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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS ARMAMENT DEVELOPMENT AND TEST CENTER (AFSC)
EGLIN AIR FORCE BASE, FLORIDA 32542



25 OCT 1968

REPLY TO
ATTN OF: ADTVE-51 (Lt Harrell/882-4481)
SUBJECT: Ecological Survey of Eglin Reservation

TO: AFATL (ATG)

1. Request AFATL (ATCA) assistance in defining and conducting a series of AFATL-ADTC in-house experiments connected with the neutron activation analysis tracer method for monitoring the effects of defoliant/herbicide and pesticide testing on the ecology of the Eglin Reservation. The overall aspects of these experiments have been discussed between Mr. B. C. Wolverton of AFATL and personnel from ADTVE and are in consonance with previously established AFATL-ADTC responsibilities (Para 8, Atch 1). In general, this request consists of technical assistance in configuring the experiments and providing laboratory support at the AFATL Botanical Facility.
2. The attached memo for the record outlines the background of the ADTVE neutron activation analysis effort. The Nuclear Engineering Test Facility (NETF) Wright-Patterson AFB, Ohio, has recommended the investigation of iodine compounds as a candidate tracer (Para 9B, Atch 1) for study during the proposed experiment program. The iodine compounds were selected on the basis of previous neutron activation analysis of plant, soil, and water samples from the Eglin Reservation. Some preliminary data concerning compatibility of these compounds with the herbicides used at Eglin is available from recent Vitro CB Laboratory work for ADTVE-51. This data will be furnished to ATCA.
3. We believe the neutron activation effort has progressed to the point where AFATL (ATCA) can now make significant contributions toward completing the objectives outlined in Para 9c through 9g of Atch 1. Specific objectives for the proposed experiments are to determine the following:
 - a. Compatibility of the iodine tracer additives with selected herbicides.
 - b. Effects of selected herbicides on specific plants.
 - c. Effects of the iodine tracer/herbicide combinations on specific plants.
 - d. Ability of the plants to absorb the tracer along with the herbicide.
 - e. Ability to isolate and detect the amount of tracer in the plants.

4. Request ATCA personnel contact Lt Tom Harrell/882-4481 to arrange discussions between ADTVE-51 and ATCA Project personnel concerning the proposed experimental program.

FOR THE COMMANDER



FRANK KARASE
Chief, Engineering Branch
Directorate of Test & Evaluation

1 Atch
Memo for Record, 3 Jun 68

3 June 1968

1. The Air Force is vitally concerned with potential hazards to local flora, fauna, and marine life both on and off the Eglin Reservation that might be created by defoliant testing. This concern is primarily the result of pending legal action against the government by cotton farmers of a surrounding county claiming damage to their cotton fields due to previous defoliant testing at Eglin.

2. PGVED is investigating the neutron activation tracer method to be used for monitoring the effects of three (3) defoliants (orange, blue, white) and one (1) insecticide (Malathion) disseminated on the Eglin Reservation. The Nuclear Engineering Test Facility (NETF) of AFIT, government contractors, and PGVED have been working together in selecting suitable tracer elements to be mixed in with the defoliants for detection purposes.

3. A representative from NETF visited AFCC on 27 March - 29 March 1968 to assist in the selection of suitable tracers for the three (3) defoliants and one (1) insecticide. The personnel involved in the discussions were:

- a. Capt James Morrow, NETF Project Engineer
- b. Mr. J. J. Bauer, PGVED-1 Supervisor
- c. Mr. Bill Toole, CB Lab Supervisor
- d. Mr. Cecil Myers, FGLPP Engineer
- e. Mr. George Wise, PGVED-1 Engineer
- f. Lt T. L. Harrell, PGVED-1 Engineer
- g. Lt A. C. Goodwin, PGVED-1 Engineer
- h. Dr. Kelly Oliver, CB Lab Personnel
- i. Dr. James Hinton, CB Lab Personnel

4. Capt Morrow, NETF representative, gave a briefing on the theory and application of neutron activation analysis. He explained that Neutron Activation Analysis is a highly sensitive tool for determining the presence and amount of very minute quantities of elements in material. He added that it has many proven applications in areas such as agriculture, geology, medicine, etc., but very little information is available on using this technique for determining the aerosol cloud travel of sprayed materials and the assimilation by plants. Because of this lack of information, the program to use this technique at Eglin requires more than just selecting a tracer and employing it in future tests. Several technical and administrative problems need to be studied and solved before AFCC can employ the neutron activation analysis tracer method.

5. The following is an outline agreed upon for selecting a tracer for the defoliants and the action to implement:

a. A group of tracer elements which are compatible with the defoliant and insecticide agents must be selected. The defoliants and insecticide must be tested with suitable tracer elements to determine if the tracers will mix and attach themselves favorably with the medium of the agents. Also tests must be run to see if the tracers have the ability to travel as an aerosol in the same manner as the agents, if the tracers will settle out of the defoliant medium thus giving a false indication of cloud or aerosol travel, and if the tracers will be absorbed by various plants proportionately with the defoliants. Prior to this action it will be necessary to determine the background elements and their quantities which presently exist in the biota. PGVED has taken the first test step by sending biological, water, soil, and agent specimens to the General Atomic Corporation for determination of elements present in the specimens. General Atomic has sent their findings to AFPC, and PGVED working with Vitro personnel are sifting through the data to pick out elements which are not common to the agents. The element, Iodine (I_2), seems to be a possible element meeting these requirements and Vitro is now in the process of determining what I_2 compounds are compatible with the agents. These candidate I_2 compounds will then be tested for assimilation by the desired biota.

b. From the group of elements which are compatible with the agents, another group of elements which have good nuclear properties (i.e. detection means) for Activation Analysis must be selected. Good nuclear properties of tracer elements for Neutron Activation Analysis consist of:

(1) Large Nuclear Cross Sections which are proportional to the probability that the bombarding particles (Neutrons) will activate the target nuclei.

(2) Long half-lives of the radioactive nuclei which help to weed out interferences from elements with shorter half-life. One half-life is the time it takes for half of the radioactive atoms in a sample to disintegrate.

(3) Good gamma-ray energies to reveal clearly the identity of the tracer element in the sample.

After selecting those I_2 compounds or other suitable tracer compounds which are compatible with the agents, Vitro is to send the solutions to NETF for assistance in selecting the I_2 or tracer compound that possesses the desired nuclear properties.

c. A Laboratory Technique is needed for getting rid of interference elements present in the samples which would hinder the identity of a tracer and concentrating the tracer element to a point where it can be easily identified when subjected to neutron activation analysis. Since each radioactive atom in a sample has a different half-life and its own private set of gamma-rays, the graph presented by a differential analyzer is the sum of all the nuclear "fingerprints" of all the elements in the sample. Although some fingerprints or peaks in the graph may be easily associated with certain elements, two fingerprints on top of one another may make a smudge that is difficult to unravel. A solution to this problem is to remove the interfering elements by chemical separation prior to activation analysis. This type technique is widely used and is very effective. Concentrating the tracer elements by taking several plant samples and getting rid of interference elements would serve to aid in identifying the tracer element.

6. Theoretically the neutron activation analysis tracer technique will work but the question is whether or not it is feasible to employ. Several questions which need to be researched and answered are:

a. What are the retention characteristics of the tracer on the plant? Will the tracer be assimilated by the plants along with the defoliants?

b. Should we limit our analysis only on the surrounding soil instead of worrying about the retention characteristics of the tracer?

c. Will the tracer have the ability to travel as an aerosol in the same manner as the agent or will it settle out of the agent medium in such a way as to give a false indication of cloud aerosol travel?

7. In the case of defoliants or herbicides, if the neutron activation analysis tracer method were employed, the government would have three steps to follow should a law suit be filed against it due to crop damage by the above materials. They are as follows:

a. Analyze a sample of the damaged crops by chemical or laboratory analysis to determine if defoliants/herbicides actually killed the crops.

b. Determine by laboratory means if the same kind of defoliant/herbicide disseminated by the government at that time was the type that killed the plant.

c. Send a concentrated sample of the damaged crops to NETF or AFIT for neutron activation analysis to determine if a tracer used by the government in their defoliants is present in the sample.

8. The policy concerning the ecological surveillance of the Eglin Reservation as stated in AFATL (ATC) letter, 12 June 1967, concerning this subject is as follows:

a. The responsibilities for monitoring the effects of substances used on the reservation and for decisions as to use of such substances is clearly the responsibility of the Air Proving Ground Center (APGC).

b. The responsibility for the development of substances used in tests and their effect on the plant, animal, and marine life is the responsibility of the Air Force Armament Laboratory (AFATL).

c. The development includes investigation of effects on wide varieties of living organisms and the amount of the various substances required to cause an effect.

d. When a request is made to use a new substance on the Eglin Reservation, all data pertaining to its characteristics, its effect on living organisms, and the amounts required to cause an effect will be furnished to APGC by AFATL.

e. Responsibility for damage is jointly shared by both organizations.

9. In view of the preceding discussion, PGVED believes the majority of the required investigation can be accomplished in-house through use of existing AFATL and Vitro capabilities. The approach would be as follows:

a. AFATL, PGVED and C-1 (CB) personnel select a group of candidate tracers.

b. NETF select best tracers from the above candidates.

c. AFATL or C-1 personnel investigate action of tracer with agent.

d. C-1 personnel investigate aerosol characteristics of agent/tracer in the C-1 aerosol diffusion chambers.

e. AFATL or C-1 personnel investigate plant absorption-retention characteristics of tracer.

f. C-1 personnel develop laboratory procedure for tracer isolation/concentration from samples.

g. AFATL or C-1 investigate plant samples versus soil samples.

h. C-1 personnel collect periodic samples on continuous basis.

10. Plans are for PGVED to arrange a meeting with AFATL, C-1 personnel and interested AFCC agencies to discuss the entire program for selecting a tracer for the defoliants/herbicides.

Thomas L. Harrell

THOMAS L. HARRELL, 2Lt, USAF
Chemical Engineer
PGVED-1

1 Atch
Cy ATC ltr, 12 Jun 67

DEPARTMENT OF THE AIR FORCE
AIR FORCE ARMAMENT LABORATORY, RTD (AFSC)
EGLIN AIR FORCE BASE, FLORIDA 32342



REPLY TO
ATTN OF: ATC (Col Cox/882-2410)

12 JUN 1967

SUBJECT: Ecological Survey of Eglin Reservation (APGC (PCLPP) Ltr, 17 May 67)

TO: APGC (PCL)

1. The Air Force Armament Laboratory is in agreement with the requirement for ecological surveillance as related to the Eglin ranges. The responsibilities for monitoring the effects of substances used on the reservation and for decisions as to use of such substances is clearly the responsibility of the Air Proving Ground Center. The responsibility for the development of substances used in tests and their effect on the plant, animal and marine life is the responsibility of the Air Force Armament Laboratory. Development includes investigation of effects on wide varieties of living organisms and the amounts of the various substances required to cause an effect. The Laboratory has been directed to accomplish this by HQ AFSC.
2. When a request is made to use a new substance on the Eglin range, all data pertaining to its characteristics, its effect on living organisms, and the amounts required to cause an effect will be furnished to the Air Proving Ground Center by the Armament Laboratory. Responsibility for damage will therefore be jointly shared by both organizations.
3. In view of the above discussion and the responsibility given to the Armament Laboratory for development of substances (i.e. simulants, defoliants, decontaminants) used in the chemical-biological program, we cannot accept the suggestion that Air Proving Ground Center develop criteria and manage this development program.

John D. Coke
JOHN D. COKE Colonel USAF
Deputy Director

ATCA (Mr. Wolverton/382-3431)

Ecological Survey of Eglin Reservation (Your Ltr, 25 Oct 68)

ADTC (ADTVE-51)

1. Reference subject and meeting between Capt. Morrow (NETF), Lt. Harrell (ADTVE), Mr. Wolverton and Mr. Harrison (ATCA), 9 December, 1968, pertaining to (ATCA) assistance in defining and conducting a series of AFATL-ADTC in-house experiments connected with the neutron activation analysis tracer method for monitoring the effects of defoliant/herbicide and pesticide testing on the ecology of the Eglin Reservation.

2. AFATL (ATCA) will conduct the following in-house experiments in support of the analysis tracer program:

a. Compatibility of the iodine tracer additive with selected herbicides: Several iodine compounds will be added to Orange, Blue, White and Malathion. After being allowed to stand for various time periods, these mixtures will be subjected to analysis by electron capture gas chromatography to determine if any change in chemical structure can be detected.

b. Effects of selected herbicides on specific plants: Several plant species, including local agronomic crops, will be subjected to a series of tests to determine the lowest herbicidal concentrations that cause visible damage. These concentrations will be used in tests designed to detect an iodine tracer.

c. Effects of the iodine tracer/herbicide combinations on specific plants: Herbicide-Insecticide/iodine tracer combinations will be sprayed onto the foliage of candidate plants. An attempt will be made to devise a method of collecting samples and preparing them for neutron activation analysis. Foliage, stem and root samples will then be taken from these plants and sent to Capt. James Morrow, NETF Project Engineer, Wright-Patterson AFB, Ohio, for neutron activation analysis. Herbicidal damage to plants will also be studied to determine any detrimental effects the iodine tracer has on the activity of the herbicides.

d. Ability of the plants to absorb the tracer along with the herbicide: Known concentrations of Herbicide-Insecticide/iodine tracer combinations will be applied to different parts of plants as well as to the soil in which they are growing. Tests will then be conducted to determine if the iodine tracer enters the plant in the same proportions as the herbicides or insecticides. The plants will also be

studied to determine the breakdown rates and sites of accumulation of the herbicides and the iodine tracer.

e. Ability to isolate and detect the amount of tracer in the plants: An evaluation of several plants will be conducted to determine the lowest quantities of herbicide that can be detected by using the iodine tracer-neutron activation analysis method. An attempt will be made to devise a method of collecting samples from field grown plants and preparing them for shipment and subsequent neutron activation analysis at Wright-Patterson AFB.

FOR THE COMMANDER

JOHN E. HICKS, Colonel, USAF
Chief, Bio-Chemical Division