
Item ID Number 00197

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Report/Article Title Annual Research Progress Report No. 12, Covering
Period: 1 July 1976 - 30 June 1977

Journal/Book Title

Year 1977

Month/Day July

Color

Number of Images 19

Description Notes The following pages relating to the collection and Dr.
Alvin Young's research interests were scanned: cover,
title page, iii-xiii, 15-19

DEAN OF FACULTY

UNITED STATES AIR FORCE ACADEMY, COLORADO

Annual Research Progress Report No. 12

July 1977



COVERING PERIOD

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reviews and personal interviews. Baseline data are being accumulated in order to assess trends and progress in genetic engineering research and potential applications. A final report will be submitted in September 1977.

8. Comparison of Stress Responses in Male and Female Cadets at the USAF Academy

Principal Investigators: LtCol Orwyn Sampson, Maj John B. Bomar, Maj M.T. Mason, and Capt Ildiko Andrews, Department of Chemistry and Biological Sciences; LtCol G.E. Robertshaw, USAF Academy Hospital; and LtCol J.C. Thomas and Capt R.W. Cote, Department of Athletics

This research is presently unsponsored. Information is required in the interest of establishing training programs and standards which yield the most beneficial effect for both male and female cadet trainees in the shortest possible time. The proposed study would provide data to document altitude acclimatization and physiological responses to physical training. The study would provide baseline data for comparison with future cadet populations. During the summer of 1976 a pilot study was conducted in a population of 50 female cadets. Partial results of the pilot study indicated improvements in cardiovascular fitness similar to that noted in previous male populations.

Publications

Cote, R.W., J.B. Bomar, Jr., G.E. Robertshaw, and J.C. Thomas. 1977. Maximal aerobic power in women cadets at the U.S. Air Force Academy. *Aviation, Space, and Environmental Medicine* 48(2):154-155.

9. Ultrastructural Evaluation of Tissues Removed from Animals Exposed to TCDD

Principal Investigator: Maj Glenn M. Buchanan, Department of Chemistry and Biological Sciences

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

Peromyscus polionotus, chronically-exposed to low levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in the laboratory. Post mortem examination of control and treated animals (exposed for 9 weeks to 2.5 ppb TCDD applied to the pelage) revealed no observable differences in organs or in total body weight. Analyses of photomicrographs of adrenal cortex tissues will be completed by 1 July 1977. Although tissue preparation is complete, the photomicrographs of testes, liver, and kidney have not been taken.

10. Radiochemical Bioassay of TCDD Uptake in Plant Material

Principal Investigators: Capt James M. Cupello and Capt Alvin L. Young, Department of Chemistry and Biological Sciences

Sponsored by Frank J. Seiler Research Laboratory (AFSC), and Air Force Logistics Command/DS

In laboratory experiments using specially designed growth boxes, cut and intact roots of sorghum [*Sorghum bicolor* (L.) Moench] seedlings were exposed to a 1 cm layer of soil containing 14 parts per million (ppm) ¹⁴C-labeled TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin). Radioisotopic and gas chromatographic mass spectrometric (GC-MS) analysis of extracts from leaf tissue collected after 64 days of root exposure indicated the absence of TCDD (detection limit was 100 parts per trillion/ppt). However, radioisotopic analysis of the non-extractable residue indicated the presence of sufficient ¹⁴C activity to be equivalent to 430 ppt TCDD in the plant tissue. Sufficient residue was not available to characterize the ¹⁴C-labeled molecule. However, if the activity is from unaltered TCDD, the maximum possible uptake into the leaves of sorghum would be 0.00003% by weight of that applied to the soil.

Publications

Cupello, J.M., A.L. Young, and J.C.H. Smith. 1977. A method for simulating subsurface disposal of herbicides. Weed Science, In Press.

Cupello, J.M. and A.L. Young. 1977. Possible TCDD uptake in Sorghum bicolor (L.) Moench. Agronomy Journal, In Press.

11. Disposal of Herbicide Orange by Soil Incorporation and Biodegradation

Principal Investigators: Capt Alvin L. Young and Capt William J. Cairney, Department of Chemistry and Biological Sciences, and Lt Col Eugene L. Arnold, USAF School of Aerospace Medicine

Sponsored by Air Force Logistics Command/LO

Four years of field data have been collected from Herbicide Orange biodegradation plots established in Utah (AFLC Test Range Complex) and Florida (Eglin AFB Reservation) in 1972. The herbicide, a mixture of 2,4-D and 2,4,5-T was soil incorporated at rates as high as 4,480 kg/ha. Periodic sampling was conducted on soil levels of 2,4-D, 2,4,5-T and the contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) as well as for the soil levels of microorganisms. Significant reduction in the level of herbicide occurred; the estimated half life appeared to be in the range of 150 to 210 days (Florida and Utah, respectively). The degradation of TCDD followed a similar pattern; the estimated half life appeared to be in the range of 225 to 275 days (Florida and Utah, respectively). The microbial studies have shown that the application of 2,4-D and 2,4,5-T at massive rates (5,000-40,000 ppm) not only did not sterilize the soil, but indeed stimulated the growth of certain microflora.

Publications

Young, A.L., C.E. Thalken, E.L. Arnold, J.M. Cupello, and L.G. Cockerham. 1976. Fate of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in the environment: summary and decontamination recommendations. Technical Report USAFA-TR-76-18, USAF Academy, CO

12. Ecological Studies of a Herbicide-Equipment Test Area
(TA C-52A), Eglin AFB Reservation, Florida

Principal Investigators: Capt Alvin L. Young, Maj Charles E. Thalken, and LtCol Lorris G. Cockerham, Department of Chemistry and Biological Sciences

Sponsored by Air Force Logistics Command/DS

Six years of field study have been completed on the ecosystem of Test Area C-52A, Eglin AFB, FL, a military test area of approximately 2.6 km² that received 73,000 kg 2,4,5-T and 76,780 kg 2,4-D herbicide during the period 1962-1970. Although the herbicides degraded rapidly in the soil (e.g., the last detectable residue was found in December 1970), the residue of the highly toxic contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) has persisted. It is now apparent that (1) although TCDD may persist in the environment for long periods of time (greater than 12 years) when initially present at high concentrations on the soil surface, it may be degraded by soil microorganisms; (2) TCDD may accumulate in the tissues of rodents, reptiles, birds, fish, and insects when these organisms are exposed to TCDD contaminated soils (however, the levels of TCDD in the tissues apparently do not exceed the levels of TCDD found in the environment); (3) rodents, reptiles, birds, fish and insects may tolerate, i.e., based on no observed deleterious effects in field studies, soil levels between 10-1,500 parts per trillion (ppt); and (4) movement of TCDD in the abiotic portions of the environment can be by wind or water erosion of soil particles, but leaching by water alone does not appear to occur.

Publications

Young, A.L., C.E. Thalken, E.L. Arnold, J.M. Cupello, and L.G. Cockerham. 1976. Fate of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in the

environment: summary and decontamination recommendations. Technical Report USAFA-TR-76-18, USAF Academy, CO.

Young, A.L. and J.H. Hunter. 1977. A long-term field study of vegetative succession following repetitive application of phenoxy herbicides. Weed Science Society of America Meetings, 8-10 Feb 77, St Louis, MO, Abstract 18.

Cockerham, L.G., A.L. Young, and C.E. Thalken. 1977. Histopathological and ultrastructural studies of liver tissue from TCDD-exposed beachmice (Peromyscus polionotus). Technical Report, USAF Academy, CO, In Press.

D. Department of Civil Engineering, Engineering Mechanics, and Materials

1. Composite Stress Distribution

Principal Investigator: Capt William J. McClelland,
Department of Civil Engineering, Engineering Mechanics
and Materials

The research into stress distribution in a unidirectional filamentary composite sheet with a finite transverse slit has been completed. A technical paper has been written and submitted to the co-author, Dr. Harold Gascoigne of the University of Utah, for his comments. The final draft will be written and submitted for publication before December 1977.

2. Elastic Waves in Layered Media

Principal Investigator: Capt R. R. Gajewski, Department
of Civil Engineering, Engineering Mechanics and Materials

Exact solution for elastic waves in layered media are obtained using concept of generalized rays and Cagnaird's method for Laplace transforms. Displacement responses for various sources have been numerically obtained. Respose of a layered geology to pressure inside a finite spherical cavity has been used to check performance of large

scale finite difference ground motion codes. Response of a plate to a single point force provides a basis for analyzing the signals recorded in acoustic emissions.

Publication

The Generalized Ray-Theory and Transient Response of Layered Elastic Solids with Y. H. Pao, Cornell University, to appear in Physical Acoustics, Vol XIII, 1977.

3. Equilibrium and Stability of Circularly Towed Cables

Principal Investigator: Maj J. J. Russell, Department of Civil Engineering, Engineering Mechanics and Materials

This work has concentrated on the application of the finite element technique to the study of a cable towed behind an aircraft traveling in a circular path. Results predicting the equilibrium shape and its stability were obtained.

Publications

"Equilibrium and Stability of a Circularly Towed Cable Subject to Aerodynamic Drag", Journal of Aircraft, Vol 14 No 7, pp 680-686, July 1977.

"Equilibrium and Stability of a Whirling Rod-Mass System", International Journal of Non-Linear Mechanics, Vol 12, pp 91-101, 1977.

4. Explosive Impulse Welding

Principal Investigators: Maj George E. Cannon, Jr., Department of Civil Engineering, Engineering Mechanics and Materials and Lt Col Douglas H. Merkle, Air Force Weapons Laboratory Trestle Project

Explosive impulse welding tests previously conducted at Los Alamos Scientific Laboratory, Denver Research Institute and the Air Force Academy have been analyzed using flash x-rays, high-speed framing camera photographs, velocity and pressure probe records and various strength tests, all made during the time period when the