
**AIR BASE DEFENSE
IN THE
REPUBLIC OF VIETNAM
1961 - 1973**

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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

* 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.

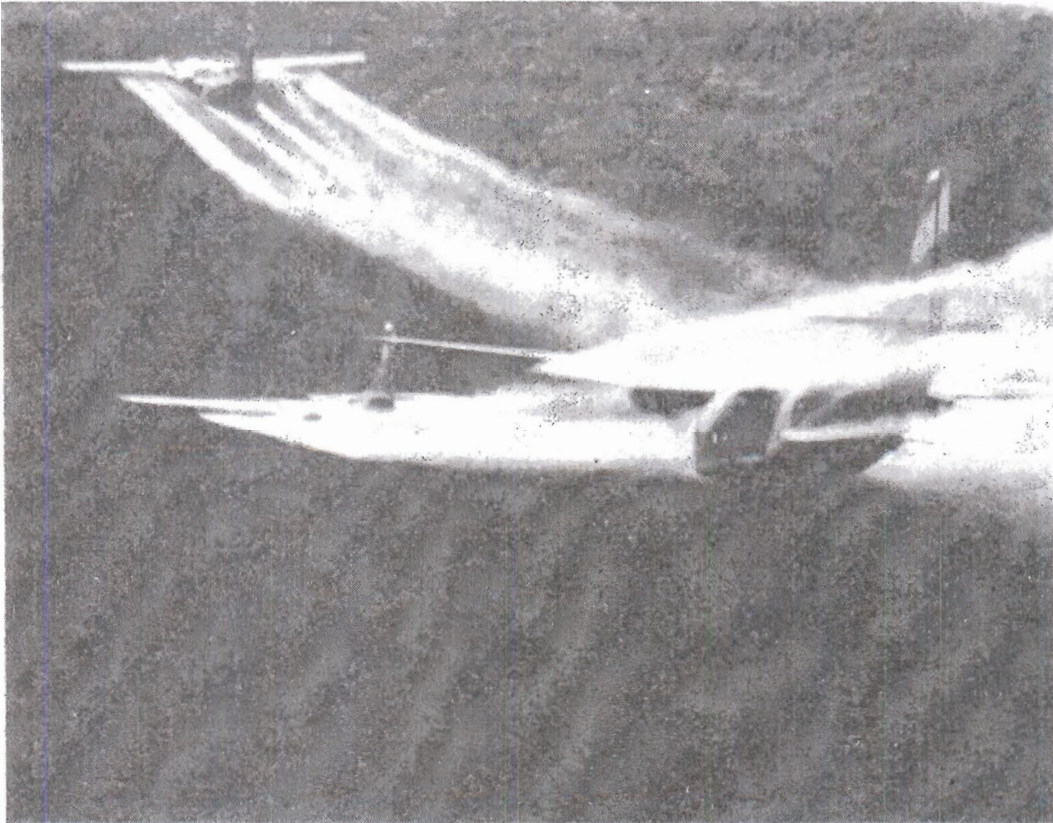
aircraft paint and walkway coatings. Contaminated aircraft should be washed with soapy water to remove the agent. Rubber hoses and other rubber parts of transfer and dissemination equipment will deteriorate and require replacement, since ORANGE softens rubber.

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.

