



February 8, 1982

Procurement and Grants Management Branch
National Institute for Occupational
Safety and Health
5600 Fishers Lane, Room 8-36
Rockville, MD 20857

Dear Dr. Lal:

The following information is provided for the Terminal Progress Report:

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|-------------------|--|
| 1. Grant Number | 1 R01 OH 00796-01 |
| 2. Period Covered | 3/1/79 through 2/29/80 with extensions
through 9/30/81 |
| 3. Investigator | Dr. William R. Burg |
| 4. Institution | Department of Environmental Health
University of Cincinnati |
| 5. Title | Aflatoxin Exposures of Agricultural Workers. |

The goals of this project with the progress and findings of this study are as follows:

1. & 2. Amount of airborne aflatoxin generated by combines. Samples were collected inside and outside the combine cabs using battery powered and 110 volt Hi Volume sampling equipment. A gasoline powered generator attached to the combine provided a mobile source of electrical power. The results indicate that a filtered air conditioning system effectively removes the airborne dust. Without an air conditioned cab and during unloading, the levels of airborne dust are high, reaching 231.1 mg/m^3 . The aflatoxin contents are variable, but levels up to 195 ppb were found.
3. Extent of drift of airborne aflatoxin from the field. Because of the effect of wind direction in relation to the travel direction in relation to the travel direction of the combine, the results were inconclusive. Much of the dust generated in handling corn is relatively large and settles out of the air in a short period of time. Recent data however shows that high concentrations of aflatoxins may be in the Aspergillus flavus spores which are $\sim 3 \text{ }\mu\text{m}$ and may therefore stay airborne for extended periods. Since most corn fields are in rural areas away from population centers, this is not believed to be a problem. Elevators which are often located within small towns may be a potential source of emissions.

4. Exposures to harvest workers. Grain handlers, truckers and farmers may be exposed to highly varying amounts of aflatoxin depending on a number of factors. Geographically, the highest levels of aflatoxins occur in the southern parts of the United States. Workers in these areas are expected to be exposed to higher levels of airborne aflatoxins and with a greater frequency.
5. Correlation between airborne levels of aflatoxins and local conditions. Attempts were made to determine a mathematical relationship between the level of aflatoxin in the airborne dust and the concentration of aflatoxin in the bulk corn. The results clearly demonstrate that when contaminated corn is handled the airborne dust also contains aflatoxins. No consistent ratio of airborne aflatoxin concentration to bulk corn concentrations were found. The results seem to depend on the process and the previous history of the corn. Recent data suggests that a considerable amount of the aflatoxin may be in the spores which are readily dislodged. Thus the airborne aflatoxin level be high during the first handling of the corn when the spores are dislodged. Subsequent handling of the same batch may generate lower concentrations.
6. Aflatoxin levels in and around large commercial grain elevators. Because of grain elevator operator refusals for admission to their facilities, data from only one elevator are available. However, measurements were taken during three harvest seasons at this Georgia elevator. The results indicate that workers may be exposed to high levels of airborne dust containing significant levels of aflatoxins during the loading and unloading of the corn. The levels of aflatoxin were similar to those encountered on the farm and were highly variable.
7. The need for controls. The effect of aflatoxins to humans is still largely unknown in spite of the fact that aflatoxins have been shown to be carcinogenic in every animal species tested. These effects however have been associated with the ingestion rather than inhalation of aflatoxins. It is therefore impossible to recommend a meaningful allowable exposure level. It is our view that most exposures can be easily reduced and we recommend that precautions be taken to prevent exposures. At the present state of knowledge, that is about the only conclusion to be reached.
8. The levels of aflatoxins in different particulate size fractions. Data collected early in this study gave confusing results. While it is well known that the level of aflatoxin varies dramatically from kernel to kernel, the level of aflatoxins found at the front of the combines was surprising. The picking process at the front of the combine generates considerable dust. This dust, however, is largely plant debris and soil dust which has settled on the leaves. The amounts of aflatoxin found at the front of the combine was unanticipated. Later work by Dr. Shotwell suggests that the spores can carry considerable aflatoxin and may explain the field results. It is now believed that the source of the aflatoxin is from the spores which are dislodged at the front of the combine.

9. The need for future research. The demonstration that the dust generated in handling contaminated commodities demonstrates the need for additional work in the areas listed below:
- a. An epidemiology study to determine whether workers occasionally handling contaminated materials are at risk to lung cancer.
 - b. Improvements are needed for the analytical determinations of aflatoxins particularly for the determination of small samples collected by battery powered equipment at the breathing zone of workers.
 - c. Determine the sources of the aflatoxin; spores, contaminated grain parts, etc.
 - d. Exposures to workers handling other materials which frequently are contaminated such as cotton seed and peanuts.

The publications resulting from this grant are listed below:

- 1. Method of Analysis of Corn Dust for Aflatoxin, Shotwell, O.L., Burg, W.R., and Diller, T., accepted by J. Assoc. of Official Analytical Chemists, 64:1060-3 (1980).
- 2. Aflatoxin in Corn: Potential Hazard to Agricultural Workers, Shotwell, O.L., and Burg, W.R., 8th Annual ACGIH Topical Symposium (1980).
- 3. Measurements of Airborne Aflatoxins During the Handling of Contaminated Corn, Burg, W.R., Shotwell, O.L., and Saltzman, B.E. Amer. Indust. Hygiene Association J. 42:1-11 (1981).
- 4. A Prospective Analysis of the Potential Risk Associated with Inhalation of Aflatoxin-Contaminated Grain Dusts, Baxter, C.S., Wey, H.E., and Burg, W.R., accepted by Journal of Food and Cosmetics, September 18, 1981.
- 5. Measurements of Airborne Aflatoxins during the Handling of 1979 Contaminated Corn, Burg, W.R., Shotwell, O.L., and Saltzman, B.E., accepted Amer. Indust. Hygiene Assoc. J. 1982.
- 6. Two additional papers are in preparation.

The investigators wish to thank numerous NIOSH, USDA and University personnel for their assistance in this project. The USDA played a major role in making this project successful.

Sincerely yours,

3 *William R. Burg*

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16. Abstract (Limit: 200 words) The exposure of farm workers to aflatoxin (1402682) was investigated. The amount of airborne aflatoxin generation by the operation of combines was examined. Sampling indicated that use of an air conditioning system in the cabs of the combines was an effective control measure. During unloading, using an cab without an air conditioning system, the levels of airborne dust reached as high as 231.1mg/m3. Aflatoxin levels varied greatly but levels as high as 195 parts per billion (ppb) were recorded. Much of the higher concentrations of aflatoxins may be in Aspergillus-flavus spores, which can remain airborne for some period of time. Grain elevators located near towns may be a source of hazardous emissions for the population. During harvesting the grain handlers, truckers and farmers may be exposed to highly varying amounts of aflatoxin, particularly in the southern parts of the United States. Attempts were made to develop a mathematical relationship between the level of aflatoxin in airborne dust and the concentration of aflatoxin in bulk corn. The aflatoxin entering the air appeared to be related to the method of handling and the history of the corn being processed. Significant levels of aflatoxins were found in and around large commercial grain elevators.				
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