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HERBICIDES USED IN SOUTHEAST ASIA

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SECTION VII

AERIAL SPRAY SYSTEMS AND APPLICATION

A. AERIAL DISSEMINATION SYSTEMS

1. <u>A/A45Y-1 Internal Defoliant Dispenser</u>

The A/A45Y-1 defoliant dispenser is a modular spray system for internal carriage in cargo aircraft. It has been used only in C-123 aircraft but is adapted for use in the C-130. Currently, only UC-123K aircraft are used with the A/A45Y-1 system. Two gasoline-burning jet engines have been incorporated in this model to provide an additional source of emergency power after spray dissemination.

<u>Essential design features</u> of the A/A45Y-1 dispenser are:

1,000 gallon tank

20 hp gasoline engine and pump

Operator's console with pump and spray release controls

Wing booms 17 feet long and 1½ inches in diameter, extending from outboard engine nacelles toward the wing tips, with 12 check-valve nozzles regularly spaced.

Tail boom 20 feet long and 3 inches in diameter, positioned centrally near the aft cargo door, with four check-valve nozzles on each end spaced at 6-inch intervals.

Nozzles are Spraying Systems Company check-valve bodies (3/8 inch) without nozzle orifices, the spray being emitted directly from the open check valves.

Performance characteristics:

Aircraft speed	135 knots
Flight altitude	150 feet
Effective swath width	240 feet
Application rate	3 gallons/acre
Delivery rate	250 gallons/minute
Spray droplets, MMD	320 to 350 microns
Spraying time for 950 gallons	4 minutes
Length of swath	10.4 statute miles (16.7 km)

2. UH-1B/D Helicopter Spray System (AGRINAUTICS)

The AGRINAUTICS (formerly AGAVENCO) spray unit is self-contained and is suitable for use in the Army UH-1B and UH-1D, the US Navy UH-1E and the US Air Force UH-1F helicopters. It can be installed in or removed from the aircraft in a matter of minutes because it is merely "tied down" to installed cargo shackles, and no modifications are required for its use. The sprayer was designed for the dissemination of insecticides or herbicides.

Essential design features of the Sprayer-Pesticide, Helicopter Mounted, UH-1B/D are:

200-gallon fiberglass tank

Cradle or support structure 10 x 4 x 3.5 ft

Externally mounted 6-bladed windmill pump

Spray booms 32 feet long with positions for 56 nozzles

Weight of system, 200 pounds empty

Performance characteristics:

Aircraft speed	50 to 90 knots
Flight altitude	50 feet
Effective swath width	100 feet
Maximum application rate	3 gallons/acre at 90 knots
Spray droplets, MMD	150 to 300 microns

The UH-1B/D system has been used extensively by the Army in small-area spray applications. Under field conditions, some difficulty has been experienced with ORANGE in softening the paint on the aircraft tail assembly and fuselage. Preventative measures include preliminary coating of the aircraft with light grease and follow-up rinsing with diesel fuel or kerosene.

3. Field Expedients

A number of "jerry-rigged" or field-expedient devices have been developed for use in helicopters for small area spraying of chemicals on perimeter defenses, helicopter landing sites, and Vietcong (VC) crop areas. These field expedients have ranged from a 55-gallon drum equipped with spray bar for temporary mounting across the skids of a UH-1B/D helicopter to large devices for a CH-47 aircraft consisting of a 400-gallon metal tank or 500-gallon collapsible fuel bladder with power-driven fuel-transfer pump and improvised boom.

As regular items of issue, such as the UH-1B/D Helicopter Spray System, become readily available, the use of field expedients may be discontinued.

B. OPTIMAL CONDITIONS FOR AERIAL APPLICATION

The basic consideration in aerial application of liquid sprays for vegetation control is to secure maximum deposition of the delivered agent on the selected target. Exact placement of the spray on target is essential to secure full advantage of the chemical and to prevent possible damage to crops or other desirable vegetation in proximity to the target area.

The following guidelines have been developed for RANCH HAND operations with the A/A45Y-1 system:

1. Missions will be accomplished under inversion or neutral temperature conditions with air temperatures not to exceed 85 F. These conditions are usually obtained in early morning hours. Spraying under lapse conditions will result in upward movement of fine drops with consequent drift and reduction of deposit.

2. Winds should not exceed 10 mph at ground level. Lateral displacement of spray droplets as affected by a crosswind of 3 mph is shown in Table VII.

3. Spray should be released at 150 feet or lower. Spray droplets of ORANGE 100 microns in diameter require 2 minutes to fall a distance of 150 feet. Under conditions of a 9-mph crosswind, the 100-micron drop of ORANGE may be laterally displaced 1,594 feet. A 300-micron drop will be shifted 183 feet from the line of delivery (Table VIII).

4. Mass median diameter (MMD) of the spray should be coarse (300 to 350 microns) to reduce the proportion of small drops available to drift off target. Small droplets (100 microns or less) are more effective than large drops in producing herbicidal or desiccant effects. The selected size is a compromise with effectiveness to reduce drift and secure accurate placement on the target.

5. Delivery aircraft speed should be slow (130 to 135 knots) to minimize droplet breakup from impingement of the airstream on spray at the nozzle and to maintain a capability to stay on target with changes in direction. Nozzle orifice tips have been removed from the A/A45Y-1 system to maximize droplet size at this speed.

6. Flight targets should be oriented in an inwind direction as far as possible to reduce drift.

7. Spray applications should not be made during or immediately preceding heavy precipitation. ORANGE, being insoluble in water, is least affected by rainfall occurring immediately after spray application. Effective amounts of ORANGE, BLUE and WHITE will be absorbed by the foliage within 1 hour after spray deposit.

TABLE VII. EFFECT OF SPRAY DROPLET SIZE ON SPRAY DRIFT

Droplet Diameter, microns	Type of Droplet	No. of Droplets per Square Inch at 1 Gal. of Spray per Acre	Time Required to Fall 10 ft. in Still Air	Distance Droplet Will Travel in Falling 10 Ft. in a 3-mph Breeze
0.5	Brownian particle	-	6,750 minutes	388 miles
5	Fog	9,000,000	66 minutes	3 miles
100	Mist	1,164	10 seconds	409 feet
500	Light rain	9	1.5 seconds	7 feet
1,000*	Moderate rain	-	1.0 seconds	4.7 feet

* 1,000 microns = 1/25 inch.

TABLE VIII. RATE OF FALL AND DOWNWIND DRIFT OF ORANGE FROM 150-FOOT ALTITUDE IN 3-, 6-, AND 9-MPH WINDS

Droplet Size, microns	Rate of Fall, ft/min	Time to Fall 150 ft, min	Feet of Lateral Drift While Falling 150 ft. in Crosswinds of:		
			3 MPH	6 MPH	9 MPH
50	18	8.33	2,199	4,398	6,597
70	36	4.17	1,101	2,202	3,303
100	73	2.0	538	1,056	1,594
150	164	0.91	240	480	720
200	291	0.52	137	274	411
250	456	0.33	87	174	261
300	657	0.23	61	122	183
400	1,162	0.13	34	68	102
500	1,812	0.08	21	42	63

C. SPRAY DRIFT ON DEFOLIATION MISSIONS AND PROXIMITY TO CROPS

Spray drift from defoliation missions may become a potential problem when desirable crops are in close proximity to the target. The principal factors influencing drift from spray applications are: droplet size, height of release, and atmospheric conditions, principally horizontal air movement. In Table VIII, data are presented for the rate of fall and amount of lateral drift of herbicide ORANGE under three crosswind velocities on release from 150-foot altitude.

Calculations for an assumed droplet spectrum for the UC-123K system with 350-micron MMD showed that 88% of the total spray volume consisted of droplets 200 microns or larger in diameter.[17] This portion of the total spray delivered under a 9-mph crosswind would fall within 411 feet of the aircraft flight path, giving a ground deposit of 1.4 to 3 gallons per acre. Under the same crosswind conditions, droplets 70 microns in diameter would drift a total distance of 1 kilometer (3,303 ft) from the flight line. Again, on the basis of an assumed droplet spectrum, droplets varying from 70 to 100 microns in size would give a total deposition volume of only 0.032 gallon/acre from a single sortie. This rate of deposition of ORANGE would cause herbicidal response only on the most sensitive or susceptible crop plants. The deposition from droplets 50 microns in size would be negligible, amounting to only 0.0012 gallon/acre for a six-sortie mission.

Thus, the most unfavorable conditions of a 9-mph crosswind, a multiple-sortie mission, and spray droplets of 350 microns MMD should give no drift damage to broadleaf crops at distances greater than 1 to 2 kilometers at a maximum. Rice and other grass crops will not be affected by drift of ORANGE at distances greater than 1 kilometer.

Under the herbicide operation procedures for aerial spray applications with the UC-123K or UH-1B/D aircraft outlined in MACV Directive 525-1,[18] the prescribed distances of defoliation targets from rubber plantations and crop areas provide an adequate safety factor to avoid crop damage from spray drift from defoliation missions. Strict adherence to these procedures will insure proper application on the assigned target and minimize the hazard of damage to nearby crops or rubber plantations.

In many instances of alleged crop damage due to drift, careful examination has shown the damage to have been caused by leaking nozzles or other malfunctioning of the spray system. Equipment should be carefully checked before and after each mission to prevent leaking or spray deposition on nontarget areas.

D. VOLATILITY AND CROP DAMAGE

Two of the three herbicides in use in RVN, agents BLUE and WHITE, are prepared as aqueous solutions of water-soluble solids. The active ingredients are nonvolatile, and there is no vapor hazard associated with their use.[19]

In the field of vegetation control, the butyl esters of 2,4-D and 2,4,5-T in ORANGE are considered volatile. However, the vapor pressure of these components and of ORANGE is less than 1 mm of mercury at 35 C (Table IX). The physical chemist would regard ORANGE as essentially non-volatile. In the tabular data presented, the values represent the temperatures at which vapor pressure of the material equals 1 mm of mercury. A high value, such as that of butyl 2,4-D, thus represents low volatility.

TABLE IX. RELATIVE VOLATILITY OF COMMON CHEMICALS*

Substance	Temperature at which Vapor Pressure Equals 1 mm of Mercury, C
Water	-17
Butyl Alcohol	- 1
Ethyl Glycol (permanent anti-freeze)	53
Naphthalene (solid moth balls)	53
Hexachlorobenzene	114
Kerosene	120
No. 1 Fuel Oil	120
Glycerine	125
Butyl 2,4-D	147
No. 2 Fuel Oil	153

* Data from R.C. Weast (ed.), Handbook of chemistry and physics, 49th edition, Chemical Rubber Publishing Co., Cleveland, Ohio, 1968.

Because vapor pressure of ORANGE is extremely low and, under optimal conditions, approximately 97% of the spray volume from the UC-123K system is deposited on the ground or vegetation in less than one minute following release from the aircraft, it may be concluded that vapor released during droplet descent represents an extremely small percentage of the entire mass of herbicide sprayed. Thus, vapors arising during actual spray operations are not a significant source of herbicide for crop damage outside the target area. The greatest hazard of vapor damage occurs under neutral conditions and near-calm winds. For this reason, it is recommended that spray missions be carried out only under inversion conditions insofar as the tactical situation permits.

The extent of vapor release from the vegetation after spray deposit is not known. However, under lapse conditions, the vapor would rise above the canopy and be dissipated. Under inversion conditions, the vapor would be trapped within the forest canopy and further supplement the herbicidal effect from absorption of spray droplets.

Observations of defoliation targets by competent personnel have consistently shown sharp demarcations between the sprayed swaths and adjacent unsprayed forest areas when spraying was conducted under conditions of minimal ground wind. If volatility of the sprayed herbicide were significant, the boundaries of the sprayed swaths would be obliterated due to lateral movement of vapor into the unsprayed areas under the normal daily convectional air movements. The sharp boundary zones of sprayed areas are thus indicative of a limited volatility response.

It is concluded that lateral movement of vapor from ORANGE is negligible under ordinary conditions and that volatility of ORANGE is not significant in causing damage to crops.

E. CALIBRATION PROCEDURES FOR AERIAL SPRAY SYSTEMS

Characteristics of the spray deposition pattern from aerial systems, including mass deposit (gallons per acre), swath width, MMD, and droplet spectrum, are determined by test flights on a calibration grid with selected agents under simulated operational conditions.

Test flights are made inwind to provide data for effective swath width and total deposit. Crosswind flights permit determination of MMD and droplet spectrum characteristics. Flights over the calibration sampling grid should be restricted to neutral or inversion conditions with wind velocities not exceeding 3 to 8 knots, except for crosswind flights. Parameters measured during test flights include flow rate (gpm) and dissemination time to permit determination of total delivered volume. If flow meters are not incorporated in the spray system, flow rate may be determined in static or ground tests.

1. Sampling Grid

Spray deposition samples are usually collected both on Kromecote cards and on aluminum or glass plates at sampling stations placed at regular intervals in a line perpendicular to the flight path. Dye is added to the agent to permit spectrophotometric determination of deposit from the aluminum or glass plate and to aid in visual determination of drop size on the Kromecote cards.

In calibration tests conducted in 1968 with the A/A45Y-1 system,[20] the sampling grid consisted of three parallel lines 5,000 feet long, each row containing 297 sampling stations. The central 1,000 feet of each line had sampling stations at 5-foot intervals.

2. Mass Deposition and Droplet Spectrum

Total mass or spray deposition (in gallons per acre) is determined for each sampling station by: (1) colorimetric or spectrophotometric determinations of the dye deposit on aluminum or glass plates; (2) visual counts of droplets by spot sizes on Kromecote cards with appropriate conversion to droplet volume or mass by means of spread factors; or (3) visual estimate from Kromecote cards by comparison with standard cards of varying deposition rates. Graphic plots of the deposition pattern in relation to the flight path are used in determining effective swath width.

The droplet spectrum may be expressed as the number or volume of droplets by size classes over the range of droplet size. Droplet diameter data may be obtained from the Kromecote cards. Card spot diameters (in 100-micron-diameter classes) may be converted to spherical droplet diameters by use of predetermined spread factors. In the recent Eglin AFB tests,[20] a minimum of 75 spots were tallied for each sampling station for computations of total deposit in droplets less than 100 microns, 100 to 150 microns, and in excess of 500 microns in spherical diameter. The spread factor for ORANGE in this test ranged from 2.441 at 100 microns to 7.957 for drops 6,000 microns in diameter.

3. Mass Median Diameter (MMD)

MMD is defined as the droplet size in microns below which one-half the total recovered mass or volume of deposit occurs. It expresses the mid-point in droplet size based on volume of spray deposited. Crosswind flights that sort out droplet sizes according to distance from the flight path are useful in measurement of MMD.

Approximations of MMD may be obtained by the spot D-max method, selecting the largest drop in a measured series of 10 to 15 individuals on Kromecote cards from crosswind flights. The spherical drop D-max computed from the spot diameter by the spread factor is then used in estimating MMD by means of a conversion factor related to aircraft speed.[21] The conversion factor varies from 2.2 for slow speeds (80 mph) to 2.5 for high-speed delivery systems (150 to 180 mph). The following formula is used:

$$\text{Estimated MMD} = \frac{\text{Spherical drop D-max}}{\text{Conversion factor}}$$

Direct calculation of MMD was obtained for data in the 1968 Eglin Air Force Base tests by computing cumulative mass deposits over the full range of droplet size classes based on actual tallies on inwind and crosswind flights.

4. Swath Width

Swath width for a specific aerial spray system, such as the A/A45Y-1, varies with several factors, such as spray altitude, droplet spectrum and MMD, inwind or crosswind conditions, etc. The most accurate determination of swath width is obtained from direct inwind releases under inversion conditions with aircraft crossing the sample grid line at right angles.

Effective swath width is based on a minimum biologically effective deposition rate for the agent or agents. For Southeast Asia conditions, the minimum biologically effective deposition rate for ORANGE was established at 1.0 gallon/acre.[20] Effective swath width can be computed as the width of a continuous swath equal to or in excess of this minimum deposit level.

5. Percentage Recovery

Percentage recovery represents the relationship between the amount of spray material released from the aircraft and the amount actually deposited on the ground at the sample line less the amount lost due to drift and evapcration. In the 1968 Eglin tests, average recovery of ORANGE was 82.74% for inwind flights and 72.36% for crosswind flights.[20]

SECTION VIII

GROUND DISSEMINATION SYSTEMS AND APPLICATION

A. BUFFALO TURBINE

Various dissemination devices, as field expedients, have been used in RVN for control of vegetation on limited areas. The Buffalo Turbine is representative of one type of disseminator that is capable of disseminating both liquid and dry chemicals and may be obtained from agricultural supply houses in the United States. One type of unit consists of a trailer-mounted, 50- or 100-gallon stainless steel tank with agitator, pump, turbine fan and air-cooled gasoline engine. In operation, the turbine fan generates a high-volume, high-velocity airstream which is projected through a restricted orifice and will develop an air blast with a velocity up to 150 mph and a volume of 10,000 cubic feet per minute. The chemical is atomized into a fine mist when injected into this air blast.

The Buffalo Turbine is adapted for roadside spraying and applications on perimeter defenses. Application of ORANGE or BLUE may be made of undiluted chemical or of 1:1 dilutions with diesel fuel (ORANGE) or water (BLUE).

B. POWER-DRIVEN DECONTAMINATION APPARATUS (PDDA)

The PDDA is a self-contained spray system mounted on military vehicles and was designed to disseminate decontaminating chemicals to eliminate toxic agents. In the field, these units are used for many purposes, including dissemination of herbicides. Several models of these decon rigs are available in RVN, and all are adaptable for use on vegetation control problems. The larger models have pumps capable of delivering chemicals at rates of 35 to 60 gallons per minute at pressures up to 800 pounds per square inch. Delivery is through two hoses, with adjustable nozzles, located at the rear of the unit.

The PDDA units have been used effectively with available chemicals to control vegetation on minefields, perimeter defenses, roadsides, etc. For localized applications of chemical, BLUE may be diluted with 2 gallons of agent in 50 gallons of water. ORANGE may be mixed with diesel fuel at the rate of 5 gallons to 50 gallons of diesel fuel. Applications may be made at volumes of 50 to 100 gallons of spray solution per acre as required to completely wet the foliage.[22]

SECTION IX

CONDITIONS INFLUENCING EFFECTIVE USE OF HERBICIDES

A. DEFOLIANT OPERATIONS

1. Target Vegetation

Two principal types of forest are recognized in RVN: (1) upland forests, which vary from dense tropical evergreen to fairly open semi-deciduous types, and (2) lowland or mangrove forests. The basis for this practical, simplified classification is the overall response to available chemical agents.

Upland forests usually consist of an overstory or dominant canopy of trees varying in height and crown size with one or more intermediate layers of smaller trees. The overstory trees may attain heights of 60 to 125 feet in high-rainfall areas and may consist of broadleaf evergreens or seasonally deciduous species. The intermediate and understory vegetation is often complex, with hundreds of species of shrubs, bamboo, palms, vines, and small trees ranging up to 20 to 30 feet or more.

In disturbed or partially cleared upland forests, remnants of the dominant overstory may remain with a dense secondary growth of small trees, shrubs and vines. Secondary forest or scrub and bamboo may develop rapidly on abandoned cropland or areas where timber has been removed.

Response to defoliant agents in the upland type will vary with the species mixtures and the complexity of the forest cover. Species differ widely in their response or susceptibility to the systemic herbicides ORANGE and WHITE. The long-term effectiveness of the defoliant treatments will be influenced by the proportion of resistant species. With the exception of areas dominated by bamboo, upland forest vegetation can be effectively defoliated for a period of 4 to 12 months with a single application of chemical. Repeat applications may be needed to maintain long-term defoliation, particularly in multiple-canopy areas. Secondary forest or scrub with a single canopy layer may show better canopy penetration and plant kill.

Lowland or mangrove forests are of two general kinds: those that grow in standing water, usually within the limits of mean high tide, and those that grow above the tidal limits but in marshy, poorly drained areas. In either type, the trees tend to be uniform in height, varying from 25 to 65 feet. These forests have a limited number of species, and an understory or ground cover is usually lacking. Trees have prop and aerial roots that impede movement and visibility. Nipa palm, water coconut, and tall ferns may occur near canal or river channel borders.

Mangrove forest shows excellent response to defoliation treatment with ORANGE. Single applications may give nearly complete kill so that repeat applications are not necessary. Nipa palm is generally slower in reaction; it is readily defoliated by ORANGE but not by WHITE. In general, ORANGE is preferred for defoliation in this forest type.

2. Selection of Agent

ORANGE and WHITE may be used for general long-term defoliation on forest areas in which a rapid defoliation is not required. BLUE may be used for more rapid but correspondingly short-term defoliation of woody and grass vegetation. In general, WHITE shows a slower initial defoliation response than ORANGE and a corresponding delay in rate of regrowth or replacement vegetation. Discoloration or browning of foliage sprayed with ORANGE is evident within one week after application. WHITE is slower in producing a visible plant response, requiring approximately 2 to 4 weeks for noticeable browning of tropical vegetation.

The oil-soluble (ORANGE) herbicides are more effective under moist and rainy conditions than are the water-soluble WHITE and BLUE. Oily agents are not readily washed off the foliage and penetrate waxy leaf surfaces more readily than do water-soluble agents.

Under temperate forest conditions, broadleaf deciduous forest types may be defoliated with ORANGE or WHITE. Evergreen conifer forests are more susceptible to defoliation with WHITE than ORANGE.

3. Rate of Application

Application rates of 3 gallons per acre are used for defoliation of tropical forest vegetation with agents ORANGE, WHITE and BLUE. Research tests in Thailand indicated that ORANGE was effective on secondary growth vegetation at 2.0 gallons per acre, but for general use the 3-gallon rate is recommended. Under temperate forest conditions, application rates of 1 to 1.5 gallons per acre of ORANGE may be sufficient.

No advantage was found in increasing the rate of BLUE above 9 to 12 pounds per acre for rapid defoliation in tropical forest areas (Table IV).

4. Season of Application

Agents ORANGE and WHITE are more effective as defoliants when applied during the rainy or growing season. Both chemicals are systemic herbicides and are more readily absorbed and translocated in the plant system during periods of active growth. Under RVN conditions, some of the trees become dormant and deciduous during the dry season and subsequently are less affected by these chemicals.

Agent BLUE, as a desiccant or contact herbicide, has been found to be effective during both rainy and dry seasons. BLUE may be preferred for short-term defoliation during the dry season.

B. ANTICROP OPERATIONS

1. Target Crops

Although extensive areas of RVN are under cultivation, selected target areas are highly restricted in location and type of crop.

Upland rice grown in recent slash-and-burn areas in the highlands area constitutes one of the principal target crops. Crop control operations are not conducted in the extensive areas of paddy rice in the IV Corps or delta region.

2. Selection of Agent

Rice, corn and other cereal crops may be effectively controlled with agent BLUE.

Most broadleaf crops such as manioc, castor beans, soybeans, sweet potatoes, garden beans, cabbage, peanuts, etc., are susceptible to treatment with ORANGE (see Section IV, A, 4).

3. Rate of Application

Recommended rate of application of BLUE and ORANGE in the UC-123K system is 3 gallons per acre. This rate is considerably in excess of the amount required as a lethal dosage but is used to provide compatibility with alternative defoliation targets, which may be chosen as replacements.

For specific crop targets to be sprayed by helicopter systems, the recommended rate of BLUE or ORANGE is 1 gallon per acre. Adjustment to the normal delivery volume of 3 gallons per acre of the UH-1B/D system may be made, if desired, by dilution of ORANGE with 2 parts of diesel fuel and dilution of BLUE with 2 parts of water per unit of chemical.

The recommended rates are considerably greater than required for crop destruction or yield reduction. Effective control of rice can be obtained with 1.0 pound/acre of BLUE and of most broadleaf crops with similar rates of ORANGE. Application of BLUE at rates as low as 0.25 pound/acre on rice will significantly reduce crop yields even though the plants may remain green.

4. Season of Application

In general, chemical applications to crops should be made during the early growth stages prior to flowering and seed or fruit production. Rice and most broadleaf crops should be treated before seed head production. Root or tuber crops, such as potatoes, sugar beets and manioc, show greatest yield reduction from application of chemicals during early vegetative growth.

C. GRASS AND TOTAL VEGETATION CONTROL

1. Target Vegetation

For base camp perimeters, minefields, and lines of communication with predominantly tall grass and woody sprout vegetation, BLUE is the preferred agent of the chemicals currently available. Repeat applications may be required at 1- to 2-month intervals to kill back regrowth.

Bulldozed or mechanically cleared areas with heavy regrowth of woody sprouts may be treated with ORANGE at the standard application rates with aerial or ground spray equipment.

Kenapon, a liquid formulation of dalapon, has received limited trial under tropical conditions and shows promise as a systemic herbicide for control of perennial grasses, such as elephant grass, wild cane, etc. Further test work is needed to provide a recommendation.

2. Rate of Application

Similar to those for defoliation, BLUE may be applied for grass control at rates of 2 to 3 gallons per acre with aerial or ground equipment. ORANGE or WHITE may be used for woody plant control at similar rates.

3. Season of Application

Similar to requirements for defoliation.

D. GENERAL RECOMMENDATIONS

A synopsis of general use recommendations for vegetation control agents in Southeast Asia is given in Table X.

TABLE X. SYNOPSIS OF USE RECOMMENDATIONS FOR HERBICIDES IN SOUTHEAST ASIA

Type of Vegetation Control	Target Vegetation	Agent	Rate, gal/acre	Restrictions on Use
Defoliation	Upland forest	ORANGE	3	Avoid proximity to rubber and crop areas.
		WHITE	3	Avoid proximity to rubber and crop areas.
		BLUE	3	Short-term effect.
	Mangrove forest	ORANGE	3	Preferred agent.
		BLUE	3	Optional near crops.
Crop	Rice and grain crops	BLUE	3	Use undiluted in C-123 system.
			1	Dilute with 2 gallons of water for total of 3 gallons per acre in UH-1B/D system.
	Broadleaf crops	ORANGE	3	Use undiluted in C-123 system.
			1	Dilute with 2 gallons of diesel fuel for total of 3 gallons per acre in UH-1B/D system.
Grass and Total Vegetation	Grasses	BLUE	3	Not effective on bamboo.
	Woody regrowth	ORANGE	3	More effective on sprouts 1 year or more old.

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