disadvantages of anticipated residue data, we are uncertain that EPA's planned guidelines will be as comprehensive as we believe they need to be. For example, one disadvantage of both percent-crop-treated data and processing data is that these factors change over time. To the extent that monitoring studies reflect the percentage of a crop treated and processing techniques, monitoring studies done at different periods of time would provide differing results. Although anticipated residue data used in risk assessments can change over time, tolerances are not necessarily changed when the percentage of a crop treated, for instance, changes. EPA's guidance for using anticipated residue data should address this issue, as well as other disadvantages associated with each type of anticipated residue data.

We also believe that comprehensive guidelines should be developed as quickly as possible in light of the 1988 amendments to FIFRA, which should increase the pace of tolerance reassessment since this act requires reregistration to be completed in about 9 years. Older chemicals with extensive agricultural uses may have potential exposure concerns, if one assumes tolerance-level residues. It is therefore likely that anticipated residue data would be used for a number of the food-use pesticides undergoing reregistration and tolerance reassessment. Such data have already been used in interim assessments of 17 older pesticides.

Finally, although EPA staff currently review the adequacy of anticipated residue studies on a case-by-case basis, they do not have a set of standards against which to measure the studies because there are no guidelines. In light of the disadvantages

associated with the data and the current lack of standards, we believe EPA will need to re-evaluate the adequacy of anticipated residue data which were used before the development of guidelines and review regulatory decisions based on such data.

Based on the above, we recommend that EPA establish guidelines as soon as possible on the development and use of anticipated residue data to estimate exposure. Further, we recommend that the guidelines for using anticipated residue data to estimate exposure also address the disadvantages of each type of data. In addition, we recommend that, once EPA develops guidelines, it should reevaluate any regulatory decisions it has made in the interim that were based on anticipated residue data.

Mr. Chairman, this concludes my prepared statement. We will be glad to respond to any questions the Subcommittee may have.

BACKGROUND, OBJECTIVES, SCOPE AND METHODOLOGY

BACKGROUND

EPA regulates pesticides and their uses under the authority of two statutes: the Federal Food, Drug, and Cosmetic Act and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Under the Food and Drug Act, EPA establishes maximum allowable levels (called tolerances) of pesticide residues in raw agricultural commodities, animal feeds, and processed foods. The act requires tolerances to protect public health, while allowing for the production of an adequate, wholesome, and economical food supply. A tolerance therefore represents both a pesticide residue level low enough to be safe and one high enough to cover residues that may be present if the pesticide is properly used. Petitions requesting that tolerances be set are submitted to EPA, usually by pesticide manufacturers. Tolerances[1] are established for each pesticide chemical ingredient and for each food commodity on which it is allowed (registered) to be used. For example, EPA has set tolerances for residues of the insecticide methomyl on 76 raw agricultural commodities, including a number of fruits, vegetables, and grains. Methomyl has a tolerance of 5 parts per million on lettuce; that is, methomyl residues are allowed on lettuce up to 5 parts per million.

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[1]The Food and Drug Act allows a pesticide to be exempted from the requirement of a tolerance when a tolerance is not necessary to protect public health. For example, EPA has exempted some naturally occurring substances not considered toxic to humans. Residues of exempted pesticides are normally allowed at any level.

The Food and Drug Administration (FDA) and Department of Agriculture (USDA) are responsible for monitoring foods and enforcing tolerances. Agriculture has monitoring and enforcement authority for pesticide residues in meat and poultry products, and FDA is responsible for monitoring and enforcing tolerances for the rest of the food supply (fruits, vegetables, grains, etc.). These agencies test samples of food to determine if any residues exceeding tolerance levels remain on food, or if residues are present from any pesticide without an established tolerance for that food. Residues over tolerance levels and residues not subject to an established tolerance render food adulterated. Adulterated food may not be sold in interstate commerce.

Under FIFRA, EPA registers pesticide products for specific uses. Pesticide products generally consist of one or more active pesticide chemicals mixed with inert ingredients. An active pesticide ingredient is one intended to control a pest, while inert ingredients are used to dissolve, dilute, deliver or stabilize the active ingredient(s). A registration is basically a license for specific uses of a pesticide product that states the terms and conditions of its legal uses. Registrations are established for pesticide products, while tolerances and tolerance exemptions are established for active and inert pesticide chemicals and, in some cases, for breakdown products of pesticide chemicals. (Hereafter, use of "pesticide" refers to active and inert pesticide chemicals.) Tolerances are a prerequisite to registering a pesticide product for a food use, under EPA regulations. FIFRA authorizes EPA to deny a new registration or restrict, cancel, or suspend an existing registration, if it finds that a pesticide product presents an unreasonable risk to human health or the environment.

Many Tolerances Need
to Be Reassessed

As we have reported and testified previously,[2] EPA has yet to reassess most previously established tolerances according to current scientific standards. Many older tolerances were not based on the testing methodologies and the full set of data that EPA now requires. We expect that the pace of tolerance reassessment will increase in the next few years, because of requirements in the 1988 amendments to FIFRA. FIFRA amendments of 1972 and 1978 required EPA to reregister all previously registered pesticides, giving priority to pesticides resulting in residues in food. EPA decided to reassess tolerances through its reregistration program. We testified earlier this week that as of April 28, 1989, EPA had reassessed tolerances and exemptions and completed all tolerance actions for only 3 of the approximately 387 food-use pesticides required to undergo reregistration because of gaps in toxicology and residue data.[3]

The pace of tolerance reassessment will probably increase because the 1988 FIFRA amendments established deadlines for completing reregistration activities and provided for fees to help fund these activities. Two kinds of fees will be paid by the pesticide industry--a reregistration fee for each active

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[2]Pesticides: EPA's Formidable Task to Assess and Regulate Their Risks (GAO/RCED-86-125, Apr. 18, 1986), and Federal Reregistration of Pesticides and Reassessment of Tolerances Will Extend Into the 21st Century (GAO/T-RCED-87-27, June 8, 1987).

[3]Reregistration and Tolerance Reassessment Remain Incomplete for Most Pesticides (GAO/T-RCED-89-40, May 15, 1989).

ingredient and an annual fee for maintaining the registration of each product. The amendments required that reregistration of pesticide products be completed in 5 phases over approximately 9 years--or by about 1997. The 1988 amendments also continued the priority for food-use pesticides. In addition, as you are well aware, Mr. Chairman, the deadlines for tolerance reassessment under H.R. 1725 and its companion bill would be about 4 years.

Overview of Dietary
Risk Assessment

In making tolerance decisions, EPA assesses possible health risks due to consuming food containing pesticide residues. EPA uses dietary risk assessments when it decides whether to establish new tolerances, when it reassesses existing tolerances as part of its reregistration effort, and when it conducts reviews of pesticides which may present significant health risks. Dietary risk assessments are a major factor in EPA's regulatory decisions regarding agricultural pesticides, but other factors, such as pesticide benefits and potential hazards to wildlife, are often considered. The aim of EPA's dietary risk assessments is to determine whether proposed (or existing) tolerances would protect public health within a practical certainty.

The risk of pesticide residues depends both on the toxicity of residues (their potential to cause adverse health effects) and potential human exposure to residues in food. EPA requires those petitioning for a tolerance, usually pesticide manufacturers, to submit data that allow EPA to determine what residue levels could result from a pesticide's use on a particular crop and to assess the toxicity of pesticide residues. Attachment V to our statement provides further information on EPA's requirements for toxicology

and residue chemistry data. EPA's process for assessing dietary risks has three steps: (1) determining the toxicity of the pesticide's residues, (2) determining potential exposure to pesticide residues in food, and (3) determining whether potential dietary exposure is an acceptable level for human intake.

In the first step, EPA toxicologists use animal and microorganism studies to determine a pesticide's toxicity and assess possible human health risks from pesticide residues. These tests indicate what effects a pesticide might cause and at what levels effects begin to occur in animals. Toxicity analyses involve an element of uncertainty because animals are biologically different from humans and susceptibility to health effects varies between human individuals. EPA uses certain conservative assumptions in its toxicity analyses, described below, to attempt to compensate for these uncertainties.

EPA uses different toxicity concepts to assess carcinogenic effects and other health effects. Chronic effects are those which can result from long-term exposure, such as weight reduction, effects on the blood, liver effects, and cancer. Acute effects are those which can result from short-term exposure, including teratogenic (birth defect) effects and effects on an enzyme in the nervous system. In assessing acute effects and chronic effects other than cancer, EPA calculates a level of daily pesticide intake considered acceptable for humans. This level is determined by dividing the level causing no observable effects in test animals by an uncertainty factor (usually a factor of 100) to arrive at the "acceptable daily intake" level for humans. EPA does not use an acceptable daily intake to assess cancer risk because scientists have been unable to determine whether a safe, threshold level exists for carcinogens. EPA uses dose-response models that assume

some risk of contracting cancer exists for even minute exposures to carcinogenic pesticide residues. EPA assesses the relationship between the dose of a carcinogen and the probability of inducing a carcinogenic effect, using animal data. The cancer potency factor is EPA's measure of toxicity for carcinogens and is developed by applying mathematical models to animal data.

The second step in dietary risk assessment is determining potential human exposure to a pesticide's residues in food. EPA needs to know how much residue a pesticide leaves in or on particular food commodities and how much of these commodities people consume. Residue chemistry studies provide information on the chemical identity and amount of residue in food commodities. EPA uses food consumption data from a USDA nationwide survey.

The third step in dietary risk assessment is comparing what is known about the toxicity of a pesticide's residue to potential human exposure to that residue. Once the Tolerance Assessment System (TAS) calculates potential exposure to pesticide residues in food, it also compares this exposure estimate with the appropriate toxicity concept. For chronic effects (other than cancer), TAS calculates the percentage of the acceptable daily intake level which potential exposure occupies, indicating whether it is over or under the acceptable intake level. The comparison is somewhat different for cancer and acute effects.

Overview of EPA's Tolerance Assessment System

EPA developed TAS to help analyze human exposure to pesticide residues in food. TAS is a computerized data base system. It can perform the repetitive calculations needed to calculate potential

dietary exposure to a pesticide's residues for the overall U.S. population and 22 population subgroups. TAS does not provide "yes-or-no" decisions on tolerance proposals. Estimates generated by TAS thus require scientific interpretation. Regulatory decision makers utilize exposure estimates from TAS in conjunction with other data to determine whether to grant proposed tolerances.

EPA began using TAS in 1986 for special reviews of pesticides of concern, the first food use of new pesticides, and reassessments of existing tolerances for the reregistration program. In April 1988, EPA extended use of TAS to all dietary risk assessments, including those for new food uses of existing pesticides.

Data in the Tolerance Assessment System

The TAS data base includes information on tolerance levels, toxicity, and food consumption. Information on residues and toxicity is developed by EPA chemists and toxicologists and entered into TAS. The ability to provide and analyze detailed data on food consumption is a major feature of the system.

The system contains a file of established tolerances, and proposed tolerances are input when they are under consideration. Anticipated residue estimates and data on the percentage of a crop treated with a pesticide (we discuss these data later in this testimony) are entered when they are available and needed for a particular decision.

TAS includes "bottom line" toxicity information, which was developed by EPA toxicologists from animal studies. Depending on

a pesticide's effects, toxicity information in TAS would include the no-observable-effects level, acceptable daily intake level, and/or cancer potency factor.

TAS contains data on food consumption based on a 1977-78 USDA nationwide survey. This USDA survey sampled over 30,000 people and asked what foods and beverages they consumed over a 3-day period. The survey also gathered socioeconomic data on respondents, such as age, gender, weight, race, and residence location. Because most tolerances are set for raw agricultural commodities, TAS lists food consumption in terms of raw commodities. If a survey respondent reported eating apple pie, for example, TAS recipe files are used to calculate the amount of apples, sugar, flour, etc. consumed.

TAS groups survey respondents into 22 population subgroups, based on age, gender, race, region of residence, and season of the year in which surveyed. TAS provides exposure estimates for the overall U.S. population (including all subgroups), as well as for each subgroup. The subgroups currently used in TAS are shown in table I.1.

Table I.1: Subgroups Currently Used in TAS

Seasons:
- Spring
- Summer
- Fall
- Winter

Region:
- Northeast
- North central
- Southern
- Western

Race/ethnicity:
- Hispanics
- Non-Hispanic whites
- Non-Hispanic blacks
- Other non-Hispanics

Age/sex/etc.:
- Nursing infants under 1 year old
- Nonnursing infants under 1 year old
- Children 1 to 6 years old
- Children 7 to 12 years old
- Males 13 to 19 years old
- Females 13 to 19 years old
- Males 20 years and older
- Females 20 years and older
- Females, 13 years and older, pregnant
- Females, 13 years and older, nursing

TAS Analyses for Chronic and Acute Effects

TAS can perform several types of analyses, depending on the type of health effect being assessed. The most commonly used analyses are routine chronic and detailed acute analyses. Routine chronic analysis calculates average exposure for the overall U.S. population and each of the 22 population subgroups. Detailed acute analysis calculates the distribution of exposure for the U.S. population and subgroups, so the EPA can determine the upper bounds

of exposure for a 1-day period. TAS acute analysis can address the overall U.S. population and 4 groupings: infants under 1 year old, children 1 to 6 years old, females 13 and older, and males 13 and older. Some of the 22 subgroups are combined for acute analysis because they were too small in sample size to calculate an exposure distribution.

Routine chronic and detailed acute analyses both calculate exposure for a food commodity by multiplying the residue estimate times the amount of that food consumed. For example, exposure to the fungicide iprodione from lettuce equals the level of iprodione residue in lettuce multiplied by the amount of lettuce consumed. For the amount of lettuce consumed, the routine chronic analysis would use average food consumption estimates for each group, whereas the detailed acute analysis would use each individual's consumption value. To estimate total exposure to iprodione, one would need to sum exposure from all of the commodities for which iprodione has tolerances. TAS expresses exposure as milligrams of a pesticide residue per kilogram of body weight per day. Therefore, TAS exposure estimates reflect exposure in relation to the individual body weights of those surveyed.

In the routine chronic analysis for a pesticide, TAS basically: (1) uses average food consumption estimates for each subgroup and the overall U.S. population, (2) computes exposure repetitively for each food commodity having a proposed or existing tolerance, and (3) sums exposures from all relevant food commodities to arrive at the total exposure from all food sources for each of the 22 subgroups and the overall U. S. population. TAS printouts for the routine chronic analysis thus include exposure estimates for the overall U.S. population and each of the 22 subgroups.

For health effects which can result from acute (short-term) exposure, a TAS analysis known as detailed acute analysis is used.[4] A major difference between the routine chronic analysis and the detailed acute analysis is that distributions of exposure, rather than average exposure figures, are generated. That is, TAS indicates the percentage of people surveyed who fall into a given range of exposure on any given day.

Since, with acute effects, EPA is concerned about health effects related to a day's exposure, the amount one eats in 1 day is the relevant consumption figure. This may be quite different from average exposure. For example, one's average daily consumption of cantaloupe over a year may be relatively small. When cantaloupe is in season, one might eat a fairly large amount in 1 day. The detailed acute analysis thus calculates exposure for each person who consumed the commodities having proposed or existing tolerances.

TAS Is an Improvement Over
Prior Exposure Methodology

TAS provides improved exposure estimates in several ways, when compared with the method EPA previously used, known as the food factor method. First, TAS provides exposure estimates for 22 population subgroups, as well as the overall U.S. population, while the food factor method only provided an exposure estimate for the U.S. population. Second, TAS used the 1977-78 USDA survey of food consumption, while the food factor method used the 1965 USDA

[4]EPA is currently developing a different method for acute analysis using TAS.

survey. Third, TAS food consumption estimates are adjusted for individual body weights, as reported by survey respondents. An average weight of 60 kilograms (132.3 pounds) and average daily food intake of 1,500 grams (3.3 pounds) was assumed in the prior food factor method. Fourth, TAS averages exposure for all population subgroups (all ages, both genders, etc.), while the food factor method based average food consumption figures and weight on young adult males.

Objectives, Scope, and Methodology

In a letter dated June 3, 1988, the Chairman, Subcommittee on Oversight and Investigations, House Committee on Energy and Commerce, asked us to review several pesticide issues, including tolerance issues relating to the use of EPA's Tolerance Assessment System (TAS). We agreed with the Chairman's office, in November 1988, to concentrate our work on TAS and return to the other issues at a later date.

The three tolerance issues we agreed to review were: (1) EPA's progress in considering the exposure of population subgroups when establishing or reviewing tolerances, (2) the status of EPA's efforts to develop and use anticipated residue data for assessing exposure and the advantages and disadvantages of the various types of anticipated residue data, and (3) the planned update of TAS with results of USDA's latest food consumption survey and the effects of the survey's reduced sample size on EPA's exposure assessments. Our work was performed primarily at EPA's Washington, D.C., headquarters because tolerance assessment is a headquarters function.

ATTACHMENT I

To obtain information on the use of population subgroups and anticipated residue data, we interviewed EPA Office of Pesticide Programs officials in the Dietary Exposure Branch, the Toxicology Branch, and the Science Analysis and Coordination Branch of the Health Effects Division; the Policy and Special Projects Staff; the Registration Division; the Special Review Branch of the Special Review and Reregistration Division, and the Economic Analysis Branch of the Biological and Economic Analysis Division.

In addition, to obtain information about EPA's consideration of population subgroups, we reviewed documentation of the TAS system and examined TAS reports. We also reviewed various EPA documents such as internal reports, fact sheets, and Federal Register notices on five pesticides--daminozide, EDB, alachlor, chlorothalonil, and captan. The first four pesticides which were suggested by OPP officials as examples of where EPA separately estimated subgroups' cancer risks. We selected captan as a recent example where EPA based its cancer risk estimate on average exposure to the U.S. population. We reviewed documents pertaining to the "Children's Dietary Exposure to Pesticides Study" being conducted for EPA by the National Academy of Sciences. We also interviewed National Academy of Sciences/National Research Council officials of the Board on Environmental Studies and Toxicology and the Board on Agriculture. We reviewed the recent National Resources Defense Council (NRDC) report, "Intolerable Risk: Pesticides in our Children's Food," and interviewed an NRDC official. We were unable to independently determine and review all cases in which EPA considered population subgroup data. Therefore, our review did not address the number of cases in which subgroups had exposure high enough to be of concern nor how EPA resolved all subgroup questions. Instead, we looked at the individual cases mentioned above and at EPA's general practices.

ATTACHMENT I

To obtain information concerning anticipated residue data, we obtained and analyzed a listing detailing pesticides for which anticipated residue data were used, reasons for using the data, and types of anticipated residue data used for each pesticide. We also reviewed documents pertaining to the advantages and disadvantages of the various types of anticipated residue data, such as reports prepared by consultants to EPA and internal memos. We reviewed program and budget documents pertaining to proposed anticipated residue projects. Our work on anticipated residue data addressed only residues in plant commodities; we did not address residues in meat, milk, poultry, and eggs. Also in looking at the advantages and disadvantages of anticipated residue data, we gathered opinions from EPA officials and internal EPA studies, as agreed with the Chairman's office.

To obtain preliminary information on the USDA food consumption survey, we interviewed USDA officials in the Human Nutrition Information Services as well as an EPA official in the Science Analysis and Coordination Branch of the Health Effects Division. We reviewed USDA documents pertaining to the survey's design and methodology. We also reviewed TAS program files for documents pertaining to EPA's input on the survey's design and interviewed former TAS staff about their input. As we previously stated, our work on this issue is incomplete because the USDA survey data has not been finalized.

We performed our review from November 1988, through April 1989.

POLICY NEEDED CONCERNING POPULATION SUBGROUPS

EPA's Office of Pesticide Programs (OPP) does not have a policy concerning how population subgroups are to be addressed in its decisions to establish or deny new tolerances and to continue or change existing tolerances. Instead, concerns about potential risks to population subgroups are resolved on a case-by-case basis, as they arise on specific pesticides. According to OPP officials, information on subgroups provided by TAS is always considered by the Health Effects Division. Infants and young children most often have the highest exposure estimates because they consume more food in relation to their body weight than do adults. However, OPP has not decided whether, or in what situations, regulatory decisions should be based on the subgroup(s) with the highest exposure or particular risk concerns, such as birth defects.

The Process for Considering Population Subgroups

EPA's process for considering population subgroups involves using TAS to generate dietary exposure estimates, and then reaching a decision on establishing a tolerance for a particular pesticide use through internal OPP discussions. The TAS staff, after performing a computerized analysis, summarize their exposure analysis in a cover memorandum, and attach detailed computer printouts addressing all 22 subgroups. The cover memorandum usually includes estimates of average exposure for the U.S. population and the two most highly exposed subgroups. TAS reports, along with toxicity and residue chemistry assessments, are the inputs OPP's Health Effects Division provides to OPP's Registration Division for decisions on proposed tolerances.

This information is forwarded to product managers in the Registration Division, who then propose a tolerance decision. Proposed decision documents are circulated for comment to the Health Effects Division and certain other EPA staff. This input, including any consideration of population subgroups, is used by the Registration Division and OPP Director in making decisions on tolerances.

EPA's process for assessing pesticides that can cause birth defects (teratogens) is somewhat different because this health effect is relevant only to certain subgroups--women of child-bearing age. As teratogenic effects to a fetus occur as a result of a mother's exposure during pregnancy, women of child-bearing age are the only subgroup relevant to the effect. The overall U.S. population average is not an appropriate exposure estimate for teratogenic effects, nor are male or children subgroups relevant. TAS analyses and reports for teratogens thus address the subgroups of women 13 years of age and older. (This is done by combining the TAS subgroups: females 13 to 19 years old, females 20 years and older, pregnant females, and nursing females.) However, no written policy exists for considering subgroups for teratogenic effects.

Subgroups' Cancer Risk Is
Usually Not Separately Estimated

The Health Effects Division generally estimates cancer risk only for the overall U.S. population, except in limited cases. As a result, specific information on population subgroups' cancer risk is not generally available to those responsible for making decisions about tolerance proposals and reassessments of existing tolerances. Instead, cancer risk estimates for the overall U.S.

population, which reflect exposure and food consumption patterns from infancy through adulthood, have been provided to decision makers. Separate cancer risk estimates for age subgroups, such as infants and children, have been considered in regulatory decisions for only three carcinogenic pesticides.

EPA's review of captan illustrates the difference between the information available regarding cancer risk and other health risks. Captan was assessed for its potential to cause cancer and reproductive effects. While EPA's decision about captan's reproductive effects specifically addressed the most highly exposed subgroup as well as the overall U.S. population, its decision about captan's cancer risks was based on averages for the overall U.S. population--averages which included all age subgroups. Captan is a fungicide used on a variety of fruits and vegetables. In February 1989, EPA completed its special review[1] of captan, canceling over 40 of its food uses and retaining 24 food uses, in order to reduce cancer risk to a level that EPA considered to be outweighed by captan's benefits. EPA estimated that the average cancer risk from the 24 remaining food uses would be less than 1 in 1 million. EPA's cancer risk estimates reported in its Federal Register notice were based only on the overall U.S. population. In accordance with Health Effects Division policy, TAS reports on captan estimated cancer risk for the overall U.S. population only. According to captan exposure estimates in detailed TAS print-outs, the two most highly exposed subgroups are nonnursing infants under 1 year of age and children aged 1 to 6. Estimated captan exposure for nonnursing infants was about three times greater than the U.S.

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[1]EPA may conduct a detailed risk/benefit analysis known as a special review when it is considering evidence of possible adverse effects.

population average, and estimated exposure for children 1 to 6 was about two times greater than the U.S. population average.

In contrast, to assess reproductive effects from captan's use, EPA did specifically consider risk to the most highly exposed subgroup as well as the overall U.S. population. Dietary exposure for nonnursing infants was calculated to be 4.1 percent of the intake level considered acceptable for reproductive effects, while dietary exposure for the overall U.S. population was estimated to be 1.25 percent of the acceptable level. These exposure levels were well below the acceptable daily intake level, and reproductive effects were thus not considered to be of concern even to the most highly exposed subgroup.

OPP officials stated a number of reasons for not developing separate cancer risk estimates for age subgroups. To begin with, cancer studies involve dosing animals with a pesticide over most of their lifetime. Therefore, the design of such studies makes it inappropriate to compare their results with age subgroups; because young animals eat more in relation to their body weight, as do young humans, the cancer studies roughly reflect human eating patterns. TAS exposure estimates for the U.S. population on average are the closest approximation to lifetime exposure, as all age groups are included in the average. TAS estimates for the U.S. population thus reflect the food preferences, and amount of food consumed in relation to body weight, of each age subgroup. Further, many conservative assumptions are made in extrapolating human risk from animal studies. OPP officials believe that these conservative assumptions are sufficient, and that using highly exposed subgroups as a basis of assessments would overstate cancer risk. An additional reason is that cancer risk estimates are rough estimates, because they are based on animal studies. Therefore, an

exposure 2 to 3 times the average is not considered that significant in assessing cancer risk, which deals basically in 10-fold differences in risk estimates. Finally, there is some uncertainty as to how to assess cancer risk from a short period of high exposure, such as children may experience; the cancer models EPA now uses assume lifetime (70 years) exposure.

A March 1986 internal EPA paper discussed the arguments over consideration of children in cancer risk assessment. The paper cited some of the arguments just mentioned as reasons against considering cancer risk to children. As arguments in favor of considering cancer risk to children, the paper discussed possible sensitivity to carcinogenic effects, noting that: (1) a sufficient amount of epidemiological evidence exists to indicate that children may be susceptible to environmentally induced cancer, including studies suggesting that pesticide exposures correlate with statistically unusual clusters of childhood cancer, and (2) evidence exists for several nonpesticidal chemicals that events occurring early in life may predispose an individual to cancer as an adult. The paper recommended that regulatory decisions be based on the relevant subgroups with the highest exposure, but did not specifically mention cancer risk assessment in this recommendation. According to OPP officials, data concerning children's susceptibility to carcinogenic effects is limited and conflicting, and EPA has asked the National Academy of Sciences to address this issue in its current study.

In exceptions to OPP's usual practice, cancer risks to young children and infants have influenced regulatory decisions in three cases. The three pesticides were EDB (ethylene dibromide), alachlor, and daminozide. In these three cases, EPA had data from animal studies showing cancer risk to young animals from a short

period of exposure. The carcinogenicity studies routinely required by EPA involve exposing animals to the residue over most of their lifetime, and do not specifically study risk to young animals. For EDB, alachlor, and daminozide, EPA had data other than that routinely required, which indicated that animals developed tumors during their youth.

For daminozide, EPA assessed cancer risks to infants because their dietary exposure was much higher than adults' exposure, because animal data indicated tumor development in young animals, and because EPA was considering whether to allow daminozide to remain on the market during the time period needed for cancellation proceedings (estimated to take a year and a half). Daminozide is used on apples, and infants and children consume greater quantities of apples and apple products, such as juice and applesauce. While exposure of infants and young children to pesticide residues is often 2 to 3 times greater than the average exposure for the U.S. population, infants' exposure was more than 9 times (9.4 times) greater than the U.S. population average exposure for daminozide. EPA's usual method for calculating cancer risk assumes 70 years of exposure. EPA usually calculates cancer risk by multiplying the average exposure estimate for the U.S. population times the cancer potency factor. For daminozide,[2] EPA calculated risks to nonnursing infants by dividing infants' daily exposure by 70 (to compensate for the usual assumption of 70-year lifetime exposure), multiplying by the time period for which that level of exposure was expected to continue (a year and a half), and then multiplying the resulting exposure factor by the cancer potency factor.

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[2]Cancer risk results from a breakdown product of daminozide known as UDMH, unsymmetrical dimethylhydrazine.

ATTACHMENT II

EPA did separately estimate cancer risks to infants and/or young children for three pesticides, and we believe a similar assessment for highly exposed subgroups could be done for other pesticides. OPP officials indicated that cancer risk estimates are uncertain enough that they generally deal in 10-fold differences. While we would not dispute OPP's decision from a scientific basis, public policy considerations may warrant separately estimating and considering cancer risk for highly exposed population subgroups. Cancer risk estimates can easily be generated from existing information, using TAS estimates of subgroups' exposure to pesticide residues. If the relevance of subgroup risk estimates needed further clarification, Health Effects Division scientists could provide such explanations for OPP decision makers and the public. There is deep-seated public concern over exposure to carcinogens and seems to be skepticism about EPA's current regulation of carcinogenic pesticides. For instance, organic food stores reported increased sales and new customers following recent publicity about legal uses of carcinogenic pesticides on food, according to major news magazines. Much public concern centered around infants and children and their exposure to potentially carcinogenic pesticide residues, such as daminozide residues in apple juice and other apple products. If EPA were to calculate cancer risk for highly exposed population subgroups, consider this information in reaching tolerance decisions, and provide this information to the public through tolerance rule-making, public fears might be allayed and EPA's credibility enhanced.

Need for a Policy

EPA has been aware for some time that it needs to establish a policy concerning population subgroups. We reported in 1986[3] that EPA planned to resolve certain issues, including how to use the capability to analyze exposure of population subgroups in reaching regulatory decisions, before fully implementing the TAS system. At that time, EPA officials told us that they in fact planned to establish such a policy.

Further, an internal EPA paper dated March 1986 recommended that, among the subgroups relevant to toxicity data, the subgroups with the highest exposure should be used as the basis for regulatory decisions. In most cases, according the document, the subgroups selected for decisions would be infants and children, except for decisions concerning birth defect and reproductive effects which may be relevant only to certain subgroups. These recommendations, however, have not been adopted as policy. According to OPP officials, OPP prefers to gain experience with individual cases before setting overall policy. While TAS had not yet been implemented in early 1986 when these recommendations were made, EPA has now had more than 2 years of experience in using TAS subgroup data to assess numerous pesticides. TAS has been used to assess about 185 pesticides, according to a TAS official.

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[3]Pesticides: EPA's Formidable Task to Assess and Regulate Their Risks (GAO/RCED-86-125, Apr. 18, 1986).

National Academy of Sciences
Study Concerning Children

EPA has contracted with the National Academy of Sciences/National Research Council (NAS) to study scientific and regulatory issues concerning pesticides in the diets of infants and children. Congress mandated the study in fiscal year 1988 appropriations legislation for EPA. It is expected to take 2 years and to be completed in the fall of 1990. To conduct the study, NAS gathered a panel of experts from various fields, including toxicology and environmental medicine. The NAS panel plans to study both exposure to pesticide residues and the toxicological significance of that exposure for infants and children. NAS tentatively plans to look at the following toxic effects: acute effects, carcinogenicity, growth impairment, nervous system development, immune system effects, and hormonal and reproductive effects. The study will also address the biological uniqueness of infants and children, which might affect their ability to deal with toxic chemicals. For instance, children's ability to metabolize (break down) chemicals in the body may differ from adults' metabolism. NAS plans to make recommendations concerning methods EPA should use to assess risks to infants and children and how to make tolerance decisions that are protective of these subgroups. However, EPA is under no obligation to accept NAS recommendations.

Conclusions

OPP officials responsible for deciding whether to establish tolerances are not receiving all available information about cancer risks, because the Health Effects Division generally does not provide cancer risk estimates for the most highly exposed subgroups. The recent heightened public concern over pesticide

residues in food in itself presents a compelling reason for calculating cancer risk to subgroups and providing this information to decision makers. The degree of concern was apparent in the recent public outcry over potential cancer risks to infants and children from eating food products containing daminozide-treated apples. We believe that EPA could strengthen the assurance it provides consumers that tolerances protect public health, if it were to develop cancer risk estimates for the most highly exposed population subgroups, consider this information in reaching regulatory decisions, and provide the information to the public through the tolerance rule-making process. We note that developing such risk estimates would not be resource-intensive, as they could readily be generated from existing data. We realize the Health Effects Division has a number of reasons for not routinely calculating cancer risks to age subgroups. If the Division therefore feels subgroup cancer risk estimates should be qualified or further explained, this information could also be reported to decision makers. Considering all available information on cancer risk in reaching tolerance decisions and providing information on subgroups' risk to the public could also increase EPA's credibility with the public concerning its regulatory decisions on carcinogenic pesticides.

In addition, we do not believe that EPA should wait for results of the NAS study before establishing a policy as to whether, and/or in what circumstances, tolerance decisions are to be based on the subgroup which is most highly exposed. This is especially important because the pace of reregistration and tolerance reassessment should accelerate over the next decade as required by the 1988 FIFRA amendments. Establishing a policy would help provide assurance that EPA's decisions about older food-

use pesticides protect public health, including the health of population subgroups such as infants and children.

Recommendations

We recommend that EPA calculate cancer risk for the most highly exposed subgroups, consider subgroups' risk in its decisions regarding carcinogenic pesticides, and report on the subgroups most at risk in its Federal Register notices for the establishment or change of a pesticide's tolerances. We also recommend that EPA proceed now to establish a policy concerning whether, and/or in what circumstances, tolerance decisions are to be based on the most highly exposed subgroup(s).

ATTACHMENT III

GUIDELINES NEEDED FOR ANTICIPATED RESIDUE DATA

When an exposure estimate based on tolerance-level residues exceeds the acceptable daily intake or other toxicity measure, EPA has a policy that anticipated residue data be used to obtain a more realistic exposure estimate. EPA, however, does not have guidelines for developing, assessing, and using anticipated residue data in its exposure assessments. Nevertheless, EPA has used such data to assess 41 pesticides over a two-year period. Although the agency has formed a work group to develop anticipated residue data guidelines, the guidelines are not expected to be completed until mid-1990 and may not address all the critical concerns EPA has about the data, such as using data that are inadequate and subject to change over time. Furthermore, as mentioned earlier in our testimony, the pace of reregistration and tolerance reassessment will probably accelerate as a result of the 1988 FIFRA amendments. EPA has already used anticipated residue data in interim reviews of 17 of the pesticides subject to tolerance reassessment, and it is likely EPA would use anticipated residue data for some of the other older pesticides as reassessment progresses. Because anticipated residue data are an integral part of the reassessment process, it is critical to develop comprehensive guidelines as soon as possible. Once comprehensive guidelines are available, case-by-case decisions made previously about data adequacy, and any regulatory decisions based on such data, would need to be reviewed in light of the guidelines' standards for using anticipated residue data.

How EPA Uses Anticipated
Residue Data

EPA has traditionally used tolerance levels in estimating dietary exposure because it assumed that using the tolerance as a maximum value provided a worst-case estimate of exposure. Assessments done in this manner assume that 100 percent of each crop on which a pesticide may be used is treated with the pesticide. They also assume the most strenuous conditions of pesticide use--that is, maximum number of pesticide applications allowed and application as close to harvest as allowed by the pesticide label. EPA's position is that while this approach represents a "useful sorting tool for determining regulatory priorities" (that is, this approach can indicate the possibility of health concerns needing further investigation), it cannot provide definitive answers concerning the risks actually associated with pesticide use on specific crops. While EPA sets tolerance levels high enough to cover the maximum residue level that could result from a pesticide's use as allowed by its label, consumers may experience less than the maximum allowable level. This is because a pesticide is not always applied as often or at the maximum rate allowed by its label, and pesticide residues may decrease due to food storage time and other factors.

If an exposure estimate based on tolerance-level residues yields an acceptable level of risk, EPA concludes that tolerances protect public health. OPP officials told us that they see little point in developing anticipated residue estimates if this worst-case estimate is acceptable. If, however, an assessment based on these conservative assumptions yields an exposure estimate which exceeds the acceptable daily intake or other toxicity measure, Dietary Exposure Branch staff revise exposure estimates using

anticipated residue data because they believe such data provide more realistic estimates of residue levels consumers encounter. In these cases, EPA uses one or more of the following types of data: percent-crop-treated data[1], processing and/or cooking data, field trial data, FDA monitoring data, and registrant monitoring data. EPA uses these data to estimate the residue levels consumers are more likely to encounter, but it does not necessarily lower the tolerance to reflect the lower anticipated residue estimates because the tolerance is an enforcement level for food "at the farm gate."

OPP's economic analysis staff generates percent-crop-treated estimates from pesticide usage surveys performed by others in both the public and private sectors. Registrants generate processing and cooking data by simulating actual processing and cooking conditions in the laboratory. Field trial data are routinely submitted to EPA by registrants as a requirement for registering pesticides. Once the registrant determines the rate and method of application during the trials, the residues on the crop are measured, and the results are submitted to EPA. Monitoring data are obtained from either FDA or registrant sampling at the retail level or at other points in the commercial life of a food.

The types of data used in assessing a particular pesticide and crop depend on the availability and adequacy of data. OPP's Dietary Exposure Branch assesses data adequacy on a case-by-case basis, using scientific judgement. According to a Branch official, EPA generally uses percent-crop-treated data first,

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[1]We are using the term, "anticipated residue data," to include percent-crop-treated data as well as the other types of data listed here.

because these data are readily available from EPA's economic analysis staff. Registrant monitoring data are least frequently used because the data are expensive and time-consuming to generate. In addition, all types of data are not necessarily used in each case. EPA will continue the assessment process using only that data necessary to demonstrate that the exposure estimate is at or below an acceptable daily intake level or other toxicity measures. For instance, if percent-crop-treated data showed that the exposure estimate did not exceed the acceptable daily intake level, EPA probably would not obtain and use additional data.

Extent of EPA's Use of Anticipated Residue Data

From January 1987 through January 1989, EPA used anticipated residue data to assess 41 pesticides, including 4 new pesticides, 11 special review pesticides, 17 older pesticides in the reregistration process, 6 pesticides for which new tolerance petitions had been submitted, and 5 for other reasons. (This totals more than 41 because some pesticides fell into more than one category.) The circumstances that triggered EPA's use of anticipated residue data for assessing these pesticides included: (1) exposure assuming tolerance-level residues exceeded the acceptable daily intake for chronic or long-term effects (in about 61 percent of the cases), (2) exposure assuming tolerance-level residues exceeded the reference dose for cancer (in about 56 percent of the cases), and (3) exposure assuming tolerance-level residues resulted in an unacceptable margin of safety for acute or short-term effects (in about 15 percent of the cases). (Percentages total more than 100 because many of the pesticides had more than one triggering circumstance.)

Of these 41 pesticides, about 90 percent were assessed using percent-crop-treated data, 49 percent using field trial data, 29 percent using processing data, 12 percent and 5 percent using FDA and registrant monitoring data, respectively, and 5 percent using cooking data. (Percentages total more than 100 because more than 1 data type was used for many of the pesticides.)

Although a few pesticides were assessed prior to 1987 using anticipated residue data, the 41 pesticides represent most of the cases using such data, according to the Acting Chief of the Dietary Exposure Branch. However, the statistics above represent a "snapshot in time" because EPA might require additional types of residue data on these 41 pesticides in the future and because additional pesticides may be assessed using anticipated residue data in the future.

Use of Anticipated Residue Data Lowers Exposure Estimates

According to OPP officials, EPA's use of anticipated residue data can result in reducing the exposure estimate and therefore the risk estimate for a pesticide. For example, in arriving at its final determination on the fungicide captan in 1989, EPA estimated the pesticide's total cancer risk to be at least 1 additional case for every 10,000 persons, assuming tolerance-level residues and 100 percent of crops treated. Using anticipated residue data, including either FDA monitoring or field trial data whenever these data were available for a particular crop, EPA estimated the cumulative cancer risk to be at least 1 additional case for every 1 million persons.

Although the risk for no individual crop was estimated to be greater than 1 in 1 million, EPA cancelled the registered uses of captan on over 40 plant commodities because these uses provided no clear indication of benefits. It retained 24 uses, because each posed an estimated cancer risk of less than 1 in 1 million while providing a clear indication of benefits, and it proposed to reduce tolerance levels for 6 uses to reflect lower residues from revised label application rates.

Advantages and Disadvantages
of Using Anticipated Residue Data

In attempting to provide more realistic residue estimates for assessing exposure, EPA, according to a Dietary Exposure Branch official, is aware of two major problems: (1) the data necessary are not always available, and (2) available data are often incapable of supporting precise residue estimates. Concerning availability, EPA appears to have little, if any, control over obtaining relevant, useful pesticide usage and monitoring data from sources other than registrants, such as FDA, USDA, and state pesticide agencies. The disadvantages EPA has associated with the various types of anticipated residue data together with the advantages of these data are discussed below.

Percent-Crop-Treated Data

The pesticide usage data EPA uses to generate percent-crop-treated estimates are drawn from whatever sources may be available. These include commercial proprietary data services, published state surveys, reports prepared by registrants, submissions from USDA, and informal telephone or personal contacts with cooperative extension personnel.

Because publicly available information is generally old and limited in score, EPA uses commercial, proprietary data bases which have two major problems, according to the chief of OPP's Economic Analysis Branch. First, the commercial data bases cover primarily major (largest acreage) crops such as wheat, corn, cotton, and soybeans. EPA considers data on major crops to be quite reliable. However, minor crops, which include many of the fruits and vegetables that are commonly consumed and heavily treated with pesticides have less reliable or no data. Second, these data bases are proprietary, so EPA cannot cite them without the data suppliers' permission in hearings or in court to support its estimates and cannot allow public access to the data.

Another disadvantage is that the data may not be up-to-date and thus may not reflect current pesticide usage. According to the Branch Chief, under an agreement with EPA, USDA has responsibility for developing national data on agricultural pesticide usage, while EPA has responsibility for developing data on nonagricultural (e.g., household, garden, industrial) pesticide uses. An OPP economist told us that, due to budgetary constraints, USDA has not funded a national pesticide usage survey since 1982, so available USDA data are old.

In addition, pesticide usage can change over time. Percent-crop-treated data are, in effect, current-years estimates. Factors contributing to changes in pesticide usage include agricultural economics and crop prices, cancellation of alternative pesticides, introduction of more cost-effective alternatives, pest resistance, and new strains of crops which may be more or less resistant to pests. For example, OPP economists told us that as a result of introducing a new strain of rice vulnerable to fungal diseases but

resistant to fungicides, fungicide use on rice increased from about 20 to almost 100 percent. The point is that this type of situation cannot be predicted. This official also pointed out that tolerances are in force for a long period of time and are not necessarily changed if the percent-of-crop-treated estimate changes.

The Economic Analysis Branch Chief told us that, in terms of advantages, percent-crop-treated data provide more realistic estimates than the tolerances because most pesticides are used on not more than 20 to 30 percent of a crop. These officials estimated actual usage of many widely-used pesticides to range from about 5 to 15 percent.

Processing and Cooking Data

The major disadvantage associated with these data is that processing and cooking procedures vary; the procedures are not sufficiently uniform either in time or across commercial processors throughout the country to allow for a set of standard procedures that can be used to simulate actual processing and cooking conditions in the laboratory. As an example of procedures varying in time, a Dietary Exposure Branch official told us that whereas some juice is now sterilized in pipes at high temperatures and short periods of time prior to packaging in sterilized containers, in the past, juice was sterilized in glass containers at low temperatures but for long periods of time. Changing the length of time the juice is sterilized could change the residue levels.

According to an OPP official, the major advantage of these data is that it is relatively easy to determine the percentage of reduction (or increase) in a given residue level after a commodity

has been commercially processed or cooked. Essentially, it requires a simple comparison of the before-and-after residue levels.

Field Trial Data

The major disadvantage associated with field trial data, according to a Dietary Exposure Branch official, is that statistical analysis (i.e., calculating an average or 95th percentile residue value) may be difficult if there are a limited number of samples and/or the data available are inadequate by current standards. Another disadvantage cited by this official is that field trial data tend to provide conservative estimates of dietary exposure because these data reflect residues in food at the farm gate, and not residues in food as consumed.

In terms of advantages, field trial data are usually available for pesticides with pending or established tolerances, since registrants are required by EPA regulations (40 CFR 158.240) to provide these data when registering agricultural pesticides.

FDA Monitoring Data

According to a Dietary Exposure Branch official, EPA uses FDA surveillance monitoring data when available, rather than field trial data, because it believes the FDA data are based on a larger number of samples and represent a larger number of geographic areas.

The major disadvantages that EPA associates with FDA monitoring data are listed below.

-- The data are not available for all pesticides and commodities of concern to EPA and may be based on too few samples to be useful for calculating average or 95th percentile residues.

-- The data are available for a given pesticide only after it has been approved. No data are available for new pesticides or new uses of old pesticides.

-- FDA's monitoring studies do not currently determine the treatment history of commodities which are sampled. Thus the results do not establish the source of the detected residues.

Registrant Monitoring Data

According to a Dietary Exposure Branch official, if properly designed and conducted, registrants' monitoring studies can provide the best data to predict anticipated residues.

The major disadvantages cited by this official concerning registrants' monitoring data are that (1) they require a large expenditure of registrants' resources (e.g., $100 to $200 per sample per commodity with sampling over four seasons); (2) the time required may be too long to be useful for regulatory decision making that has a short time frame, and (3) the surveys must be sensitive to significant changes in pesticide usage.

EPA Plans to Develop Guidelines

At present, EPA has no guidelines or regulations for developing anticipated residue data or using such data for

estimating dietary exposure. For example, EPA currently has no standard procedures for registrants carrying out processing, cooking, and monitoring studies needed to develop anticipated residue data. Consequently, many of the disadvantages EPA has associated with the various types of anticipated residue data, including the problems of evaluating and using data that are inadequate and subject to change over time, have not been resolved. A Dietary Exposure Branch official believes guidance is needed in these areas so that registrant studies on actual residues will have real-world relevance. For the same reason, specific guidance is also needed on the content and format for these data. Proper data formatting can also save scarce agency resources, according to these officials.

Although work on these guidelines has been proposed since at least 1986--in an effort to have them in place before TAS became fully operational--EPA did not begin extensive work on guidelines until March 1989. Several projects to begin developing guidelines were proposed earlier, but EPA did not fully fund them because of competing budgetary priorities.

In March 1989, EPA formed a work group of agency staff to oversee guidance development. The work group plans to obtain contractor assistance with the guidelines and expects that the contractor can complete its work by the end of calendar year 1989. According to a co-chairman of the work group, the contractor's report should provide information needed for guidelines for both performing residue studies and using anticipated residue data. The contractor is to provide statistical advice concerning assessing the suitability of different types of anticipated residue data. Because EPA's work is in its initial stages, it is unclear whether and how EPA intends to address nonstatistical issues about using

anticipated residue data and issues concerning percent-crop-treated data. According to the co-chairman of the work group, it would be about mid-1990 when EPA would finalize its guidelines and make them available to registrants.

Conclusions

We are encouraged that EPA has taken positive steps in the past two months with regard to developing guidelines for anticipating residue data. However, we have some concerns about how comprehensive the guidelines will be, how quickly they will be developed, and whether EPA would use the guidelines to review regulatory decisions made in the interim which were based on anticipated residue data.

Although EPA is aware of the disadvantages of anticipated residue data, we are uncertain that EPA's planned guidelines will be as comprehensive as we believe they need to be. For example, one disadvantage of both percent-crop-treated data and processing data is that these factors change over time. To the extent that monitoring studies reflect the percentage of a crop treated and processing techniques, monitoring studies done at different periods of time would provide differing results. Although anticipated residue data used in risk assessments can change over time, tolerances are not necessarily changed when the percentage of a crop treated, for instance, changes. EPA's guidance for using anticipated residue data should address this issue, as well as other disadvantages associated with each type of anticipated residue data.

We believe comprehensive guidelines should be developed as quickly as possible in light of the 1988 amendments to FIFRA, which

should increase the pace of tolerance reassessment since this act requires reregistration to be completed in about 9 years. Older chemicals with extensive agricultural uses may have potential exposure concerns, if one assumes tolerance-level residues. It is therefore likely that anticipated residue data would be used for a number of the food-use pesticides undergoing reregistration and tolerance reassessment, and such data have already been used in interim assessments of 17 older pesticides.

Although EPA staff currently review the adequacy of anticipated residue studies on a case-by-case basis, they do not have a set of standards against which to measure the studies because there are no guidelines. In light of the disadvantages associated with the data and the current absence of standards, we believe EPA will need to re-evaluate the adequacy of anticipated residue data which were used before the development of guidelines and review regulatory decisions based on such data.

Recommendations

We recommend that EPA establish guidelines as soon as possible concerning the development and use of anticipated residue information to estimate exposure. We recommend that the guidelines for using anticipated residue data to estimate exposure also address the disadvantages of each type of data. In addition, we recommend that, once the agency develops guidelines, EPA re-evaluate any regulatory decisions it has made in the interim which were based on anticipated residue data.

EPA'S PLANS TO UPDATE TAS

EPA plans to update TAS with results of the 1987-88 USDA nationwide survey of food consumption, in order to reflect Americans' current eating habits. EPA budgeted $123,000 in fiscal year 1989 for entering updated data into TAS. USDA performs nationwide surveys every 10 years, and the prior survey was the basis of the food consumption data TAS currently uses. USDA has completed administering questionnaires for the 1987-88 survey and is currently compiling the data. The survey data are to be provided to EPA after USDA compiles and checks it.

The 1987-88 nationwide survey of food consumption sampled less than half the number of people sampled in the prior nationwide survey. Exact numbers of households and individuals completing the survey will not be available until survey results are compiled, but USDA officials provided rough estimates. The 1987-88 survey included approximately 11,000 to 12,000 people. In contrast, TAS includes data on 30,770 people from the 1977-78 USDA survey. According to USDA officials, the Department decided on a smaller sample for budgetary reasons.

USDA did inform EPA TAS officials of the expected sample size. According to a former TAS official, an EPA contractor with statistical expertise was asked if the smaller sample would present a problem for TAS. The contractor responded that certain subgroups having a smaller number of people sampled might need to be combined, but that the sample size should not be a major problem. Accordingly, TAS officials did not comment to USDA on this issue.

We plan to evaluate to what extent the smaller sample size affects the precision of the subgroup data used in TAS. For

instance, infants under 1 year of age were one of the smaller subgroups in the 1977-78 survey. TAS includes a sample of 566 infants in total from the prior survey, and further breaks this sample down into nursing and nonnursing infants, with samples of 109 and 457, respectively.

We also plan to evaluate whether EPA could use other USDA food consumption surveys in combination with the 1987-88 nationwide survey, in order to provide larger numbers for TAS subgroups. For example, in 1986-87, USDA surveyed food consumption among children 1 to 5 years old and their mothers, and it might be possible to use statistical analysis to combine this survey with the nationwide survey.

We have not completed our work concerning the effects of the reduced sample size on TAS and possible additional sources of data. We will proceed with this work after USDA compiles the nationwide survey results and will report to the Subcommittee at a later date.

EPA'S REQUIREMENTS FOR TOXICOLOGY AND RESIDUE CHEMISTRY DATA

Tests required for agricultural pesticide uses are specified in EPA regulations (40 CFR 158). Studies are performed by those petitioning for tolerances, under EPA guidelines and review. Toxicology studies of animals and microorganisms are used to assess a pesticide's possible toxicity to humans. Health effects for which EPA requires testing include birth defects, effects on the reproductive system, cancer and other chronic effects, and illnesses related to short-term (acute) exposure. The toxicology data EPA routinely requires registrants to submit for agricultural pesticide uses are listed in table V.1.

Table V.1: Toxicology Data Requirements

Type of data	Purpose of data
Acute oral exposure	To identify health hazards likely to rise from short-term exposure.
Subchronic feeding studies (90 days)	To identify health hazards that may result from repeated exposures over a limited time.
Chronic feeding studies	To determine effects from prolonged and repeated exposure, in order to detect effects which have a long latency or are cumulative.
Oncogenicity studies	To determine potential of the pesticide to cause benign or malignant tumors, by observing animals over most of their life span for tumor development.
Teratogenicity studies	To determine potential of the pesticide to induce abnormalities in a fetus (birth defects) as a result of the mother's exposure during pregnancy.

2-generation reproduction studies	To identify effects on reproductive systems and functions, such as gonadal function, mating behavior, conception, and lactation.
Mutagenicity studies	To assess potential of the pesticide to affect the mammalian cell's genetic components.
Metabolism studies	To determine behavior of the pesticide in the body--its absorption, distribution, metabolism, and excretion.

EPA requires those petitioning for a tolerance to submit the residue chemistry data listed in table V.2. EPA may require several types of studies to determine the magnitude of residues resulting from a pesticide's usage. Crop field trials are required for all food uses. In crop field trials, test plots of the crop in various geographic areas are treated in a manner corresponding to proposed uses of the pesticide, and resulting residues are measured. Locations of field trials are to reflect all the principal growing regions of the crop, including an arid region where residues are likely to be high. Tests for residues in meat, milk, poultry and eggs are required when pesticide residues occur in livestock feed. If residues could concentrate from processing, data on residues in processed food and feed are required. Other data may be required in certain circumstances to more precisely estimate residues experienced by consumers.

ATTACHMENT V

Table V.2: Residue Chemistry Data Requirements

Type of data	Purpose of data
Nature and magnitude of the residue	Chemical identity and amount of residue, to determine what residue and how much residue may remain in or on food.
Residue analytical method	Adequate method(s) for analyzing amount of residue, for use in tolerance enforcement.
Proposed tolerance	Level petitioner proposes as tolerance, which must reflect the maximum residue likely to occur from the proposed use.
Directions for use of product	Information on the amount, frequency, and time of pesticide application to ensure that tests reflect intended pesticide use practices.