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AIR BASE DEFENSE
IN THE
REPUBLIC OF VIETNAM
1961 – 1973

Roger P. Fox

OFFICE OF AIR FORCE HISTORY
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explosives devices dictated that this complex be kept free of concealing vegetation. Ignoring the French experience, the USAF discovered anew the problems associated with defoliation of the perimeter barrier system.[48]

Rarely if ever charted, the minefields of the perimeter barrier prohibited use of manual labor to cut and remove the vegetation. The mines, fencing, and wiring prevented mowing or scraping by mechanized equipment. Burning was unsatisfactory on several counts. Vegetation was highly fire resistant, particularly during the rainy season when growth was most rapid. It ignited slowly, even if sprayed with a flammable such as contaminated jet fuel. Because fire hardly ever consumed the vegetation, the residue went on obscuring the barrier system and offering cover to penetrators. Burning also detonated or destroyed mines and flares within the complex.

Next in importance was defoliation of the base interior. Here too, the ideal was to clear the ground cover that concealed penetrators and reduced surveillance by defense forces. For example, the defense vegetation negated sentry dog detection—the base's most reliable alarm. And the exertion in plowing through this thicket sapped dog and handler. Because the interior was without the perimeter's hazards or obstructions, it seemed that the clearing methods mentioned earlier could be given full play. In practice this was not the case. Safety factors forbade burning in or near fuel and munitions storage areas. The immense labor entailed in clearing a sizable area in a reasonable time curtailed manual cutting. Cutting by hand nonetheless left the root system intact, and so was well-suited to Cam Ranh Bay's very unstable soil. Elsewhere, however, an undisturbed root system meant rapid regrowth of vegetation. Even though scraping served well in the base interior, the conventional USAF civil engineer squadron usually lacked the needed mechanized equipment. In light of these facts, the answer to vegetation control in the interior as on the perimeter appeared to be herbicides.

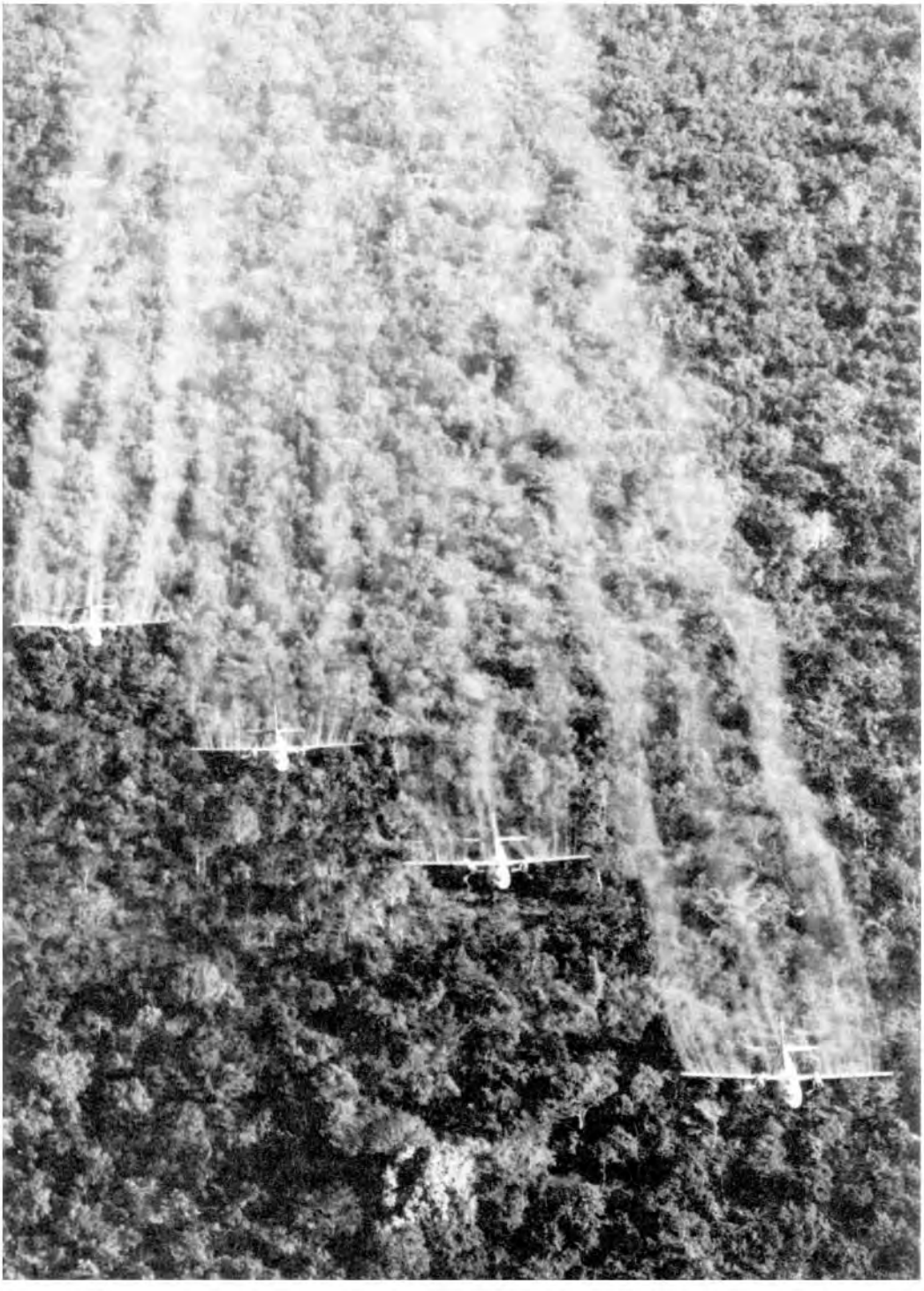
By the time the Air Force turned to herbicides for base vegetation control, they were in full-scale military use in support of other ground operations. The dispensing of defoliants centered on foliage along thoroughfares to deny the enemy ambush cover. Spraying also focused over VC/NVA camps and assembly areas, as well as over crops intended for feeding the foe. The acreage treated with agents from the 1,000-gallon tanks of USAF UC-123 (Ranch Hand) aircraft rose from 17,119 in 1962 to 608,106 in 1966.[49]

None of these herbicides was believed to endanger humans or animals. All had been widely used in the United States for more than 20 years on foods and other crops, rangeland, and forests. None persisted in the soil and periodic respraying was required to kill regrowth. All were liquids. Those dispensed in RVN were designated Orange, White, and Blue. Appendix 5 gives general data on their composition, application, effect, and safety precautions.

The use of these herbicides was a GVN program supported by the United States. The U.S. Ambassador and COMUSMACV acted jointly on GVN requests for herbicide operations on the basis of policy formed by State and Defense Departments and approved by the President.[50] Senior U.S. Army advisors at ARVN corps and division level were delegated authority to approve requests in which dispersal of the herbicides was limited to hand or ground-based power-spray methods.

A herbicidal defoliation request from a USAF air base was prepared and documented by the base civil engineer, using a set checklist. (See page 77.) It was then processed through U.S. military channels to the senior U.S. Army headquarters in the corps tactical zone. If approved there, it was sent on to the ARVN commanding general of the same CTZ for military approval and political clearance. It was at this point that delay most frequently occurred, due to opposition from the district and/or province chief. These officials were influenced by such things as superstition, concern for local crop damage, and possible propaganda value to the VC/NVA. Final action on requests for ground-delivered herbicides was taken at this level. If aerial delivery was desired, the request could only be approved at USMACV/JCS level.

A C–123 sprays defoliation chemicals over South Vietnamese jungles



Technical factors also entered into the dispensing of herbicides. Dry weather was essential, because rain quickly washed chemicals from the target vegetation to nearby crops and other desirable growth. Ideally, spraying was done between dawn and 1000, at ambient temperatures under 30° C (86° F), and in calm or very low wind conditions to minimize drift. Storage and mixing points had to be kept to a minimum, isolated from cultivated areas. Empty herbicide drums required close control to avoid accidental contamination.[51]

Approval and execution of herbicidal defoliation projects were time-consuming and uncertain. In February 1968 Phan Rang requested defoliation of a 200-meter strip both inside and outside the perimeter, around the entire circumference of the base. The approving authority reduced the scope of the project to one-half the perimeter. In addition, problems in obtaining herbicide and other obstacles delayed completion of the project for 1 year.[52]

Excessive vegetation at Tan Son Nhut and Bien Hoa hindered the base defenders throughout the 1968 Tet attacks.[53] At Bien Hoa the approval process for aerial defoliation was termed "hopelessly complicated," one

Checklist for Defoliation Requests

1. Overlays or annotated photographs depicting the exact area.

2. Target list:
   a. Area—province and district.
   b. UTM coordinates.
   c. Length and width.
   d. Number of hectares.
   e. Type of vegetation.

3. Justification:
   a. Objectives and military worth.
   b. Summary of incidents.

4. Psychological warfare annex (prepared by sector):
   a. Leaflets.
   b. Loudspeaker texts.

5. Civil affairs annex (prepared by sector):
   a. No crops within 1 kilometer.
   b. Contingency plan to provide food or money to families whose crops are accidentally damaged by the defoliation operation.

6. Certification by province chief:
   a. Province chief approval.
   b. Indemnification will be made by the Republic of Vietnam for accidental damage to crops.

SOURCE: Lib of Cong Rprt, 8 Aug 69, to the House Subcommittee on Science and Astronautics, 91st Cong, 1st sess, *A Technological Assessment of the Vietnam Defoliant Matter: A Case History*, p 19.

that might take two or more months. Plant growth meanwhile continued unabated. Even when authorized, a project was apt to be fettered with restrictions. Thus aerial delivery of Orange was denied at Bien Hoa, and only parts of its perimeter were approved for chemical defoliation. Accordingly, because Blue and White were not suited to local conditions, Orange had to be dispensed from a tank truck by a power spray that did not reach beyond the second fences. Local terrain made it impossible to go outside the third and fourth fence and spray inward.[54]

As noted earlier, Binh Thuy faced the most extreme defoliation problem. Here the one herbicide approved for use was Blue, which killed only those portions of plants with which it came in contact. With the root systems left intact, regrowth was rapid. In 1 month, 2,420 gallons of Blue valued at $22,000 were sprayed over limited areas of the interior and a narrow zone around the perimeter of the 550-acre installation without making any significant inroads against the teeming vegetation.[55]

Herbicides for air base defense seldom if ever improved the horizontal view at installations by the desired 40 to 60 percent.[56] Defoliation needs of the 10 primary bases were specific, permanent, and known in advance. Still no ongoing long-term program to satisfy them was ever set up. Instead the job was done piecemeal, with each base handling defoliation requests. Despite administrative and technical controls, chemical agents remained the single sure way to control vegetation in places where other means could not—notably in the critical perimeter complexes. As the war drew to a close, however, curbs on the use of herbicides grew more and more rigid. The last herbicide mission by fixed-wing aircraft was flown on 7 January 1971. On 1 May, a presidential directive ended *all* U.S. herbicide operations.[57] In the ensuing months, mines killed eight and injured seven Army personnel who were trying to clear vegetation by hand from wire entanglements and fields of fire.[58] With the Ambassador's full backing, COMUSMACV urged Washington to alter at once the ban on chemical herbicides because immediate defoliation was "essential to security of bases."[59]

On 18 August the President permitted the resumption of chemical defoliation until 1 December 1971. He authorized the use of Blue and White but not Orange. Approved herbicide operations were restricted to the perimeters of firebases and installations, with delivery limited to solely helicopter or ground-based spraying equipment, under the same regulations applied in the United States.[60] As the expiration date for this authority neared, COMUSMACV asked for an extension. On 26 November 1971 the President authorized continued use of herbicides and set no termination date. At the same time, he stipulated that U.S. defoliation assistance to the Government of Vietnam be confined to "base and installation perimeter operations and limited operations for important lines of communications." This policy prevailed until the last U.S. forces departed RVN in 1973.[61]

No defoliant method tried for air base defense purposes in South Vietnam proved to be at once efficient, economical, and politically acceptable. The practical value of herbicides was much impaired by technical, administrative, and political constraints. For chiefly technical reasons, the same could be said for techniques such as burning and scraping. For the United States—as it had for France—vegetation remained a major unresolved problem.

APPENDIX 5

Herbicides Employed in Air Base Defense Operations*

General

Antiplant agents are chemical agents which possess a high offensive potential for destroying or seriously limiting the production of food and defoliating vegetation. These compounds include herbicides that kill or inhibit the growth of plants; plant growth regulators that either regulate or inhibit plant growth, sometimes causing plant death; desiccants that dry up plant foliage; and soil sterilants that prevent or inhibit the growth of vegetation by action with the soil. Military applications for antiplant agents are based on denying the enemy food and concealment.

Antiplant agents in use

a. **ORANGE.**

(1) Description Agent ORANGE is the Standard A agent. It is composed of a 50:50 mixture of the n-butyl esters of 2,4-D and 2,4,5-T (app D and C1. TM 3-215). ORANGE appears as a dark-brown oily liquid which is insoluble in water but miscible in oils such as diesel fuel. It weighs about 10.75 pounds per gallon and becomes quite viscous as the temperature drops, solidifying at 45° F. It is noncorrosive, of low volatility, and nonexplosive, but deteriorates rubber.

(2) Rate of application. The recommended rate of application of ORANGE is 3 gallons per acre. This may vary depending on the type of vegetation. In some situations better coverage may be obtained by diluting ORANGE with diesel fuel oil, which results in a less viscous solution that is dispersed in smaller droplets. Dilution may also be required when using dispersion equipment which does not permit the flow rate to be conveniently adjusted to 3 gallons per acre.

(3) Effect on foliage. ORANGE penetrates the waxy covering of leaves and is absorbed into the plant system. It affects the growing points of the plant resulting in its death. Rains occurring within the first hour after spraying will not reduce the effectiveness of ORANGE to the extent that they reduce the effectiveness of aqueous solutions. Broadleaf plants are highly susceptible to ORANGE. Some grasses can be controlled but require a much higher dose rate than broadleaf plants. Susceptible plants exhibit varying degrees of susceptibility to ORANGE. Death of a given plant may occur within a week or less, or may require up to several months depending on the plant's age, stage of growth, susceptibility, and the dose rate.

(4) Safety precautions and decontamination. ORANGE is relatively nontoxic to man or animals. No injuries have been reported to personnel exposed to aircraft spray. Personnel subject to splashes from handling the agent need not be alarmed, but should shower and change clothes at a convenient opportunity. ORANGE is noncorrosive to metals but will remove

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* Lib of Cong Rpt, 8 Aug 69, to the House Subcommittee on Science, Research, and Development of the Committee on Science and Astronautics, 91st Cong, 1st sess, *A Technological Assessment of the Vietnam Defoliant Matter: A Case History*, pp 67-73.

aircraft paint and walkway coatings. Contaminated aircraft should be washed with soapy water to remove the agent. Rubber hoses and other rubber parts of transfer and dissemination equipment will deteriorate and require replacement, since ORANGE softens rubber.

2. **BLUE (Phytar 560G)**

(1) Description. Agent BLUE is an aqueous solution containing about 3 pounds per gallon of the sodium salt of cacodylic acid, the proper amount of surfactant (a substance which increases the effectiveness of the solution), and a neutralizer to prevent corrosion of metal spray apparatus. BLUE is the agent normally used for crop destruction.

(2) Rate of application. BLUE may be sprayed as received from the manufacturer without dilution, if desired. The recommended application rate for crop destruction is about 1 to 2 gallons per acre. However, much higher use rates of BLUE are required to kill tall grasses, such as elephant grass or sugarcane, because of the large masses of vegetation. For hand-spray operations, two gallons of BLUE diluted with water to make 50 gallons will give a solution that can be dispersed by hand at a rate equivalent to approximately 1 to 3 gallons of pure agent per acre.

Air Force C–123s spray defoliation chemicals over the A Shau valley

A Vietnamese soldier sprays fuel oil on dense foliage to determine the effectiveness of defoliation by fire. This failed because the fire would not keep burning

(3) Effective on foliage. Enough BLUE applied to any kind of foliage will cause it to dry and shrivel, but the agent is more effective against grassy plants than broadleaf varieties. Best results are obtained when the plant is thoroughly covered, since the agent kills by absorption of moisture from the leaves. The plants will die within 2 to 4 days or less and can then be burned if permitted to dry sufficiently. BLUE in low dose rates can also prevent grain formation in rice without any apparent external effect. The plant develops normally but does not yield a crop. Spray rates higher than about one-half gallon per acre usually kill the crop. Although BLUE can produce relatively rapid defoliation, regrowth may occur again in about 30 days. Repeated spraying is necessary to provide a high degree of continuous plant kill.

(4) Safety precautions and decontamination. Normal sanitary precautions should be followed when handling BLUE. Although it contains a form of arsenic, BLUE is relatively nontoxic. It should not be taken internally, however. Any material that gets on the hands, face, or other parts of the body should be washed off at the first opportunity. Clothes that become wet with a solution of BLUE should be changed. Aircraft used for spraying this solution should be washed well afterward. When WHITE is added to BLUE, a precipitate forms that will clog the system. If the same spray apparatus is to be used for spraying agents WHITE and BLUE, the system must be flushed to assure that all residue of the previous agent is removed.

Effects of aerial defoliation

c. WHITE (Tordon 101).

(1) Description. The active ingredients of agent WHITE are 20 percent picloram and 80 percent isopropylamine salt of 2,4-D. Active ingredients constitute about 25 percent of the solution. A surfactant is also present. WHITE is soluble in water, noncorrosive, nonflammable, nonvolatile, immiscible in oils, and more viscous than ORANGE at the same temperature.

(2) Rate of application. WHITE usually should be applied at a rate of 3 to 5 gallons per acre on broadleaf vegetation. However, the rate may vary depending on the type of flora. Quantities required to control jungle vegetation may vary from 5 to 12 gallons per acre. This quantity exceeds the spray capability of most aircraft spray systems for a single pass. It is usually unfeasible in large-scale military operations to apply such large volumes. For ground-based spray operations, however, high volumes are necessary. Hand-spray operations cannot evenly cover a whole acre with only 3 gallons of solution. Three gallons of WHITE diluted to a 30-gallon solution can be more easily sprayed over an area of one acre. The manufacturer recommends diluting WHITE with sufficient water to make a 10-gallon solution for each gallon of agent.

(3) Effect on foliage. WHITE kills foliage in the same manner as ORANGE, since 80 percent of the active ingredient is 2,4-D. PICLORAM is more effective than 2,4-D, but acts slower. WHITE is effective on many plant species, and equal to or more effective than ORANGE on the more woody species. The material must be absorbed through the leaves. The water solution does not penetrate the waxy covering of leaves as well as oily mixtures, and is more easily washed off by rain.

(4) Safety precautions and decontamination. WHITE exhibits a low hazard from accidental ingestion. However, it may cause some irritation if splashed into the eyes. Should eye contact occur, flush with plenty of water. Splashes on the skin should be thoroughly washed with soap and water at the first opportunity. Contaminated clothing should be washed before reuse. When WHITE is used in the same equipment as BLUE, all of the WHITE should be removed before using BLUE. The two agents produce a white precipitate that will clog spray systems.