HEALTH HAZARD EVALUATION REPORT 72-46-29

HAZARD EVALUATION SERVICES BRANCH

DIVISION OF TECHNICAL SERVICES

Establishments	:	Sleepy Hollow Corporation Goshen, New York
	:	Gurda Farms Goshen, New York
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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

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SLEEPY HOLLOW CORPORATION
GURDA FARMS
GOSHEN, NEW YORK

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I. SUMMARY DETERMINATION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received two similar requests from employers of the Sleepy Hollow Corporation, Goshen, New York, and the Gurda Farms, Goshen, New York, to evaluate the possible health hazard for migrant farmers from exposure to organic phosphate insecticides.

Parathion is the most commonly used insecticide (70%), followed by Diazinon (20%). The remaining 10% of insecticides include many carbamates which have biologic activity similar to Parathion and Diazinon. Each field is sprayed weekly by airplane by a small number of people, usually members of the owners' family or local residents. Re-entry period into sprayed fields is no less than three days.

A study was conducted in July 1972 to evaluate the possible health hazard associated with worker exposure to anti-cholinesterase (anti-ChE) insecticides, i.e., the organo-phosphate compounds. Seventy-nine workers in a low risk group (field workers and packers) and five workers (mixers and sprayers) in high risk group were studied. Thirty controls (people who had no exposure to insecticides) were also studied for comparative purposes. A follow-up study in September 1972 involving 75 subjects in high and low risk groups was also performed to evaluate the effect of eight additional weeks of insecticide exposure on the ChE levels.

A medical questionnaire, which included an occupational history, questions concerning symptoms of anti-ChE compound exposure, and work habits was administered to each participant. In addition, a blood sample was obtained for ChE determination.

Since no pre-exposure ChE levels were available, July and September ChE individual worker results were compared with the mean of a control population. Any value which varied below 33% (for plasma ChE) and 20% (for red blood cell ChE) of the control mean was defined as indicating probable exposure and absorption of anti-ChE compounds.

Evaluation of the statistical results of comparison of all group means in the July study did not reveal any group which had significantly different ChE levels. Furthermore, the field workers means in July and September did not differ significantly from each other or the control.

Evaluation of individual worker ChE levels in July revealed that 10% of the low risk group and 20% (one of five) of the high risk group had ChE levels indicating probable absorption of organo phosphorus insecticides. In September, 16% of the low risk population and all of the high risk group had levels indicating probable absorption. Evaluation of symptoms was not revealing. There was no significant correlation between symptoms and abnormal ChE levels.

Recognizing the low risk and the unlikely possibility of acute heavy dose exposure to anti-ChE compounds to field workers and packers, it is concluded that despite the indications of some individual minimal absorption, there is no significant health hazard to field workers and packers from exposure to anti-ChE compounds.

However, because the potential for acute, heavy dose exposure to mixers and sprayers is well known and is further documented by cases of acute intoxication occurring in the Pine Island area, it is our conclusion that a significant hazard could exist to these workers assuming they are not educated in the proper handling of these insecticides.

Eleven cases of skin disease consistent with celery dermatitis were discovered. Treatment for this phytophotodermatitis is mentioned.

Recommendations are made to monitor all personnel directly involved with concentrated anti-ChE insecticides by pre-exposure and exposure ChE determinations. No ChE program is considered necessary for other workers. However, it is noted that it would be of interest to obtain pre-exposure ChE levels and one ChE level a few weeks after the beginning of the 1973 season on those migrant workers who had "abnormal" ChE levels in the September study. This monitoring would give a more exact indication of their normal ChE levels and their degree of exposure after some weeks of field work. It is recommended that all workers be educated as to the signs and symptoms of insecticide poisoning and the safe handling of insecticides and that they wear protective clothing, and practice good personal hygiene. These recommendations are especially significant for mixers and sprayers.

Copies of this Summary Determination as well as the Full Report of the evaluation are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th & Walnut Streets, Cincinnati, Ohio 45202. Copies of both have been sent to:

a) Sleepy Hollow Corporation, Goshen, New York
b) Gurda Farms, Goshen, New York
c) U.S. Department of Labor - Region II

For purposes of informing the approximately 300 "affected employees" who are in the job classifications of field workers, packers, mixers, and sprayers, the employer will promptly "post" the Summary Determination in a prominent place(s) near where affected employees work for a period of 30 calendar days.

II. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such requests

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Both farms employ migrant farm workers in growing their major crops of celery and lettuce. Organic phosphate and carbamate insecticides, both with similar biologic activity, are the main types of insecticides used.

The most commonly used insecticide is Parathion (70%); Diazinon is used about 20% of the time, and the carbamate group of insecticide makes up a majority of the remaining 10% of compounds.

III. BACKGROUND HAZARD INFORMATION

A. Introductory Discussion

Both Quinby and Gage considered the most important route of absorption of insecticides in an agricultural setting to be the skin. Obviously the greater the body area exposed, and the greater the concentration to which one is exposed the greater the risk of over-exposure. Many cases of insecticide poisoning have been associated with mixing or spraying where whole body exposure to high concentration over a short period of time occurs (Gage). Other cases are reported in workers spraying trees or high vines, where whole body exposure to leaves or mist is a good possibility (Quinby). The field workers in Pine Island have considerable less risk. They are largely exposed to low growing crops (celery and lettuce)

resulting in hand, arm and leg exposure. Protection is easily provided by the use of gloves, long sleeved shirts, and long trousers. To further reinforce the relatively small risk to field workers at Pine Island only five cases of poisoning over the past five years have been reported. The first two were from careless handling of concentrated solutions of pesticides. The third case occurred on one of the evenings of our July study when a mixer reported to the Migrant Clinic with a classic history and the signs and symptoms of anti-ChE exposure. He responded well to the specific treatment with atropine. His case history along with blood test results appears in the appendix, but in light of such grossly abnormal symptoms and blood results he was not considered in the compilation of the other data. A fourth case of over-exposure occurring in the summer of 1971 was discovered when a sprayer being interviewed during our study admitted to classic symptoms of anti-ChE poisoning a few hours after saturating his clothes with insecticide. The fifth case occurred in mid August 1972, when a new mixer presented with suspicious symptoms to the Migrant Clinic. Although no ChE levels are available, it is understood that they were extremely low.

B. Standard

The health standard for inhalation of parathion in air is 0.1 mg/m^3. (Code of Federal Regulations) This standard is apparently based on two studies (Brown, 1950; Kay, 1952). Our study relies primarily on the basic test which Brown, Kay and other authors have used to study the effect of exposure to organic phosphate and carbamate insecticides, namely, the activity of the enzyme cholinesterase (ChE).

Diazinon is noted to be somewhat less toxic than parathion, in most instances (Documentation of Threshold Limit Values). However, the same threshold limit value was established for it as for parathion.

C. Toxic Effects

The Organophosphate and Carbamate Insecticides: (Koelle, 1965, Barnes, 1951).

Both the organophosphates and carbamates have the same basic biologic activity for men and insects, i.e., inhibition of the enzyme cholinesterase. This enzyme prevents the accumulation of acetylcholine, a substance normally found at certain nerve endings in the body. Almost all signs and symptoms of absorption of organophosphate or carbamate insecticides can be attributed to the accumulation of excessive amounts of acetylcholine at certain nerve endings.

In severe, acute poisoning, the diagnosis is readily made by the history of exposure, and typical signs and symptoms. However, in suspected cases of milder intoxication, a questionable history is usually obtained, and symptoms are less specific or obvious. Determination of plasma and red blood cell cholinesterase activity in these cases can be diagnostic since the values, although showing considerable variation in the normal population, are usually depressed well below normal before any manifestations of systemic poisoning are evident. It should be noted that although the plasma or RBC ChE activity values are of importance, "they do not reflect with any accuracy the levels of the corresponding enzymes in the tissues, the depression of which is the basis of the toxic effects" (Koelle, 1965).

In general, the organo-phosphorus insecticides are readily absorbed via the GI tract, the lungs, and the skin. After local exposure to vapors or aerosols or after their inhalation, ocular and respiratory effects generally appear first. Marked constriction of the pupils, injection of the conjuntiva and ciliary muscle spasm may occur. Respiratory effects include a tight feeling in the chest and wheezing respiration, due to a combination of bronchoconstriction and increased bronchial secretions. Gastro-intestinal symptoms include loss of appetite, nausea, vomiting, diarrhea and abdominal cramps. Local application to the skin may result in localized sweating and muscle fasiculations.

The symptoms of weakness or easy fatigability are related to effects on the ChE at neuromuscular junctions. The central nervous system (CNS) effects are varied, but usually present excitation, followed by inhibition actions at various levels of the CNS. Symptoms and signs such as dizziness, incoordination, slurred speech, coma, loss of reflexes, irregular breathing and convulsion are the result of such abnormal CNS activity. The cause of death is primarily respiratory failure.

IV. HEALTH HAZARD EVALUATION

A. Initial Visit - Observational Survey

On June 29 and 30, 1972, in response to the health hazard evaluation request of , a NIOSH team composed of Steven K. Shama, M.D., Mr. Paul Caplan, Deputy Director of the Division of Technical Services and Mr. Henry Ramos, Industrial Hygienist visited the Pine Island area. We met with , Project Director of the Migrant Labor and Family Clinic of Orange County; , Medical Consultant, Region II, Community Health Services, HSMHA, DHEW; , Cooperative Extension Agent for Orange County, Agricultural Division and , Head Nurse at the Migrant Clinic. The meeting was held at the Migrant Clinic.

It was learned that the request was made in an attempt to evaluate the allegations made by the members of the Mid-Hudson Valley Legal Services (a group within OEO) that sixty (60) percent of the migrant farmers were being poisoned by insecticides used in the Pine Island fields. Since there were only two cases of insecticide poisoning reported (Umhey) in the Pine Island area over the past five years and both resulted from apparent extreme carelessness in the use of insecticides, both employers wished clarification of the risk to their employees from exposure to the most commonly used insecticides as routinely used on these farms.

Approximately 200-250 migrant workers are employed on each farm. The migrants come from various areas of the country, but primarily Florida and Texas. Many come from similar crop work in other areas and may have previously been exposed to similar insecticides. The migrant population is composed mainly of Blacks and Mexican Americans. They arrive in Pine Island during the months of April, May and June and stay through the harvest season of August and mid-September. The great majority work as field hands who help plant, prune and weed the major crops of lettuce and celery. Their contact with insecticides is judged to be primarily that of skin contact with the short, low lying plants. They are not involved in the mixing or spraying of insecticides, these jobs being performed by a small number of people, either the owners' family members or local residents. Most spraying of insecticides is done by airplane or less commonly by tractor rigs. Spraying is done weekly and the re-entry period is no less than three days. Parathion is the most commonly used insecticide (70%) with an application rate of 1/3 pint per acre; followed by Diazinon (20%) with an application rate of 1/5 pint per acre. Both are organo-phosphate compounds. The remaining 10% of compounds include many carbamates (5%) examples of which are Sevin, Granular Fegadex, Thiodan (1 lb. per acre) and Sprayable Carbaryl Insecticide and fungicides e.g. Dithan M-22.

On the second day we toured many of the fields and observed field workers and aerial spraying. We concluded our visit by agreeing that a study would be initiated within a few weeks. The study group was to be a representative sample of the migrant worker population (all of whom could be considered to have similar exposure) who would be given medical and occupational questionnaires and donate a blood sample for cholinesterase (ChE) activity levels.

B. Follow-up Visits:

1. Second Visit

On July 13 and 14, Steven K. Shama, M.D. and Mr. Henry Ramos returned to Pine Island for the purpose of finalizing plans. We met with _____, Suffolk County Health Department and _____, Medical Director of the Migrant Clinic.

Mr. Ramos and Dr. Shama spoke with large numbers of migrants describing the study and asking for voluntary cooperation and participation. It was understood that individual results from this study would be regarded as confidential. It was also decided by NIOSH investigators that the study be performed near or at the workers homes to allow for the greatest participation.

The following points were agreed upon at the close of the second visit:

(a) The potential hazard to be evaluated was that of exposure to the organo-phosphate and carbamate insecticides since they represented 95% of the total insecticide used and therefore posed the greatest potential hazard to those who came in contact with them.

(b) The study would consist of eliciting symptoms associated with over exposure to anti-ChE insecticides, and an analysis of plasma and red blood cell (RBC) ChE activity.

2. Third Visit

On July 18 and 19, 114 people participated in the study involving questionnaires and blood testing. NIOSH participants were Dr. Steven Shama, Henry Ramos, and Richard Young.

3. Fourth Visit

A follow-up study was performed on September 6 and 7 by Dr. Phillip Polakoff and Dr. Steven Cohen, during which 75 persons donated blood ChE samples for group and individual comparison with the July results, in order to evaluate exposure during the July-September period.

C. Method

The July study involved 114 persons, 84 of whom had exposure to insecticides and 30 controls, with no known exposure. The control group consisted of nurses, social workers, and teachers. The exposed group was divided into three sub-groups: field workers, with an assumed low risk of high dose exposure; a miscellaneous group composed mostly of packers of crops, with similar assumed low risk of high dose exposure; and a sprayer-mixer group with a high risk of high dose exposure.

A questionnaire was administered which obtained information about activities and length of stay. Information about personal hygiene and protective equipment, eg. daily bathing, use of long sleeved shirts, and gloves was obtained. In addition, participants were asked to answer "yes" or "no" to whether they had experienced, while in the Pine Island area, any of a group of 16 symptoms known to be associated with known or suspected cases of anti-ChE insecticide illness (Sumerford). (See Appendix II, page 2)

Workers were labeled as having a suspicious symptom complex (SSC) if they responded affirmative to three or more symptoms on the list. Information relating to existing or recent medical problems of the chest, heart, stomach, or liver, was also obtained in an attempt to evaluate the list of symptoms and separate symptoms not easily explained by pre-existing medical conditions.

Blood samples for plasma and RBC ChE activity levels were collected in 20 cc heparinized vacutainer tubes from all participants, placed in crushed ice and delivered within 24 hours to the Albany Medical College, Institute of Toxicology, where the analyses were performed.

The September study consisted solely of obtaining blood samples for ChE activity. Seventy-five people participated (70% of whom had participated in the July study including 68 exposed workers - 66 of whom were field workers and two mixer-sprayers. Because only 6 controls could be obtained, it was decided to use the July control values for the purpose of statistical analysis. The use of July's controls is justified considering that although there is evidence of variability in ChE activity with time, the evidence is slight, and the variation noted between winter and summer levels (Gage). Our samples were collected six weeks apart and within a given season.

D. Results

Table I illustrates the mean values for each of the four groups in the July study and the mean value for the field worker group in the September study. All values are expressed as activity of cholinesterase (u M/ml/min.)

TABLE I

Mean ChE Activity Values

	JULY			SEPTEMBER		
GROUP	No. in Group	RBC	Plasma	No. in Group	RBC	Plasma
Control	30	14.15	4.54	6	15.30*	4.62*
Field Worker	71	14.54	4.10	66	14.62	4.15
Misc.	8	15.44	4.44	0	-	-
Sprayer-mixer	5	13.20	3.96	2	9.65*	3.7*

*Although means are calculated, there are too few values to be used for statistical purposes.

No statistical difference was found between the various mean values presented in Table I except for the difference between the control mean and the mean of the miscellaneous group (RBC data). Such a difference may have arisen by chance and doesn't seem to warrent further consideration since we are concerned only with values lower than normal.

Table II summarizes "Probable Absorption" as defined as all individual values falling below 33% and 20% of the control mean for Plasma and RBC, respectively (Gage).

TABLE II

Abnormal ChE Values (indicating probable absorption)

	JULY		SEPTEMBER	
	No. in Group	Probable Absorption	No. in Group	Probable Absorption
Control	30	1 (RBC)	6	0
Field Worker	71	7 (36%-54%) plasma	66	11 (33%-43%) plasma
Sprayer Mixer	5	1 (53%) plasma	2	2 (22%-57%) RBC
Misc.	8	1 (52%) plasma	0	

It should be noted the increase in "probable absorption" field workers, from 7 to 11, represents of the 11, all seven of the original field workers who not reverting to normal either did not change their ChE significantly or actually improved, but not enough to put them in the normal range.

Of interest is the one control with an abnormal low RBC value, indicating how criteria such as labeling abnormal values falling below 20% of the control mean can actually include normal individuals.

TABLE III

Symptoms

		No. in Group	SSC*	
Normal ChE	Control	29	10% (3)	
	Field Worker Mixer-Sprayer Misc.	76	9% (7)	
Average % of Normal ChE Group				$\frac{10\%+9\%}{2}$ = 9%
Abnormal ChE	Control			
	Field Worker Mixer-Sprayer Misc.	10	10% (1)	
Average % of Abnormal ChE Group				(10%) = 10%

*Suspicious symptoms complex

Table III allows for comparison of the percentage SSC in groups composed of exposed vs. unexposed who have normal ChE; it also makes possible the comparison of percentage SSC in the group composed of normal vs. abnormal ChE values.

As can be seen, there is no difference in the percentage of suspicious symptoms complex (SSC) whether one looks at unexposed vs. exposed workers with normal ChE levels or compares those participants with normal ChE levels (9%) with those with abnormal values (10%). The SSC is therefore not correlated with mere exposure or ChE - value.

Table IV compares workers with normal ChE with those workers with abnormal ChE levels in terms of personal hygiene and protective clothing (all data from July).

TABLE IV

Protection From Exposure

	Worker with normal ChE levels (76)	Workers with Abnormal ChE levels (9)
Daily showers	85%	100%
Gloves	25%	44%
Long sleeve shirt	75%	66%

There is no significant difference between any of the three personal hygiene or protective clothing parameters and the ChE levels.

E. Criteria For Evaluation of ChE Levels

On the assumption that the major route of absorption for field worker in the Pine Island area is through the skin, it was decided to monitor blo cholinesterase ChE activity levels. Although sprayers are exposed also by the respiratory route and a standard is available for air levels of par thion, it was felt that blood ChE levels would be an effective way of moni toring the effect of exposure to all groups, regardless of route of exposu

The assay for plasma and red blood cell (RBC) cholinesterase (ChE) activity is well established as an effective method of measuring the effect of exposure to anti-ChE compounds (Gage, Barnes & Davies). A distinction is made between RBC and plasma ChE because some compounds preferentially inhibit RBC while others inhibit plasma to a greater degree. In addition, RBC ChE inhibition due to organo phosphates is irreversible and it is replaced more slowly than the plasma enzyme. Weeks may be required to replace depleted plasma enzyme while a few months may be needed for the RBC enzyme to return to normal level. With regard to the ChE levels, it should be noted that there is some difference in interpretation of (1) normal levels, (2) what constitutes a significant exposure and what the term significant means to the health of the individual, (3) what action should be taken given a significant level, including what routine monitoring system should be set up

considering the job designation. These points will be taken up in the following discussion. It should be pointed out that the differences in significant levels and subsequent action depends upon each author's consideration of the actual level and the rate at which it was reached from pre-exposure, if the latter is known.

The views and standards of Gage are conservative and are easily adopted and have been used along with the personal evaluations of Dr. Hays in analysis of the Pine Island data.

1. Normal Levels of ChE:

ChE activity has a normal variation which must be taken into consideration when evaluating a given level of activity. When a pre-exposure baseline ChE is known, both plasma and RBC ChE activity levels may vary as much as 30%, i.e. a given value of RBC ChE if decreased by more than 30% from pre-exposure is assumed to have been the result of absorption of an anti-ChE and is not to have been due to normal biologic variation of the enzyme.

When no pre-exposure data is available a significant decline is generally considered to have occurred when individual ChE values have decreased to 33% below the plasma mean of the control or 20% below the RBC mean (Gage). Although the comparison with a control mean is less satisfactory than comparison with pre-exposure levels, it was the only option at Pine Island since all workers were already exposed to insecticides when the study was initiated. A delay until next season to obtain blood from workers before they entered the fields would not have yielded true pre-exposure values since most workers were coming from other parts of the country from similarly sprayed fields. Thus, there was no realistic way of establishing pre-exposure ChE levels in this population.

It must be realized that in comparing individual values with a control mean, subjects with normally high values and who have received exposure resulting in decreased levels might not be recognized, as they might still remain within the normal range of values. This situation would result in a false negative value (Gage). Conversely, a healthy person with exposure to insecticide but no significant absorption, whose ChE value is normally in the lower normal range might now fall below this limit (false positive). Furthermore, Gage notes a report describing a state of a genetically controlled atypically low plasma ChE activity, in which values can easily vary below the limits of normal without exposure (false positive).

2. Significant Exposure:

Recognizing that ChE values may vary without exposure and that pre-exposure levels are the most valuable baseline for measuring change, it is with the definition of significant level that one should be most concerned. Levels per se are far less important than the rate of change following exposure. In a consideration of risk to a worker, concern must be given to the potential for large dose exposure and absorption, thereby increasing the rate of inhibition of ChE and increasing the chance of toxic manifestations.

As Gage point out, "It should be noted that although a decrease in blood ChE may be regarded as an interference by a foreign substance in a natural state of the body, there is no reason to suppose that this is to be regarded as a toxic manifestation." An asymptomatic worker who has had a slow drop of ChE activity to 70% of his normal RBC or plasma ChE should be removed from further exposure, but this removal is not required because the health of the individual is thereby affected but rather to ensure that further absorption and possible increased sensitivity to further absorption may occur (Gage). Thus, slow depression of ChE level often has no clinical effect and does not, in general, place a worker in a precarious state in which he is more subject to poisoning than normal persons (Hayes). There have been numerous reports in which both workers over exposed for weeks to anti-ChE insecticides, and experimentally exposed subjects, developed ChE levels 10% of normal for plasma and 13% for RBC without clinical signs or symptoms (Grob, Sumerford, Braux, Ganelin). The point should be made that exposed workers having values of 10% of normal could have symptoms.

3. Action To Be Taken Given a Significant Level ChE Decline:

One can summarize by saying that if an abnormal ChE level, as previously defined, is detected in a worker exposed to anti-ChE insecticide, this is almost always the result of absorption. The detection of an "abnormal" value should not, however, be used as prima facie evidence that poisoning has occurred but should be regarded as an indication that the working conditions or methods are unsatisfactory, or at least, deserve some investigation. Hence, in field workers, occasional low levels do not suggest impending

illness since the risk of large dose absorption is small, but do suggest the need for observation of work practices. However, with mixers and sprayers, who traditionally have been the group which has the greatest risk, abnormally low levels should be regarded as indicators of poor work practices and of a potential large dose exposure with considerable risk of illness.

It should be stressed that no interpretation of the toxicity of the organic phosphate insecticides can be accurate without taking the elements of carelessness and human error into account (Sumerford), and no criteria, no matter how strict, will give any protection against heavy, accidental exposure (Hays).

F. Discussion of Results

1. Cholinesterase (ChE) Levels

A statistical evaluation of the data in Table I indicates that the data within each group was extremely homogenous and that no group mean differed significantly from any other group mean. It should be noted that even after two additional months of exposure to the fields there was no significant difference between the control mean and the field worker mean. On a group basis there was no evidence that exposure to the fields in July or during the period July through September caused any change in the ChE levels.

When looking at individual ChE levels, however, in Table II, we note that ten ChE levels in July were labeled as "probable asborption" and 17 in September. With regard to the field workers and miscellaneous group, taking into account the discussion in Section E, "Criteria for Evaluation of ChE Levels" involving the comparison of individual values with a control mean, and the small potential for acute large dose exposure, thereby making unlikely the risk of rapid decline in ChE activity, the levels for field workers and the miscellaneous group are indicative of probable mild absorption of anticholinesterase compounds, however, posing no real danger or significant hazard.

Continued surveillance of these two groups of workers with ChE levels is unnecessary. However, it would be of interest to obtain pre-exposure ChE levels and one ChE level a few weeks after the beginning of the 1973 season on those migrant workers who had "abnormal" ChE levels in the September study. This monitoring would give a more exact indication of their normal ChE levels and their degree of exposure after some weeks of field work. However, supervisors should routinely check for poor work habits or insufficient protective gear and should provide for the general education of all workers in the signs and symptoms of anti-ChE over-exposure.

In evaluating the ChE levels of individual mixers or sprayers, where the risk is significant for acute exposure to concentrated insecticides, absorption was detected and is an indication of potential risk. It is strongly recommended that all mixers and sprayers to be involved in a ChE monitoring program and be taught good work and personal hygiene practices. In addition, they should be instructed as to the signs and symptoms of anti-ChE compound over-exposure. Protective clothing should be provided.

2. Symptoms

Using the Suspicion Symptom Complex (SSC) in which any three or more symptoms associated with anti-ChE compounds are considered an indication of possible exposure, Table III shows that there is no difference among groups. Furthermore, SSC did not correlate with ChE levels, demonstrating that workers with abnormal ChE levels did not have more suspicious symptom than workers with normal ChE levels. It should be noted that it was not possible by the method used to obtain symptoms, to determine whether the three or more symptoms occurred together in time or separately.

Therefore, because the symptoms elicited, whether three or more, are too non-specific, and since they are not associated with abnormal ChE levels to any greater extent than with normal ChE, one cannot conclude that any group is being over-exposed to anti-ChE compounds.

3. Dermatitis

As part of our medical evaluation, we noted that eight field workers admitted to a skin rash which they attributed to working with celery. In addition, three other field workers were examined at the Migrant Clinic with skin rashes which the worker also attributed to working with celery. With regard to the three Clinic cases, the onset of the rash followed by a few weeks, exposure to the celery fields. The rash had the appropriate distribution, i.e. on exposed areas of the skin only. History, characteristics of the rash and distribution were consistent with a celer dermatitis of the photo-toxic variety (Birmingham). Although some pesticides have been known to cause a dermatitis of an allergic nature, celery dermatitis is more common; furthermore, the pesticide dermatitis is a local reaction and not necessarily an indication of a systemic disorder (Lucas).

Dermatitis from celery is prevented by avoiding skin contact with celery juice and sunlight. The use of trousers and long sleeve shirts are effective. "Physical sunscreens containing at least 5% titanum

dioxide or chemical preparations containing 10% dihyphroxy benzophemone-in-oil were effective preventatives in laboratory tests. To be fully effective, the chemical and physical sunscreens should contain water-repellent substances." (Birmingham)

As seen in Table IV, protective clothing habits or personal hygiene were no different between normal and abnormal ChE groups. However, it should be stressed that a majority of field workers do not routinely wear gloves, considered to offer some of the best protection against possible absorption of insecticides.

G. Conclusions

A number of workers have evidence of minimal absorption of anti-ChE compounds. In evaluating the significance to health of such absorption, the relative risk of exposure to acute large doses is the main factor. The absolute ChE value cannot, in general, be used to label a particular exposure as a health hazard.

For all field workers and workers in the miscellaneous group who have a very small risk of high dose exposure, no health problem is judged to be posed by the minimal exposure to insecticides in the fields. However, concern for protective clothes and personal hygiene measures should be stressed.

In evaluation of the mixers and sprayers the data indicates the probable absorption of significant amounts of anti-ChE compounds, but still does not allow one to draw the firm conclusion that a health hazard exists. However, since the risk of over-exposure is significant, the recognition of probable absorption is an indication of potential serious exposure. Since we do not have pre-exposure data, we cannot say that a significant change in ChE levels has occurred. However, we strongly recommend the institution of a ChE monitoring program, in addition to a protective clothing personal hygiene and education program for all mixers and sprayers.

An evaluation of symptoms associated with suspected or diagnosed cases of anti-ChE compound over-exposure was not helpful in determining over-exposure in any of the exposed groups.

The dermatitis noted in eleven workers is most consistant with a celery dermatitis.

V. RECOMMENDATIONS

1. ChE levels need not be done routinely on field workers, packers, or other workers who are not exposed to the concentrated anti-ChE insecticides. However, it would be of interest to obtain pre-exposure ChE levels and one ChE level a few weeks after the beginning of the 1973 season on those migrant workers who had "abnormal" ChE levels in the September study. This monitoring would give a more exact indication of their normal ChE levels and their degree of exposure after some weeks of field work.

2. Any worker who will be exposed to concentrated solutions of anti-ChE compounds (eg. mixers and sprayers) should have performed prior to his first exposure to these compounds (normally at the beginning of each season), two and preferably three ChE activity levels for both RBC and plasma. The average ChE value should be considered the worker's individual norm.

The following limits and actions are considered to be reasonable, recognizing that a physician should make the final decision as to whether a given ChE value, with a history of exposure and particular symptoms is sufficient evidence for a diagnosis of ChE over-exposure. Return to work after anti-ChE poisoning, should also ultimately be the decision of the worker's personal physician. Depending on the risk; if the danger of large dose exposure is unknown, because of new workers or new techniques, ChE levels may need to be determined daily or weekly. If no change is noted after several determinations the schedule for testing can become less frequent and after several months discontinued. Routine determinations however, should be done on workers exposed to concentrated solutions of parathion (Hays).

If either RBC or plasma decrease below 25% of the pre-exposure level, the worker's safety precautions should be examined (Gage, Hays).

If either RBC or plasma ChE declines 30% below pre-exposure levels and can be confirmed by another determination made of the following day, "then the worker concerned should be removed from further risk of exposure until his ChE has returned to normal. At the same time, the process should be carefully investigated to ascertain the origin of the excessive exposure. If the reduction of activity cannot be confirmed by a second test, or if the reduction is between 25 and 30% of normal then there is a case for investigation of the safety precautions, but an interruption of the process by removal of the man concerned from his occupation is not justified".

When no pre-exposure levels are known, the methods described and suggested actions in this study are recommended.

3. All workers, regardless of the risk, should wear protective equipment and practice good personal hygiene. When small risk is involved, as in the field workers and packers, clothing covering most parts of the body, but especially the lower legs and upper extremities is recommended. Gloves should always be worn. All clothing should be cleaned and dried daily. Daily baths and showers are also important.

With large dose risk workers, rubber clothing including rubber boots are recommended and appropriate respirators for sprayers. Any spills of concentrated liquid should be treated with great care to avoid skin contact. Contaminated skin should be washed immediately with copious amounts of water, the workers supervisor should be notified at the time of the incident, and any suspicious symptoms should be evaluated by a physician immediately.

4. All workers should be aware of the hazards associated with exposure to anti-ChE compounds, specifically the organic phosphate pesticides, including routes of entry into the body, ways of avoiding such exposure and signs of symptoms of over-exposure.

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APPENDIX I

Case Report, _____

He has been working as a mixer for approximately one week and had received little instruction regarding the proper handling of pesticides. He complained of abdominal pain which was constant, in the mid-epigastrium, and had begun in the afternoon. He also stated that he had been sweating uncontrollably since the early afternoon and that he had vomited three times. Physical examination showed a tremulous, middle-aged Spanish American male with normal temperature, blood pressure, and pulse. He was markedly diaphoretic. Pupils were round, reacted to light, and were not constricted. He was admitted to the hospital where he responded well to .4 mg of Atropine x2. ChE values are as follows:

Date Time	RBC ChE*	Plasma ChE*
19 July evening	71%	88%
19 July evening	73%	88%
20 July 8:00 a.m.	64%	73%
20 July 5:00 p.m.	61%	71%
21 July 8:00 a.m.	56%	64%

*% variation from control mean

PESTICIDE STUDY -- -- ORANGE COUNTY, NEW YORK

APPENDIX II

JULY 1972

1. Name _____
Last First Middle

2. Age _____ 3. Sex _____ 4. Race _____

5. Address: Farm _____ Unit _____

6. Occupational History: (list present job first)

Employer (state)	Job description* (include crops)	Dates of job	Pesticide Exposure		
			name (if known)	last exp. (days ago)	Exp. x 7 days

* 1. Field worker (no spraying of pesticides)
2. No exposure:
   a. office
   b. housewife of field worker
   c. other (specify)
3. Odd job: some exposure (specify percent of day or week)
4. Full time sprayer:
   a. aerial
   b. ground

7. Do you use any pesticides at home? Yes_____ No_____

8. Have you ever had an illness caused by pesticides? Yes_____ No_____

If "Yes":

a. when? _____

b. what were the symptoms? _____

c. who made the diagnosis? _____
(M.D., other worker, etc.)

d. what was the treatment? _____

9. Do you have any health problems you see a doctor for? (like chest, heart, stomach, liver) Yes_____ No_____

If "Yes" specify briefly: _____

_____

10. Have you had a problem recently with.

	Yes	No		Yes	No
headaches?	☐	☐	short of breath?	☐	☐
stomach problems - like lost your appetite?	☐	☐	wheezing or whistling in your chest?	☐	☐
			dizziness or fainting?	☐	☐
nauseous or sick to stomach?	☐	☐	nervousness, drowsiness or can't sleep?	☐	☐
vomiting?	☐	☐			
diarrhea?	☐	☐	too much sweating?	☐	☐
pain in stomach?	☐	☐	cough?	☐	☐
weakness or fatigue?	☐	☐	difficulty seeing, blurred vision?	☐	☐
pain or tight feeling in your chest?	☐	☐	skin rashes?	☐	☐

11. Do you shower every night? Yes____ No____

12. When working with pesticides or plants sprayed with pesticides, do you wear gloves (circle)

always sometimes never

13. What other special clothing might you wear work working with pesticides or plants sprayed with pesticides?

hat? Yes____ No____

mask or respirator? Yes____ No____

long sleeve shirt? Yes____ No____

plastic or rubber protective cover over shoes? Yes____ No____

14. Results:

RBC

plasma

15. Notes: