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Herbicides in the Vietnam War

These important excerpts are from the "Official" Operation Ranch Hand report from 1982.

Page V: "Especially helpful in providing not only photographs but also first-hand information was Maj. Alvin L. Young, an Air Force consultant in environmental sciences."

Page 133: "Freeman foresaw tight supplies of herbicide for American agriculture and, consequently, reduced crop yields with accompanying complaints from farmers and other civilian users. At the same time, Freeman wrote to the Director of the Office of Emergency Planning, Farris Bryant, to ask him to assume a role of leadership in allocating existing supplies of 2,4-D and 2,4,5-1 and in increasing their production. McNamara's response was to ask the Secretary of the Army to develop a plan to increase production while at the same time asking Bryant to allocate all commercial production capacity for agent orange and its critical components to military use. Bryant agreed to this request and took steps to insure that the entire U.S. output of 2,4,5-T, the limiting component in the production of orange, would be diverted to military requirements.

Page 195: "A search undertaken to find less expensive and more active artificial plant hormones in 1942 identified 2,4-dichlorophenoxyacetic acid (2,4-D) as one of the most promising. Field trials during the World War II years provided that a related compound, 2,4,5-trichloro-phenoxyacetic acid (2,4,5-T) could also be used as a selective herbicide. These two compounds later became important agricultural chemicals, and they were primary components of several of the herbicides employed in the Ranch Hand program.'"

Page 196: "None of the herbicides used in Southeast Asia were of a new or experimental nature. They had all been used for several years in commercial agriculture both in the United States and in other countries. By way of illustration, in 1961, the year before the Ranch Hand program began, about 40 million acres plus hundreds of thousands of miles of roadsides, railroads, and utility rights of way were treated with phenoxy herbicides in the United States."
"The compounds 2,4-D and 2,4,5-T are chlorinated phenoxy acids, and herbicides contain them in the acid form, as salts, and as esters. Which form is chosen for a specific application depends on desired characteristics such as solubility, volatility, and melting point." "However, considerable concern has developed over the potential danger from 2,3,7,8-tetrachlorodi-benzo-paradioxin, commonly known as dioxin, an impurity present in 2,4,5-T."

Page 197: "A third compound used in the Ranch Hand herbicide formulations was picloram. Sold commercially as Tordon." (Agent White) "Cacodylic acid, formally known ashydroxyd-imethylarsine oxide and sold as Phytar." (Agent Blue)

Page 198: "Combinations of these four herbicides were used to formulate the different Color coded agents used in the Ranch Hand operation in Southeast Asia."

The idea that these herbicides were "Tactical Herbicides" is a false notion! It appears to have come from twisting the title "Tactical Employment of Herbicides" of Army Manual FM 3-3. In later years Alvin Young has made the claim there were two different classes of herbs "Tactical" and "Commercial" of course this is a false claim to try an evade liability for making people sick. Young has been paid millions, over time, by the U.S. government and DOW and Monsanto to push this deception on anybody that tries to make a claim for exposure. It is time to do the right thing and take care of these people.

Author's Acknowledgements

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Members of the support staff in the Office of Air Force History—Ann W. Caudle, Barbara C. Fleming, and I. Jewell Newman—performed the burdensome task of typing and retyping drafts of the manuscript. Warren A. Trest and Dr. Richard Kohn, the Chief Air Force Historian, guided it through publication.

I am indebted to each of these people, and many more, and I credit much of the improvement in the book to their help. Of course, I accept responsibility for all errors which remain.

Due to its long, slow buildup, the herbicide program in Southeast Asia had no immediate effect on the herbicide market in the United States. From 1962 through 1964, only about 250,000 gallons of chemicals had been consumed in South Vietnam. The total U.S. herbicide production in 1965 was about 3.4 million gallons. Some 2.8 million gallons of the total went to agriculture and other non-military pursuits, while the Air Force requirement for that year was only about 400,000 gallons. The use of herbicides as a weapon in Southeast Asia increased, however, and in 1966 a shortage developed, causing projects to be postponed or completed over a longer period of time. Industrial production facilities in the United States, though taxed, were able to fill the fiscal year 1966 (FY 66, Jul 1, 65–Jun 30, 66) military requirement of 1.6 million gallons. The projected requirements for the next two years, FY 67 (5.6 million gallons) and FY 68 (11.9 million gallons) clearly exceeded the existing production capability.

To cover a projected FY 67 shortage of orange herbicide, the Air Force procured 1.5 million gallons of agent white, commercially known as Tordon. Chemically, it was 80% 2,4–D and 20% picloram in a water-soluble formulation. White had the same effect on vegetation as orange, but it acted more slowly. At first, this slow reaction made it less desirable than orange. Later, however, because of the erroneous belief that white was less volatile than orange, it became more popular than orange for targets where drift was a consideration. MACV studied and discarded other proposed remedies for the herbicide shortage, including diluting orange herbicide with 50% diesel fuel.[47]

On January 26, 1967, Secretary of Agriculture Orville Freeman wrote to Secretary McNamara and asked him to have someone in his department look into the herbicide problem. Freeman foresaw tight supplies of herbicide for American agriculture and, consequently, reduced crop yields with accompanying complaints from farmers and other civilian users. At the same time, Freeman wrote to the Director of the Office of Emergency Planning, Farris Bryant, to ask him to assume a role of leadership in allocating existing supplies of 2,4–D and 2,4,5–T and in increasing their production. McNamara's response was to ask the Secretary of the Army to develop a plan to increase production while at the same time asking Bryant to allocate all commercial production capacity for agent orange and its critical components to military use. Bryant agreed to this request and took steps to insure that the entire U.S. output of 2,4,5–T, the limiting component in the production of orange, would be diverted to military requirements. The shortage of herbicides in Southeast Asia peaked in 1967, but the situation never became as bad as had been forecast, primarily because actual herbicide usage never reached the high levels predicted. By early 1969, herbicides were no longer a critical item of supply.[48]

In October 1967, researchers from the RAND Corporation issued two

Appendix 1
Characteristics of Herbicides Used in Southeast Asia

The chemicals present in the defoliant mixes employed by the United States Air Force in Southeast Asia were developed originally to control weeds, that is, plants growing in places where man does not want them to be. Weeds present serious problems to agriculture because they compete with crops for available sunlight, moisture, and nutrients. For millenia the only weapons farmers had to use against weeds were mechanical, such as the hoe and plow. In 1896 the modern use of chemicals to control weeds began with the work of a French scientist named Bonnet. He observed that the seedlings of wild mustard, a common weed in Western Europe, died when sprayed with a fungicide developed for use on grape vines. Bonnet later found that copper sulfate, a component of the fungicide, would selectively kill the wild mustard growing in a cereal crop. Other research showed that chemical compounds such as sodium nitrate, ferrous sulfate, and dilute sulfuric acid also acted as selective herbicides against broad-leafed weeds in fields of cereal plants with narrow, upright leaves. These compounds were dessicants and worked by extracting water from plant tissues. Their selectivity depended on the broad, level surfaces of the weeds collecting more of the chemical spray or dust than cereal leaves. The performance of these chemicals, except for dilute sulfuric acid, was, however, erratic.

Synthetic plant hormones or plant growth regulators, precursors of the primary herbicides used in Vietnam, were discovered in the 1930s. The first synthetic plant hormone herbicides were quite expensive and therefore impractical as agricultural chemicals. A search undertaken to find less expensive and more active artificial plant hormones in 1942 identified 2,4-dichlorophenoxyacetic acid (2,4-D) as one of the most promising. Field trials during the World War II years provided that a related compound, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) could also be used as a selective herbicide. These two compounds later became important agricultural chemicals, and they were primary components of several of the herbicides employed in the Ranch Hand program.[1]

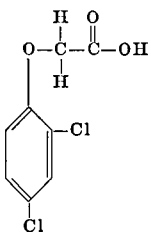
Three terms used throughout this study need to be defined: "herbicide," "defoliant," and "dessicant." An herbicide is a chemical which will kill or injure a plant when applied to air, soil, water, or the plant itself. The defining characteristic of defoliants is that they cause the leaves of a plant to fall prematurely, although the plant may or may not die as a result. A dessicant is a drying agent which causes a plant's tissues to lose their moisture,

thereby killing or damaging the plant. The use of a dessicant may or may not result in subsequent defoliation. Thus, a given chemical may fall into one or more of these categories. Two of the terms, "herbicide" and "defoliant" are used practically interchangeably in discussions about the Ranch Hand program, but sometimes the differences in meaning may be important.[2]

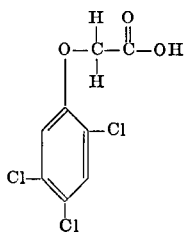
None of the herbicides used in Southeast Asia were of a new or experimental nature. They had all been used for several years in commercial agriculture both in the United States and in other countries. By way of illustration, in 1961, the year before the Ranch Hand program began, about 40 million acres plus hundreds of thousands of miles of roadsides, railroads, and utility rights of way were treated with phenoxy herbicides in the United States. Of this total, more than ten million acres, an area about one-fourth the size of South Vietnam, received aerial spray applications. The herbicides used in Southeast Asia were familiar agricultural chemicals, and aerial spraying of them was common.[3]

Agent Orange was 50% 2,4-D and 50% 2,4,5-T

2, 4-D



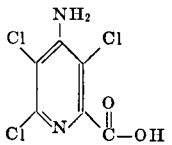
2, 4, 5-T



The compounds 2,4-D and 2,4,5-T are chlorinated phenoxy acids, and herbicides contain them in the acid form, as salts, and as esters. Which form is chosen for a specific application depends on desired characteristics such as solubility, volatility, and melting point. The persistence of 2,4-D and 2,4,5-T in soil is limited to only a few weeks, and high dosages are necessary to produce any overt effects in humans. However, considerable concern has developed over the potential danger from 2,3,7,8-tetrachlorodibenzo-para-dioxin, commonly known as dioxin, an impurity present in 2,4,5-T.

Phenoxy herbicides are growth regulators which have extensive effects on the structure of plants. Their action is generally rapid, and the fact that they may spread throughout a plant allows them to affect almost all of its biological activities. A plant's reaction to 2,4-D or 2,4,5-T may result in an abnormal production of buds or roots and the excessive growth of tissues. In lesser concentrations, the growth in tissues surrounding a plant's vascular system and the resultant restriction in the flow of nutrients may cause a slow death of the plant. In short, these two herbicides stimulate a proliferation of tissues.[4]

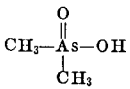
Picloram



Agent White

A third compound used in the Ranch Hand herbicide formulations was picloram. Solid commercially as Tordon, it has the formal chemical name of 4-amino-3,5,6-trichloropicolinic acid. In its pure state, it is a white powder with a smell like chlorine. Picloram's toxicity to man is thought to be lower than that of 2,4-D or 2,4,5-T. Like the phenoxy herbicides, picloram regulates plant growth, but the precise mechanisms involved are not known. It is an extremely mobile compound, being readily absorbed by both the leaves and roots and transported throughout the plant's tissues. Its mobility enhances its effectiveness against woody plants. Some of the effects of picloram are to stunt leaves and cause terminal growth to stop. Also, tissues along the stem proliferate, and the stem tends to bend and split. Roots may deteriorate, and the plant soon dies. Compared to 2,4-D, picloram is much more mobile, better able to penetrate roots, and more toxic to plants. One important difference between picloram and the phenoxy herbicides is that it is persistent in soils whereas the phenoxy compounds generally are not. Its persistence allows it to be used as a general soil sterilant under some conditions.[5]

Cacodylic Acid



Agent Blue

Cacodylic acid, formally known as hydroxydimethylarsine oxide and sold as Phytar, is not a plant growth regulator like the other three herbicides. Rather, it functions as an "uncoupler," keeping the plant from using the products of its metabolism for growth and tissue maintenance. It is thought that the effectiveness of cacodylic acid, like other arsenic compounds used as herbicides, derives from its ability to substitute arsenic for phosphorus in biochemical reactions. Its effects on a plant are to stop growth, attack membrane integrity, and cause drying, yellowing, and, eventually, death. Because drying is its primary observable effect, cacodylic acid is often labeled as a dessicant. It is a contact herbicide and is rapidly rendered ineffective in soil. Cacodylic acid, an organic compound, can replace the highly toxic inorganic forms of arsenic such as sodium arsenite and sodium arsenate in an herbicide role. These inorganic arsenic compounds are very toxic to both man and animals and can cause accidental fatalities. Cacodylic acid itself is only slightly toxic to humans, with a probable lethal

oral dose of one ounce or more, and it has little or no toxicity when applied to the skin.[6]

Combinations of these four herbicides were used to formulate the different color-coded agents used in the Ranch Hand operation in Southeast Asia. Appendix 2, Table 1 lists the composition of these mixtures.