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REPLY TO  
ATTENTION OF

DEPARTMENT OF THE ARMY  
US ARMY INSTALLATION MANAGEMENT COMMAND  
US ARMY ENVIRONMENTAL COMMAND  
5179 HOADLEY ROAD  
ABERDEEN PROVING GROUND, MD 21010-5401

April 16, 2012

IMAE-CDE

Joseph Gortva  
Installation Restoration Manager  
IMFD-SOE  
Fort Detrick USAG  
Environmental Management Office  
1546 Porter Street  
Frederick MD 21702

Dear Mr. Gortva

The U.S. Army Environmental Command is submitting the Archive Search Report Findings for Field Testing of 2, 4, 5 – T and Other Herbicides at Fort Detrick, Frederick, Maryland. This report was prepared in accordance with the Comprehensive Environmental Response, Compensation and Liabilities Act (CERCLA) and should be placed in the installation's CERCLA Administrative Record file. There are no restrictions on the release of this document.

Sincerely,

A handwritten signature in blue ink, reading "Laurie B. Haines-Eklund", is positioned above the typed name.

Laurie B. Haines-Eklund  
Environmental Restoration Manager  
U.S. Army Environmental Command  
Cleanup Division

Enclosure



**US Army Corps  
of Engineers**

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**Archives Search Report  
Findings for Field Testing of  
2,4,5-T and Other Herbicides**

**Fort Detrick**

Frederick, MD

**4 April 2012**

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Prepared by  
U.S. Army Corps of Engineers St. Louis District

Prepared for  
U.S. Army Environmental Command (USAEC)  
and  
U.S. Army Garrison Fort Detrick

## EXECUTIVE SUMMARY

**ASR Purpose and Scope:** In August 2010, based on recent public concerns regarding past testing of Agent Orange at Fort Detrick, the U.S. Army Environmental Command (USAEC) and the U.S. Army Garrison Fort Detrick requested an Archives Search Report (ASR) to document the testing of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) (a component of Agent Orange contaminated with dioxin) and related herbicides at Fort Detrick. The archive search was required as these records were not retained at Fort Detrick. In October 2010, the ASR team produced a preliminary findings report based on analyzing a number of previously identified published reports regarding field testing of 2,4,5-T at Fort Detrick. That preliminary findings report was finalized and released to the public in February 2011. Given the desire to respond to public concerns as quickly as possible, the preliminary findings report relied on analyzing readily located reports that had been identified as documenting the Fort Detrick field tests. While this methodology provided a history of those test results that had been published, it did not allow for the review of material at the various elements of the National Archives and Records Administration and a number of other record repositories. In order to provide as thorough an ASR as possible, USAEC and the U.S. Army Garrison Fort Detrick requested a comprehensive archive search to include all available records regarding the testing of 2,4,5-T at Fort Detrick including research regarding broader potential environmental releases that may have occurred on Fort Detrick. That investigation took significantly longer to complete. This ASR documents the findings of a detailed review of documents relating to the field testing of herbicides at Fort Detrick, quantifying the amounts of 2,4,5-T and arsenic related herbicides used and identifying the probable locations where those tests occurred. A companion ASR volume to be published separately will document the findings on the broader potential environmental releases.

**Fort Detrick Crops Division Chemical Branch:** Herbicides research at Camp Detrick, later Fort Detrick, began during World War II. In April 1944, the Chemical Warfare Service (CWS) gave the Plant Research Branch at Camp Detrick the mission of developing chemical herbicides to destroy or reduce the value of crops. These “Chemical Plant Growth Regulators” or inhibitors were studied under the code letters “LN”. Initial work at Camp Detrick involved a series of screening tests conducted inside the laboratory involving seeds, a few plants and minute quantities of organic herbicides. The investigators determined that the halogenated phenoxy acetic acids appeared to be the best suited and more thorough studies began on selected LN herbicides. Of the herbicides tested, LN-8, 2,4-dichlorophenoxyacetic acid (2,4-D) proved the most effective against a wide variety of crops and was used as the common reference material in the plant growth regulating tests. Another herbicide identified during these tests was LN-14 or 2,4,5-T. Later, a 50/50 mix of the n-butyl ester of 2,4-D, also known as (a.k.a.) LN-143 and the n-butyl ester of 2,4,5-T, (a.k.a. LN-974) became known as the military defoliant or herbicide Agent Orange (a.k.a. Agent LNX). By the late 1960s, it became known that the manufacture of 2,4,5-T was contaminated with small amounts of the dioxin 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), and that TCDD was the main



concern related to possible adverse health effects from the use of 2,4,5-T, as well as Agents Orange and Purple which included it.

The Crops Division at Fort Detrick published the results of the 2,4,5-T field work in a series of reports, specifically Special Reports Nos. 79, 92, 105, 130, 153, 156, 201, 234, 256 and 262. Results of field work were also published in Status Report 53-6, Technical Reports 6, 16, 17; Technical Studies 11 and 15; Technical Memoranda 9-24 and 212; and Interim Reports 94 and 140. Unpublished field work was found in laboratory notebooks CD 331, 333, 482, 595, 677, 1775, 2081, 2504, 2886, 3053, 3153, 3155, and 3264.

**Summary of Findings:** The following findings are based on the details found in the documents reviewed for this ASR:

- From 1944 through 1968, the Chemical Branch of the Crops Division at Camp Detrick conducted small garden field plot experiments with plant growth inhibitors or herbicides.
- The primary objectives of the tests were to ascertain:
  - the most effective herbicide for reducing yield of various crops and causing defoliation of woody plants;
  - the best methods of application, and
  - the effects of the herbicides on plant growth during different stages of development.
- The described field trials on Fort Detrick were small-scale efforts involving test plots typically 6- by 18-feet in size
- Although application rates were frequently expressed in “pounds per acre”, because the field plots were small, the actual amounts applied are expressed in grams (i.e., a dollar bill weighs approximately one gram)
- The herbicides being tested were applied with handheld sprayers or in at least one instance a small bicycle-wheeled cart and for one test, a truck mounted sprayer.
- A movable, light-weight metal-framed shelter with wind resistant cloth was often used to prevent drift of spray onto adjacent test plots, which would have invalidated the test results for those plots,
- There is no indication that large-scale dissemination tests of herbicides involving aerial spraying occurred at Fort Detrick as the installation did not have the space or quantities of the vegetation required to do so. As early as World War II and into the 1950s and 1960s, Fort Detrick personnel did conduct or participate in the larger-scale aerial dissemination spray tests that occurred at locations other than Fort Detrick. These locations have been publically listed by the Department of Veterans Affairs web site since at least 2008:  
[http://www.publichealth.va.gov/docs/agentorange/dod\\_herbicides\\_outside\\_vietnam.pdf](http://www.publichealth.va.gov/docs/agentorange/dod_herbicides_outside_vietnam.pdf).

## 1 INTRODUCTION

### 1.1 REPORT AUTHORIZATION

On 18 August 2010, the U.S. Army Environmental Command (USAEC) tasked the Ordnance and Technical Services Branch of the St. Louis District of the U.S. Army Corps of Engineers (CEMVS-EC-P) to provide research and analysis assistance regarding Fort Detrick, which will be documented in an Archives Search Report (ASR). The assignment included completion of a report regarding the field testing of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) (a component of Agent Orange contaminated with dioxin) and related herbicides at Fort Detrick as quickly as possible. The archive search was required as these records were not retained at Fort Detrick. CEMVS-EC-P completed a Preliminary Archives Search Report Findings for Use / Testing of 2,4,5-T Compounds on 27 October 2010, and finalized it in February 2011 for release publically (see section 1.4.5). This current report supersedes those preliminary findings based on a review of additional documents located during a more extensive archival search and revision to the previous calculations regarding 2,4,5-T field testing at Fort Detrick as applicable. It also examines the field testing of other herbicides at Fort Detrick, including in particular arsenic based ones.

### 1.2 SUBJECT

Research with herbicides at Camp Detrick, later Fort Detrick, began during World War II. . In April 1944, the Chemical Warfare Service (CWS) gave the Plant Research Branch at Camp Detrick the mission of developing chemical compounds to destroy or reduce the value of crops. These “Chemical Plant Growth Regulators” or inhibitors were studied under the code letters “LN”. Initial work at Camp Detrick involved a series of screening tests in the laboratory involving seeds, a few plants and minute quantities of synthetic organic compounds to determine the ones best suited for military purposes. They determined that the halogenated phenoxy acetic acids appeared to be the best suited and began studying selected LN compounds more thoroughly. Of the compounds tested, agent LN-8, 2,4-dichlorophenoxyacetic acid (2,4-D) proved the most effective against a wide variety of crops and was used as the common reference material in the plant growth regulating tests. Another compound was LN-14, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). Later, a 50/50 mix of the n-butyl ester of 2,4-D, also known as (a.k.a. LN-143) and the n-butyl ester of 2,4,5-T, (a.k.a. LN-974) became the military defoliant or herbicide Agent Orange (a.k.a. Agent LNX). By the late 1960s, it became known that the manufacture of 2,4,5-T was contaminated with small amounts of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), a dioxin and that TCDD was the main concern of the possible adverse health effects from the use of the herbicide and Agent Orange and Purple. TCDD formed in the manufacture of 2,4,5-trichlorophenol, a precursor in production of 2,4,5-T.<sup>1</sup> In April 1970, the US Department of Agriculture (USDA) announced the suspension of certain uses of 2,4,5-T and subsequently the Department of Defense suspended the use of Orange as well. In July 1974, the Army transferred the

One non-aerial spray test did occur at Fort Detrick in 1968 . The test included investigating the lateral and vertical movement of four herbicides through soil as applied with a hand-held sprayer, including Orange and was conducted in the Area B portion of Fort Detrick.<sup>36</sup>

What did affect the program was the growing controversy over the US application of chemical herbicides in Vietnam, as the North Vietnamese accused the US of using Chemical Warfare and Biological Warfare weapons. This and other factors lead to increasing international pressures including the United Nations acceptance of a report urging a halt to production, development, and stockpiling of BW and CW agents in July 1969. At the same time, increasing Congressional interest and a pull back of the Army activities relating to BW culminated with President Richard Nixon's announcement of a major shift in US policy relating to CW and BW on 25 November 1969, which was made at Fort Detrick. In regard to CW, President Nixon renounced the first use of lethal and incapacitating chemicals. Relating to BW, President Nixon renounced the use of lethal biological agents and weapons and all other methods of BW, directing the DoD to dispose of existing BW weapons. He further directed that the US would confine its BW research to defensive measures, such as immunization and safety measures.<sup>37</sup> The statement left out discussing the use of chemical herbicides but that did not last much longer.

 In April 1970, the Secretaries of Agriculture; Health, Education and Welfare, and the Interior jointly announced the suspension of certain uses of 2,4,5-T based on the concerns of the health effects of a contaminant in the manufacture of 2,4,5-T, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). Subsequently, the Department of Defense suspended the use of Orange.<sup>38</sup>

As a result of the 1969 BW policy change, Fort Detrick entered a period of demilitarization, downsizing and reorganization in the early 1970s. The reorganization included the splitting of the U.S. Army Garrison, Fort Detrick and the U.S. Army Biological Defense Research Laboratory (USABDRL) into two separate entities in September 1971. The garrison served as a facilities manager or landlord for the USABDRL, which was a tenant organization among a growing group of tenant entities from different organizations. Prior to that, referencing Fort Detrick was essentially synonymous with the organization operating there: Chemical Corps or U.S. Army Biological Laboratories, U.S. Army Biological Warfare Laboratories and variations of the names of these organizations. Another element of the reorganization occurred earlier in March 1971 when the Army transferred the Plant Pathology Division (i.e. biological anticrop group) to the USDA, including facilities, buildings and personnel. The Army transferred the Plant Physiology Division, renamed as the Vegetation Control Division (i.e. chemical or herbicide group) to the USDA later in July 1974, including additional land and facilities. After that, the USDA had a total of  $\pm$ 189 acres permitted of unimproved land at Fort Detrick for field studies.<sup>39</sup>

industry. The material used was manufactured between 1952 and 1954 and repackaged in new drums. The Army reacquired the last of the stocks in January 1963, though Dow had resold balances in 1961 and apparently manufactured new quantities to meet Army contracts in 1962.<sup>176</sup>

In July 1963, the Chemical Corps developed military specifications for 55-gallon drums of both n-butyl 2,4-dichlorophenoxyacetate (LNA) and n-butyl 2,4,5-trichlorophenoxyacetate (LNB), with a caveat on the n-butyl 2,4,5-T specification that it not be diverted to domestic use (i.e. not for grounds keeping maintenance on installations). The specification noted that Federal Specification O-H-210 be used for domestic needs. The Defense Supply Agency, established in 1961, handled acquisition, storage and distribution of this material and its later variants. In October 1963, Detrick ordered 15 drums (approximately 825 gallons) of a 50-50 mix 2,4-D and 2,4,5-T following the July military specifications. This is Orange though the procurement document does not use that term.<sup>177</sup>

On 30 December 1965, the formal specification for Defoliant, LNX (i.e. Orange) (MIL-D-51239) was established, also stipulating that it not be diverted for domestic use. On 7 November 1966, the specifications for both 55-gallon drums of LNA and LNB were revised and included the stipulation that both not be diverted to domestic use. The Specification for LNX was revised on 20 September 1967 and was called Orange. That same specification also included the specifications for Orange II (50% n-butyl 2,4-D and 50% isooctyl ester of 2,4,5-T) and Orange III (66.6% n-butyl 2,4-D and 33.3% n-butyl 2,4,5-T). In 1968, the Army Supply Bulletin on herbicides includes a listing for Herbicide, 2,4-D and 2,4,5-T (Orange) FSN 6840-926-9095 based on the military specs for LNA and LNB. Though listed among domestic use herbicides, such use would have been precluded by the military specifications cited. In May 1968, Defense General Supply Center, procured 20 quarts or 5 gallons of n butyl 2,4-D and n butyl 2,4,5-T for Fort Detrick<sup>xxiii</sup>. Documentation exists indicate denial of Orange for brush control on a base in New Mexico in 1969. The Army modified the specification for Vegetation Control Agent Orange on 27 October 1969, though acquisition would end as the DOD ceased use of Orange the following year.<sup>178</sup>

→ In April 1970, the Secretaries of Agriculture; Health, Education and Welfare, and the Interior jointly announced the suspension of certain uses of 2,4,5-T based on the effects resulting from the concerns of the possible health effects of a contaminant in the manufacture of 2,4,5-T, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). Subsequently, the Department of Defense suspended the use of Orange, although the Air Force had large inventory Orange, as well as bulk 2,4,5-T in South Vietnam and at the Naval

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<sup>xxiii</sup> It is undetermined how much, if any, of the 1962 Purple procurement and the 1963 and 1968 Orange procurements Detrick used on site. During the 1960s Detrick investigators participated or led a number of aerial dissemination field trials at other locations. It is also undetermined how complete these three procurements are of the herbicides shipped to Detrick during that period but it not thought to be comprehensive.