Doc
FAA
AM
78
31

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FAA-AM-78- 31		

4. Title and Subtitle	5. Report Date
AGRICULTURAL AVIATION VERSUS OTHER GENERAL AVIATION: TOXICOLOGICAL FINDINGS IN FATAL ACCIDENTS	6. Performing Organization Code
	8. Performing Organization Report No.
7. Author(s) Delbert J. Lacefield, Patricia A. Roberts, and Curtis W. Blossom	
9. Performing Organization Name and Address FAA Civil Aeromedical Institute P.O. Box 25082 Oklahoma City, Oklahoma 73125	10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address Office of Aviation Medicine Federal Aviation Administration 800 Independence Avenue, S.W. Washington, D.C. 20591	13. Type of Report and Period Covered 14. Sponsoring Agency Code FAA

15. Supplementary Notes

Research leading to preparation of this report was performed under Tasks AM-A-68-PHB-14 through AM-A-72-PHB-14 and AM-A-73-TOX-14 through AM-A-78-TOX-14.

16. Abstract

Results from the toxicological study of samples from 174 pilots killed while engaged in aerial application and samples from 2,449 other general aviation pilots are compared. The incidence of alcohol in specimens was similar for ag pilots and other general aviation pilots but the blood levels of alcohol tended to be lower in the ag pilots. Carbon monoxide as an incapacitating agent did not appear to be a factor in aerial application operations. Evidence of the use of drugs or medications was less in ag pilots than in other general aviation pilots. Over half of the ag pilots had below normal cholinesterase levels, suggesting a continuing problem of acute and/or chronic toxicity from the pesticides being applied by agricultural aircraft. This finding suggests that better educational efforts could reduce the accident rate in this important segment of our agricultural activity.

17. Key Words	18. Distribution Statement
Aerial applicators General aviation Toxicology	Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	5	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

AGRICULTURAL AVIATION VERSUS OTHER GENERAL AVIATION: TOXICOLOGICAL FINDINGS IN FATAL ACCIDENTS

I. Introduction.

Although the accident and fatality rates have declined among pilots engaged in agricultural aviation activities in the past few years, the National Transportation Safety Board (NTSB) lists pilot error as the accident cause in 75 to 80 percent of the cases. Nearly 10 percent of all general aviation accidents come from agricultural aviation, and about 5 percent of the fatal accidents are attributable to this segment of aviation. Aerial application has long been considered a hazardous occupation for a number of reasons: (i) Many of the aircraft used were adaptations of existing planes not designed for such work; (ii) Low altitude flying leaves little time to seek a landing site in the event of equipment malfunction; (iii) The operator is never far from ground obstacles such as power poles and lines, fences, crops, trees, dikes, and buildings; (iv) Pilots are required to engage in long workdays on many consecutive workdays when crops are ready for aerial treatment; (v) Extremely alert and skillful pilots are required to safely participate in any segment of agricultural aviation and the highly toxic nature of the chemicals applied, combined with fatigue and other factors, may impair full physiological performance by the pilot.

Because of the risks in this type of flying, modern planes used in aerial application are designed to be crashworthy. Numerous safety features are employed such as rugged cockpits, shoulder harnesses, helmets, protective clothing, and respirators. Such features help protect the pilot from having an accident and assist in survival of accidents. On the other hand, because of the nature of the work certain toxicological conditions may be present that may impair flying skills and increase the probability of accidents.

For over 11 years the Forensic Toxicology Research Unit of the Civil Aeromedical Institute (CAMI) has operated a nationwide laboratory service to analyze for various toxic materials in blood, urine, tissues, and other specimens from victims of fatal aircraft accidents. This continuing research activity to identify and determine the magnitude of toxicological factors in fatal air carrier and general aviation including aerial application accidents has revealed significant results (1,2). For this study the accumulated data were reviewed for contrast of toxicological factors operative in aerial application accidents with those found in other general aviation accidents.

II. Findings.

Since 1968 the laboratory has analyzed samples from 174 pilots killed while engaged in agricultural aviation operations and 2,449 pilots killed

in other general aviation accidents. Table I shows the number of accidents, the number of fatal accidents, and the percentage of accidents that resulted in fatalities in agricultural aviation and all general aviation accidents in the years 1973 through 1977.

TABLE I. Accidents and Fatal Accidents for Agricultural and All General Aviation, 1973-1977*

Year	1973		1974		1975		1976		1977		Total	
	Ag.	All Gen.	Ag.	All Gen.	Ag.	All Gen.	Ag.	All Gen.	Ag.	All Gen.	Ag.	All Gen.
Total Accidents	395	4,255	467	4,424	452	4,244	453	4,567	477	4,476	2,244	21,966
Fatal Accidents	43	723	31	729	37	652	38	636	37	693	186	3,433
Percent of total Accidents That Were Fatal	11	17	7	16	8	15	8	14	8	15	8	16

*Accident and fatality data from NTSB and FAA records.

Table II shows the number of cases analyzed at CAMI in which ethyl alcohol was found in both groups, and Table III shows the concentrations found. It can be seen that, on the average, concentrations of alcohol in the blood of agricultural pilots were lower at the time of death than with other general aviation pilots.

TABLE II. Alcohol Findings in Fatal Accidents

	Ethanol above 0.05%	%	Ethanol below 0.05%	%	Total %
Aerial Applicators	12	6.9	3	1.7	8.6
Other General Aviation	214	8.7	23	0.9	9.7

TABLE III. Ethyl Alcohol Levels

Alcohol Level	Agriculture		General Aviation	
	No.	%	No.	%
0.050 - 0.099	7	58.3	41	19
0.100 - 0.199	4	33.3	90	42
Above 0.200	1	8.5	83	39

Carbon monoxide, leading to incapacitation, occurred in 13, or 0.5 percent, of the general aviation accidents investigated by this laboratory. Fire was not a complicating factor in the cases recorded; thus, carbon monoxide accumulation was due to a faulty heater or exhaust system. In none of the 174 fatal agricultural accidents was carbon monoxide detected at a significant level unless there was a post-crash fire.

Drugs were identified in samples from pilots or were found in the wreckage at a rate of 4.9 percent in general aviation accidents, but in only two (1.1 percent) agricultural cases were drugs found that indicated a possible preexisting medical conditon that could have caused incapacitation.

Blood samples suitable for cholinesterase analysis were obtained on 130 of the 174 aerial applicator fatalities. Fifty-three, or 41 percent, of the samples had values in the normal range. Since the laboratory rarely knows the normal level of cholinesterase for the individual pilot in the fatal accident, some of the values in the lower portion of the normal range may represent enzyme depression sufficient to cause symptomatology. The other 77 samples had values below the normal range. Some of the specimens from accident victims had no cholinesterase activity, indicating acute exposure to one of the organophosphate or carbamate insecticides. Many of the values were in the range seen from chronic low-level exposure but could not be differentiated from partial inactivation of the enzyme due to heat exposure as a result of post-crash fire.

III. Discussion.

Although the skills and level of alertness demanded of the aerial applicator are much greater than those required for other categories of general aviation pilots, the ag pilots, the subjects of this study, had an incidence of alcohol similar to that found in other pilots. Because of stresses and the long hours of work leading to fatigue, one might expect an increased usage of drugs; however, this was not borne out by the analysis of the data. The exact rate of exposure to highly toxic chemicals applied by the ag pilot leading to deleterious physiological effects could not be derived from the data; however, a number of individual cases in which toxicity from pesticides can be inferred suggests improvement is needed in the handling of toxic pesticides and herbicides. A better system is

needed of monitoring the individual pilot's cholinesterase level for the early detection of the insipient toxic effects of cholinesterase-inhibiting insecticides. It appears that cessation of exposure to toxic chemicals and early treatment could prevent a substantial number of accidents. Methods are needed to better educate the pilot to recognize early symptoms of poisoning and to discern the value of medical monitoring for chronic exposure.

REFERENCES

1. Lacefield, Delbert J., and Paul W. Smith: Toxicological Investigation of Aircraft Accidents: Selected Case Reports from 450 Fatal Aircraft Accidents, Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kansas, March 1971, Unpublished.

2. Lacefield, Delbert J., Patricia A. Roberts, and Curtis W. Blossom: Toxicological Findings in Fatal Civil Aviation Accidents, Fiscal Years 1968-1974, AVIATION, SPACE, AND ENVIRONMENTAL MEDICINE, 46(8): 1030-1032, August 1975.

ACCESSION for
NTIS White Section
DDC Buff Section
UNANNOUNCED
JUSTIFICATION
BY
DISTRIBUTION/AVAILABILITY CODES
Dist. A... 1/or SPECIAL
A