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CORONA HARVEST
DEFOLIATION OPERATIONS IN SOUTHEAST ASIA (U)

A SPECIAL REPORT

Prepared by

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Project CORONA HARVEST

March 1970

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FOREWORD


General. This CORONA HARVEST special report is one of a continuing series of short, informative papers on highly significant airpower or airpower-associated subjects related to the war in Southeast Asia. Distribution of special reports is limited and controlled, with specific recipients determined separately for each report.

Purpose. To present in detail and sequence the development and success of the defoliation program conducted by the United States Air Force in Vietnam from the beginning of American participation there to June 1969.

Scope. For background purposes, a brief description of the past efforts of the Air Force in defoliation is included by way of introduction. This is followed by a brief history of our involvement in defoliation efforts in Vietnam and the sources and problems involved in bringing the project to fruition. The remainder of the study examines in detail the units involved, their aircraft, personnel training, hazards, and finally the results of the project and the contribution it made to the war effort. A final section is devoted to United States public opinion on defoliation in recent years.

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TABLE OF CONTENTS

	PAGE
Background	1
Defoliation in Southeast Asia	3
Crop Destruction	5
Increasing Defoliation	7
Operations in Laos	12
Year of Acceptance	12
Project PINK ROSE	14
Herbicide Shortages	15
Operations in 1967	16
RAND Evaluation and Response	18
Operations in 1968	22
Recent Operations	24
Vietnam Operations Summary	25
Civilian Attitude Toward Defoliation	27
Attachment No. 1	
"Types of Herbicides Used in South Vietnam" . . .	30
Footnotes	32

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DEFOLIATION OPERATIONS IN SOUTHEAST ASIA

Background

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The concept of spraying chemicals from airplanes in an effort to destroy ground foliage or insects is not peculiar to the United States military effort in South Vietnam. This most recent conflict does represent the first large-scale military attempt to destroy vegetation over vast areas. The adaptation of herbicidal chemicals to warfare on such a scale marks the hostilities in South Vietnam as unique in this respect.

At the end of World War I, the Army Air Service was left with a large surplus of airplanes and a rapidly diminishing number of pilots. Our newest and most romantic combat arm was faced with both military and public apathy once combat flying was over. The Air Service tried in many ways to interest the American people in the value of the airplane and in flying in general. One of the earliest means of dramatizing the usefulness of the airplane in peacetime was brought about by the periodic recurrence of insect infestation.

In the summer of 1921, AAS test pilot Lieutenant John A. Macready experimented with the dusting of lead arsenate from a DH-4 over a grove of catalpa caterpillar-infested trees near Troy, Ohio. Despite the crude hopper used to dispense the poison, the result was sufficiently successful to cause further experimentation.[1] In 1922, working with Department of Agriculture officials, the Air Service pilots began the aerial dusting of Louisiana cotton fields under attack from the cotton leafworm. Operating with hastily constructed equipment -- even paper bags filled with calcium of arsenate for a brief time -- the Louisiana group learned that aerial dusting could effectively poison leafworms on cotton plants. These dusting experiments, and others on apple orchards and fields of tomato plants, convinced commercial companies to build and operate specially designed aircraft with manually operated or automatic hoppers to dispense poison dust. A new, practical, and publicly accepted use had been found for the airplane.[2]

The military viewed aerial spray operations differently. The use of poison gas during World War I had caused countless casualties at very little cost to the army using the gas. It was reasonable to expect that the "next war" would find greater use of gas. When the airplane proved successful in dusting crops it was an easy step to visualize aerial spraying of poison gas against troops and

6003

DEFOLIATION OPERATIONS in Southeast Asia (U):

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installations. It was in this area that the Air Service, and later the Army Air Corps, concentrated much of its effort in the inter-war period. Even then, the results did not seem to be conclusive and the reports of the day simply recommended further study.[3] Of the many uses contemplated for the aerial dispersal of gas, none were concerned with defoliation or destruction of crops, nor were any tests of this particular type conducted.[4] There were many tests and drills using aircraft to dispense gas and the Air Corps was relatively well-prepared in this field with the advent of World War II.

When the use of gas in World War II no longer appeared a threat, the concept of aerial spraying, except domestically for insect control, received less emphasis. Still the use of aerial spraying for purposes other than health was under study. For example, in 1944 the Army Air Forces Board completed a study project on defoliation. It was designed to study the effects of chemicals in destroying or discoloring trees and foliage sufficiently to provide bomb line demarcation or navigational guides for pilots. The report indicated that such spray operations were an excellent means of destroying food crops being grown by isolated Japanese soldiers on bypassed islands in the Pacific. The best chemicals available at the time were ammonium thiocyanate and zinc chloride. While each compound would destroy crops and foliage, the report stated that they were unsatisfactory for marking bomb lines or lines of maximum penetration because of their slow-acting characteristics. In defoliation, three days passed before the leaves of the trees began to fall and this condition did not reach its height until the fourth or fifth day after spraying -- a period of stability not usually allotted to a ground commander. The AAF Board recommended that aerial defoliation had no immediate, practical, tactical application, and that the results of the report and accompanying pictures be distributed to various commands with further action contingent upon a need to be expressed by them. Incendiary tests, attempts at defoliation by burning, conducted simultaneously, were also judged to be tactically impractical and generally unsatisfactory, and little time was spent on them.[5]

Development continued, meanwhile, on the more practical aspects of aerial spray for insect control. During the war the airplane became an extremely important pest-control vehicle. Following further significant work by agricultural scientists and military officers, aircraft sprayed streams of DDT over many inaccessible breeding areas of disease-carrying insects. This technique proved especially important in protecting U.S. and Allied troops fighting in the Southwest Pacific and other regions where malaria-bearing mosquitoes posed almost as great a threat as the

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enemy soldiers. The end of World War II caused a cessation of military interest or testing in the area of defoliation.[6]

The Korean conflict brought no tactical necessity for large-scale defoliation of combat areas. Insect control concerned the military, just as it did the civilian community, but the necessity to defoliate did not arise, primarily due to the climate in which our troops fought where vegetation density was very similar to that of a majority of the United States. Aerial spraying capabilities of the post-World War II USAF were concentrated in the Special Aerial Spray Flight (SASF) based at Langley AFB, Virginia. It was charged by Air Force Regulation 90-3 with the dispersal of insecticides whenever needed at zone of the interior bases. Using C-47 and L-20 aircraft, the Flight had not only sprayed areas surrounding military bases but had assisted the Army occasionally in maneuvers involving the use of aerial spraying at Camp Detrick, Maryland. As a result of this limited activity, there were practically no experienced personnel upon whom to call when the need arose in Vietnam.[7]

Defoliation in Southeast Asia

(S) With the Viet Cong infiltrating into the heart of South Vietnam (SVN) through the use of natural cover, a demand for the elimination of the foliage was initiated in the headquarters of the Chief, Military Assistance Group, Vietnam (CIMAAGV) in July of 1961. At the time the plan was limited to defoliation along routes of communication, canals and main roads, to preventing ambushes and to denying the use of these vital arteries to the enemy. The first aerial defoliation test was conducted in August 1961 along Route 13 in Chon Thanh province.[8]

(S) By mid-1961 the SASF had received two C-123s for pilot checkout and testing in aerial spray operations. The organization was small, limited to the commander, four pilots, one entomologist, one assistant NCO entomologist, one clerk, and twenty maintenance personnel. The MAAGV requirement was relayed to SASF in late July 1961 with a request for the availability and suitability of using C-123s in Southeast Asia (SEA). The answer was none too firm, but the requirement was, and in November TAC was ordered to provide six spray-equipped C-123s along with sufficient support to operate in the field for four months. The six aircraft were hastily modified with MC-1 tanks installed internally. Armor plating was added to the floor of the cockpit and unnecessary equipment removed. The six modified C-123 aircraft and SASF personnel were alerted for SEA and the C-47 and L-20 experimental aircraft were placed in storage.[9]

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(S) For the purpose of deployment the unit was included in the overall operation plan, FARMGATE. A separate operations plan was published in December 1961 specifically for aerial spray operations at which time the code name RANCH HAND was assigned. The C-123s were in place at Clark AFB, Philippines by 6 December 1961, where they were delayed while clearance was obtained through diplomatic channels for entry into Vietnam. Under a heavy cloak of secrecy, three of the six planes were cleared into Tan Son Nhut Airfield, SVN on 7 January 1962. These three planes were the beginning of what became, in October 1966, and remains today, the 12th Special Operations Squadron.[10]

(S) From their arrival in January until mid-February 1962, the three planes participated in test missions of defoliation, chiefly along communication routes. As predicted, the reaction of the Communist press throughout the world, and of the Viet Cong (VC) in particular, was immediate and violent. After an initial series of missions were flown, there was a standdown while evaluation took place. IIq MAAGV and the Vietnamese government were generally pleased, but the evaluation noted that the targets flown were not representative of all the vegetation to be found throughout Vietnam. On 12 February the Joint Chiefs of Staff, (JCS) gave the whole operation "close scrutiny" and requested the Commander-in-Chief, Pacific Command (CINCPAC) to furnish a detailed report. Additional tests that continued into March included the Vietnamese Air Force (VNAF) who flew a C-47 and several H-34 helicopters. Not only were different kinds of vegetation under experiment, but spray tactics, loading procedures, equipment, and the establishment of target selection and approval routing were also tested. When the crews were not involved in a mission they flew basic, familiarization runs over SVN to increase their proficiency. On one of these flights the first RANCH HAND aircraft and crew were lost. A plane from the three remaining at Clark was dispatched as a replacement, and in March 1962 the other two planes at Clark joined the RANCH HAND operations in SVN.

(S) On 12 March Brigadier General F. J. Delmore, USA, Chief of the Department of Defense defoliation evaluation team, replied to the JCS questions with a rather pessimistic estimate of the use of defoliants in SEA. He reported that only 20-25 percent of the foliage around Bien Hoa had been killed, and that attempts to burn the foliage had failed. He concluded that the "operational benefits of defoliant operations is assessed as only marginal." [11] As a result of this and other pessimistic evaluation reports, the defoliation program was looked upon as "disappointingly ineffective." Despite the fact that U.S. Military Assistance Command, Vietnam (MACV)

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personnel disagreed with the reports and wanted a much more intensified program, orders were received to reduce the RANCH HAND organization to two planes and minimal supporting personnel. As a result two C-123s were flown home, one via the Pacific and the other, at the request of the State Department and the U.S. Agency for International Development (USAID) flew west to Afghanistan to spray for locusts and thereafter continued to the U.S. via Europe, becoming in the process the first C-123 to fly around the world. The third aircraft had been converted to airlift while in SVN and during one such mission crashed on takeoff and was destroyed. The crew was saved. [12]

(§) The need for defoliation continued to exist however and, in August 1962, President Kennedy approved an operational defoliation program against a few specific targets in SVN. By this time the program had gained many adherents among personnel at MACV and among the Vietnamese themselves, the latter having been pleased with the results from the beginning. Modifications were made on the two remaining C-123s to increase the spray flow rate to 1-1/2 gallons per acre. A third C-123 was sent back to SVN and, after JCS approval of continued operations, a series of missions was flown along the canals on the Ca Mau peninsula. These tests proved successful and resulted in 90 to 95 percent improved visibility along the canals. In December 1962, targets were sprayed along roads leading to the city of Qui Nhon. At the conclusion of this project all spraying was halted until the rainy season during which the vegetation grows most rapidly and the systemic herbicides have the greatest effect. From January to May 1963, the RANCH HAND aircraft flew logistic missions, radar target missions, and navigational aid testing.

Crop Destruction

(§) Nor was crop destruction as a weapon in the guerrilla war being ignored at this early date. Along with defoliation, crop destruction had been considered in October 1961. The main justification offered at the time, and the one that continues to justify the program, is the elimination of food sources which the Viet Cong "requisition" from local farmers to supplement rations from North Vietnam. The immediate problem in a basically agricultural country such as SVN is that the crops destroyed hurt innocent villagers and can drastically affect their allegiance to the SVN government, already on a none-too-solid foundation.

(§) The crop destruction proposal called for the VNAF to spray carefully-selected areas using H-34 helicopters. In addition, the

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South Vietnamese were to control the choice of targets and provide maintenance for the planes. The U.S. would supply the herbicide to the port of unloading as well as technical advice and assistance. The Commander of MACV and the American Ambassador to SVN agreed that the program had sufficient merit to warrant testing. A program of psychological warfare (psywar) was planned to counter the effects of the expected Communist propaganda. The proposal was approved by the Secretary of Defense, who, because of possible diplomatic problems, recommended the plan to President Kennedy in August of 1962. The State Department refused to endorse the plan and Secretary of State Dean Rusk submitted a memorandum to the President outlining his objections, chief among which was the problem of worldwide "political repercussions."

(S) The objections of the State Department caused the whole program to be returned to the Defense Department for additional review. An extensive series of conferences took place in the Defense Department and additional information and review was asked of CINCPAC, MACV, and the American Ambassador to SVN. Again their recommendations were on the positive side, refuting the State Department's argument by showing the strong desire of the SVN government to deny food to the VC. Another review of the situation was made and on 3 October 1962 approval was granted for crop destruction operations on a limited basis with control retained in Washington. [13]

(S) The first crop destruction missions were flown on 21-23 November 1962 and were sufficiently successful in destroying rice crops that further tests were conducted. In March 1963, the American Embassy in SVN recommended to the State Department that crop destruction, and defoliation as well, be continued in whatever areas its employment would most hurt the Viet Cong. The Embassy also asked that the Ambassador and the Commander, United States Military Assistance Command, Vietnam (COMUSMACV) be given authority to approve crop destruction requests on the scene.

(S) As the propaganda efforts of the People's Army of Vietnam increased, the State Department demanded another evaluation of crop destruction and set forth the following criteria for such operations:

"...All crop destruction operations must be approved in advance by Assistant Secretary Far East and the Department of Defense.

Crop destruction must be confined to remote areas known to be occupied by VC. It should not be carried

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on in areas where VC are intermingled with native inhabitants and the latter cannot escape. Also should be limited to areas where VC do not have nearby alternative sources of food or areas in which there is available food deficit, i.e., high plateau and Zone 'D'. [14]

(S) In the same message authority was granted the Ambassador/COMUSMACV to approve certain specific crop defoliation missions, but only in limited numbers and in carefully delineated areas. Increased psywar was called for and full reports were requested. These constraints added greatly to the time required to clear and coordinate a target. From inception at the lowest operational level until the crops were sprayed took anywhere from three months to a year -- far longer than growing and harvesting the crops in question. This excessive time for approval was reduced later by the removal of some coordinating agencies within MACV but the average time at the end of 1963 was a minimum of sixty days.

(S) Throughout the first half of 1964 crop destruction missions continued to be flown and good results obtained. The Ambassador and COMUSMACV persisted in their request for full approval authority and it was finally granted on 29 July 1964. By this time over 1300 acres of VC foodstuffs had been destroyed. [15]

Increasing Defoliation Program

(S) By May 1963 targets to be defoliated during the coming monsoon season were being selected and processed through the headquarters system. The results of the late 1962 defoliation missions had caused MACV to reverse its earlier finding of "disappointingly ineffective" and, based upon the correction of some technical shortcomings, that headquarters now recommended the defoliation program proceed at full speed. In June and July 1963, defoliation projects began again along canals, powerlines, roads, and railroads. VNAF helicopters aided in the operations, especially in the mountainous terrain. In August, diplomacy again intervened in the mission accomplishment as Thailand requested aerial spraying for an epidemic of locusts. Two C-123s were detailed to this operation which had to be coordinated between the embassies of the two countries plus SVN, adding to the complications. The project was actually flown during the period from 31 August to 16 September. In October and November the planes resumed normal RANCH HAND missions flying some 65 sorties on four projects. [16]

(S) In December 1963 night missions were suggested to counter increasing ground fire being received by the spray ships and to

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combat temperatures above 80° which cause thermal raising and a scattering of defoliant beyond the target. Initial attempts, on 8 December 1963, utilizing flare ships to illuminate the target, failed to improve the situation of vulnerability since the flares simply silhouetted the spray plane. Nighttime operations markedly reduced chances for rescue and survival, and reduced visibility required that targets be selected in relatively unobstructed areas which would permit rapid maneuvering. There was an additional problem of coordination between the flare ship and the spray aircraft, one which proved difficult to resolve. Because of these several drawbacks, night defoliation was discontinued except for rare occasions and never flown over the same target on successive nights. [17]

(8) By late 1963 the level of herbicide operations had surpassed that experienced by the British in Malaya in 1948. Areas being sprayed were no longer in friendly hands nor had they been first cleared by an aircraft strike. As a result, many of the herbicide spray ships were receiving hits from small arms weapons. Fighter aircraft were called upon to protect the spray ships, but were not effective in preventing ground fire hits. According to the tactical rules in effect at the time, the fighter aircraft could not pre-strike a target. They were allowed to take only defensive actions for rescue operations or to post-strike after small arms fire had been experienced.

(8) As in the previous year, the period from January to June of 1964 was one of inactivity so far as the herbicide program was concerned. This period of the slow-growing dry season was used to evaluate the program while the aircraft were utilized in MULE TRAIN logistics missions.

(8) Mid-1964 brought greater enemy activity in the rice-rich Mekong delta area. Because of heavier enemy fire, spray operations in this area rapidly became the "hottest" in Vietnam, increasing in intensity as the VC gained control over additional areas. To combat the intensifying enemy fire, spray plane pilots developed a new mission tactic best described as the "pop-up" maneuver. This involved flying very low (about 20 feet above the ground) through open areas to reach the target at which time the plane would "pop-up" to 100-150 feet for the spray run. On 30 April 1964 50-caliber and possibly an air-burst mortar fire was experienced. As a result, a copilot was wounded and his aircraft received over 40 holes of varying sizes. Missions were suspended pending another evaluation, the result of which was a new policy allowing the scheduling of multiple targets. Having more than one target, pilots

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could choose another if the primary one proved too "hot" due to enemy fire. In an additional effort to protect the crews from hostile fire, the same target was not scheduled more than two days in succession to prevent the VC from massing troops in the spray zone. [18]

(S) While operations in the Delta area were being evaluated and new missions scheduled, RANCH HAND aircraft moved north temporarily to Da Nang where, during May and June of 1964, they defoliated winding dirt roads which connected Vietnamese outposts in the mountainous area along the Vietnam-Laotian border.

(S) In late July 1964, the first pilots began reporting on a permanent basis (PCS) to RANCH HAND operations. During the first two and one-half years in Vietnam, crews had rotated on a four-to-six month temporary (TDY) basis, flying 800 sorties and dispensing 250,000 gallons of defoliant over some 80,000 acres. RANCH HAND personnel (still SASF assigned) had lost three crewmen and two aircraft. By the end of July 1964, defoliation became a part of the Pacific Air Force's (PACAF's) overall mission in SEA. [19]

(S) With the arrival of the PCS pilots, the Special Aerial Spray Flight (SASF) was reorganized as Detachment #1 of the 315th Troop Carrier Group. Based upon previous experience, new spray pumps were installed on the C-123s which increased the spray delivery rate to three gallons per acre. An armored "box" was placed in the cargo section to protect the spray operator and more armor added behind the instrument panels of each of the C-123s. Attempts were made to have the VNAF fly crop destruction missions in H-34 helicopters. While the missions were flown in July and August of 1964, the results were not completely satisfactory. Some of the reasons for this were failure to obtain permission to destroy crops where the VC control of the people was marginal, lack of experience on the part of the VNAF pilots, plus lack of motivation, and simply fear as well. In some cases poorly-engineered equipment also contributed to delays and poor results. As a consequence of this failure, a new concept was adopted whereby USAF and VNAF crews were mixed on all C-123 crop destruction missions.

(S) In October 1964 the first of the mixed crew concept missions was flown. Thus began a policy that remained in effect even after the step-up in U.S. involvement in SEA. Ground fire continued to increase, and one of the C-123s was severely damaged but landed safely. In December 1964 a fourth C-123 arrived in South Vietnam. The C-123 aircraft proved to be an excellent choice as a spray aircraft with its dual, rugged and simple support systems backing up two reliable reciprocating engines.

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During 1964, a total of 257.7 square kilometers of roads, railroads, canals and VC base areas were sprayed with defoliant and 15,215 acres of crops were destroyed, all as a result of 363 spray sorties flown. The C-123s were flown approximately 48 percent of their maximum capacity during 1964, but during the last four months of 1964 they used 92 percent of their available time. This utilization rate underscores the increased emphasis upon defoliation in the latter part of 1964. That RANCH HAND aircraft were not flown to their maximum capability was due to: (1) the fact that the herbicide program was still a small, adjunct program in the early part of the year, (2) operations were usually terminated when hostile fire was encountered, and (3) the chemicals were most effective during the wet season which at the same time had an adverse effect upon mission accomplishment. [20]

(S) In 1965 RANCH HAND missions and sorties became more important as the scale of fighting increased. A new idea was tried early in the year known as Project Sherwood Forest. Planning had begun in December 1964 on the project to clear a 48 square mile section of the Boi Loi forest some 26 miles northwest of Saigon. Long a VC stronghold, the forest was so dense that the enemy could operate with little fear of observation. A network of tunnels, caves, and trenches made the area a veritable fortress. The plan was to heavily bomb the area, then defoliate it using RANCH HAND aircraft. After the chemicals had killed and dried the foliage, 50-gallon fuel drums would be dropped in the area and ignited by M-6 parachute flares. The hoped-for result was a huge fire storm which would burn off the vegetation thereby exposing the ground to observation.

(S) The concept was approved and RANCH HAND aircraft did their part by spraying 78,800 gallons of defoliant during the period 22 January - 18 February 1965. By the end of March, with the dry season about to end, the chemicals had taken effect and the flare-rigged fuel barrels were dropped. The forest burned well for a short time, but by the following day all fires were out and the project was a disappointment. About the only benefit realized was that the enemy was denied the use of the area for a considerable period. The hoped-for denuding of a large area by fire simply did not occur. Still it was the first time fighter aircraft had been allowed to pre-strike a defoliation target, and it revealed the expanding use of chemicals in warfare. [21]

(S) For the rest of March and early April, RANCH HAND aircraft flew crop destruction missions in the An Lao valley area. In addition to destroying the crops there was a hope that the villagers would leave their homes and migrate into SVN-controlled

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areas. By so doing the declining food production would put an additional strain on VC requisitioners and force them to put more men to work growing food instead of fighting.

(S) By the time these crop missions had been completed, the final approval for Project Swamp Fox had been received. The largest defoliation project undertaken to that date, Swamp Fox called for the spraying of large areas in central SVN which the enemy had been using without fear of harassment for arms factories, hospitals, repair shops and training camps. Spraying operations began on 30 April after A-1E aircraft had pre-struck each target. In addition to the pre-strike, a forward air controller (FAC) was used to guide the fighters and the spray aircraft. The project was 70 percent complete when it was terminated because of increasingly heavy enemy ground fire on 25 May 1965. Some 77,600 gallons of defoliant had been sprayed.

(S) With the cancellation of Swamp Fox, a revaluation of the entire defoliation program was conducted by MACV-J2 (Intelligence). The result of this analysis was another indorsement of defoliation along with a recommendation to provide more A-1E fighter cover for the C-123 aircraft. Headquarters 2d Air Division and PACAF expressed concern for the safety of the crews. During the two projects flown that year eight crewmen had been wounded but there had been no fatalities. The A-1E aircraft was singled out for particular praise as a support aircraft in that it had the necessary airspeed and maneuverability and could carry a large amount of munitions to suppress ground fire during spray operations. In the IV Corps area, tactics called for the use of four A-1Es per mission, each armed with mixed loads of bombs and 20 mm ammunition. The fighters pre-struck the target based upon directions radioed from the FAC working the area. This strike was followed in three to five minutes by the C-123 spray planes. These tactics did not halt the incidence of ground-fire hits, but they did reduce the number somewhat. A lively debate ensued as to whether the fighter pre-strike was more beneficial or whether the element of surprise, which was lost by a pre-strike, was safer for the aircraft crews. The debate continues. The other major problem was in the area of target approval, which had slowed down considerably. Approval for some targets in sensitive areas took as long as a year, which resulted in the RANCH HAND backlog dwindling to as little as a single project at times. [22]

(S) The remainder of 1965 was spent defoliating "lines of communication" targets. In November, jet fighters (F-100s) flew pre-strike and cover for the C-123s for the first time while HH-3E

11
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"Jolly Green Giant" helicopters stood by. All such missions were under the control of a FAC. In September and October 1965, three more C-123 aircraft were modified for spray operations and reached SVN by 13 November. At this time the designation of the spray aircraft was changed from C-123 to UC-123.

Operations in Laos

(S) In December 1965, defoliation operations were begun in Laos to counter the use of the Ho Chi Minh trail by the VC. A network of foot trails, dirt roads and other lines of communication were sprayed by the UC-123s based at Tan Son Nhut and Da Nang. Weather, ground fire and high mountainous terrain combined to make these missions hazardous. The strong winds dispersed the spray, making it less effective than normal which required more sorties over the same target to complete the mission. The operation continued into late June 1966 and was credited by the FAC's and fighter pilots with aiding considerably in the destruction of over 1000 trucks on the defoliated roads. With the value of the missions established, sorties continued to be flown over Laos with great military benefit and little diplomatic difficulty.

Year of Acceptance

(S) While the sorties over Laos proceeded, operations throughout SVN increased in tempo. During January and February 1966 most of the missions were in the central part of South Vietnam with some in the northern area being flown by the RANCH HAND planes stationed at Da Nang. Several attempts were made to fly missions close to Tan Son Nhut using Tacan fixes and dispensing with a navigator. A careful study of this tactic was sufficient to discredit the idea and it was abandoned. Another jungle burning project (Hot Tip I and II) was attempted in January and February on Chu Pong mountain. Approximately 29 square miles of mountainous terrain were sprayed with 22,000 gallons of "orange" defoliant and, after it took effect, B-52s fire-bombed the area. At a headquarters MACV briefing on 13 March 1966, the briefing officer stated that the target was sprayed correctly, the weather, wind, humidity and ordnance delivery conditions were all satisfactory but "the damned trees just wouldn't burn." Inspection showed that only five percent of the area sprayed had burned. [23]

(S) Defoliation and crop destruction missions increased 20 percent in April with the result that COMUSMACV requested eleven more aircraft within the calendar year. Additional quantities of

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herbicide were requested to meet the stepped-up demands which now included missions in the demilitarized zone (DMZ) as well. By way of comparison of the growth of the defoliation/crop destruction program, there were 218 sorties flown in May of 1966 dispensing 199,450 gallons of herbicide. In the same month of 1964, only 20 sorties had been flown that sprayed 11,075 gallons of chemicals.

(S) In June 1966 the first RANCH HAND aircraft to be lost during a tactical mission was shot down by ground fire in Quang Tin province. Marine Corps helicopters rescued the crew, all of whom survived. In July, an effort was made to modify the spray equipment on the UC-123s to improve the volume as well as the "quick dump" capability. New spray tanks were installed, and a 20-hp pump, capable of delivering 400 gallons per minute, was added to each plane. The completed system was known as the A/A 45Y-1 Dispenser System. Included in this was a new tail boom 20 feet long and weighing 120 pounds, and a 10-inch dump valve instead of the previous 5-inch valve. The new system was capable of spraying 250 gallons per minute (3 gallons per acre) and the entire 1000 gallon capacity could be distributed in four minutes of spray time.

(S) During the summer of 1966 the first spray missions over North Vietnam were flown. Again, the target was lines of communication, in this case roads traversing Mu Gia pass leading from North to South Vietnam. Late summer found RANCH HAND aircraft flying missions throughout the length and breadth of SVN while efforts were maintained in Laos and in the North. Such extensive operations put a real strain on the seven aircraft on hand since November of 1965. In April of 1966, Hq MACV had requested eleven additional UC-123s to assist in the stepped-up herbicide program. Plane modifications and crew training delayed receipt until August when three were flown in. Four more arrived in September giving the Detachment a total of 14 UC-123s. On 15 October 1966 the Detachment was deactivated and the 12th Air Commando Squadron (ACS) formed, retaining the code name RANCH HAND. The unit was assigned to the 315th ACW, Troop Carrier. [24]

(S) With the arrival of the additional aircraft defoliation along the DMZ was stepped up. As many as four missions per day were flown due to good weather and the proximity of the base at Da Nang and the targets. The missions went so well that the aircrews exhausted the supply of herbicide and aircraft maintenance began to fall behind. It was necessary to slow down the operations which coincided with another detailed review of the political implications of defoliation in the DMZ itself. Close study of this

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action had begun in August of 1966, and in October permission had been requested by COMUSMACV to defoliate the entire IMZ. In November the Department of State responded that only the southern portion could be sprayed.

(8) Stepped-up operations were not without penalty in other respects as well. In October a UC-123 was shot down in the "Iron Triangle" area, but the crew was again saved. During spray operations in Laos on 31 January 1967 yet another plane was lost, this time with its crew. On 1 December 1966, the 12th ACS moved to Bien Hoa where there was more room for storage and operation. Eighteen UC-123s were authorized the squadron and as of the last of December 1966, 14 were on hand, two en route from the U. S. and two more were being modified in the Zone of the Interior. [25]

Project PINK ROSE

(8) In a continuing search for an economical way in which to clear large areas of jungle foliage and thereby deny concealment to the VC, a third jungle-burning project was attempted. In May 1966 COMUSMACV was requested by CINCPAC to plan a large-scale test to be code named PINK ROSE. The test was scheduled for 1967, to be accomplished in conjunction with other defoliation projects. Three targets were selected on 6 November 1966 and spraying began on each of the seven kilometer square targets (some 12,000 acres each) almost immediately. Under the general supervision of Hq 7th AF, personnel of the U. S. Forest Service evaluated all functions as the project progressed. By 27 November the first spraying of the two and three canopy forest was completed. Defoliant "Orange" was used on targets A and B while Area C received treatment of "White." In January 1967 a second application was made over the same areas, and ten days before ignition, agent "Blue" was sprayed. Close to 255 sorties and 255,000 gallons of herbicide were sprayed by 12th ACS planes.

(8) Flying out of Guam, ARC LIGHT B-52 aircraft began the ignition of the separate target areas on 18 January 1967 when 30 of the huge jets ignited Area C. On 28 January Area A was hit while bombing on Area B was delayed until 4 April. The effectiveness of the operation varied with the area. Area C revealed only spot burning wherever a bomblet fell with the open areas burning best. Otherwise the fires failed to spread more than two feet from point of impact of the bomblet. In Area A much the same results were experienced, but under the jungle canopies fires spread little more than six feet from the point of ignition. Very little change in canopy

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thickness or aerial visibility was experienced. Fire bomblets released over Area B were aimed at a small area in an attempt to create a fire storm, but only 50 percent of the fires burned into each other and the hoped-for storm was not created. Overall damage to the forest was not appreciable and the major conclusions of the project personnel, many of whom visited the areas for first-hand inspections, was that "results did not warrant the high cost of resources to continue testing." [26]

Herbicide Shortages

(S) One more result of the stepped-up spray operations of 1966 and 1967 was a shortage of herbicide. Despite an increase in quantity of herbicide requisitioned a shortage began to appear by November 1966, and, with the exception of PINK ROSE, previously approved missions were reexamined and some lowered in priority.

(S) One of the complications facing American military personnel in trying to solve the herbicide shortage was the method of accounting for and handling the chemicals once they reached SVN. Hq MACV refused to make the herbicides an item of USAF supply, despite numerous accounting errors and delivery delays due to delegating to the SVN government the responsibility of herbicide operations:

" . . . The GVN approves all projects and provides logistical support to include receipt, movement, storage, accounting, and loading of the herbicide on the spray aircraft. The U. S. provides the aircraft and crews (12th ACS). Crop destruction operations are conducted under the State/DOD approved Farm Gate concept. VNAF markings are placed on the aircraft and a VNAF observer is present during each mission. The present procedure has been successful from an operational and a public affairs point of view. Any advantages gained by making herbicide a 7th Air Force item of supply would be overcome by the requirement for more Air Force personnel and by the disadvantage of any reduction of GVN participation in the program. . . . "

(S) Herbicides are procured from normal domestic supplies within the U. S. and are packaged in 55-gallon drums for shipment to SVN as bottom-hold cargo. Since it is a heavy liquid, about 11 pounds per gallon, each drum (close to 640 lbs.) requires mechanical handling equipment from the factory to the point of

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aircraft loading. This means a harbor for the ship and a dock with sufficient facilities, as well as available labor, to move several million gallons. Resupply, in this light, becomes an expensive and manually tedious job, hence better left to the South Vietnamese despite accounting irregularities. After the initial off-loading, the drums are usually, due to weight, moved by barge to the using air base. This necessitates a base sufficiently close to a waterway to provide access, yet large enough to provide both storage and loading space as well as adequate runway length. [27]

(S) In December 1966, COMUSMACV requested the number of aircraft assigned be increased from 18 to 24. This increase would permit a spray capability of more than four million acres. Nevertheless, by early 1967 the increased spray requirements had already outstripped the available planes and herbicide. Accordingly targets were rearranged and priorities adjusted, especially during the most acute period of shortages, early in 1967. After this critical interval the mention of herbicide shortages disappeared from unit and command histories. One of the chief reasons for this is that the use of herbicides "Orange" and "White" were made interchangeable since the ultimate effect was the same. Prior to this time, each "color" herbicide had been restricted to a specific type of foliage or mission with "Orange" the more preferable, hence in shortest supply. "White" was found to be just as effective but took longer to react upon foliage. In this manner the total quantities of herbicide proved to be sufficient for the needs of SVN. [28]

Operations in 1967

(S) With a year of successful performance behind them, the 12th ACS was able to expand its operations in 1967. Experience proved a sound teacher as high-level examinations, reviews, and evaluations diminished while sound operating procedures were standardized. In the first six months of 1967, the 12th ACS flew 2325 sorties and sprayed 1,900,510 gallons of herbicide and, in some cases, insect control agent. [29] As the missions became more complicated, so did the scheduling thereof, and the attendant coordination. During the year, 7th Air Force put out a "Fact Sheet" for RANCH HAND pilots as well as FACs, personnel of the Tactical Air Control Centers (TACC), and escorting fighter pilots. It is revealing in the standardization which operations experience and command acceptance at long last allowed.

(S) While no two targets were ever the same, missions of defoliation were generally flown with an "on-the-deck" approach

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followed by the familiar "pop-up" maneuver. The target was then sprayed from an altitude of 100 to 150 feet at a speed of 130 knots. At the efficient deposit rate of three gallons per acre, this usually meant that a plane could spray a swath 80 meters wide and 16 kilometers long. Anywhere from two to six UC-123s flew a loose trail, echelon formation while on target spending about four minutes over the target if continuous spray was permitted. Crop targets on the sides of mountains required much more time since the plane had to fly down the side of the mountain to prevent spray dispersal, and would often have to repeat the process one or two more times to completely cover the target. After one pass hostile targets could be, whether completed or not, left for another target close by. On defoliation as well as crop missions when hostile fire was experienced, as more often than not it was, the crew chief, inside his armored box, tossed out a smoke grenade to mark the general spot. On a defoliation mission the observing FAC would notify covering fighters that would then descend upon the area just as soon as the mission in progress was completed and no longer required escort.

(8) Target pre-strikes became common, but if the area had been considered "cool" the mission might be flown without preliminary activity. Pre-strikes, when scheduled, were coordinated the day before between the RANCH HAND crews, the fighter pilots, and the FACs. A surface wind velocity of over 10 knots was sufficient to cause a mission to be scrubbed, as was a temperature in excess of 85 degrees. For this reason, most spray missions were flown at dawn or shortly thereafter. Seldom were any missions flown after noon because of the intense heat. Foliage sprayed usually turned brown within six days depending upon the herbicide used; however, a wind or rainstorm is necessary to remove the dying vegetation from the trees.

(9) Mission scheduling (then and now) begins at the province level. Usually a meeting is held with the province chief, with representatives of the Hq MACV and ARVN chemical offices, 7th Air Force and 12th ACS in attendance. Details of the target, intelligence data, psywar efforts necessary and other details are worked out, put into writing and forwarded for clearance by Hq MACV, SVN Joint General Staff, the American Ambassador, and other interested staff agencies. Usually MACV issues the basic order to spray a target. Then the TACC schedules the mission, coordinates the data between fighters, FACs and ground commanders along with the province chief. Once-frequent complaints about excessive delays for target approval seem to have been resolved for mention of this is seldom found in herbicide reports after late 1967. [30]

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RAND Evaluation and Response

(S) During October 1967, the RAND Corporation published an evaluation on crop destruction operations in SVN. The report was critical of the effectiveness of the program stating that the "Data consistently suggests that the crop destruction program has not in any major sense denied food to the VC. Moreover it appears that it will be exceedingly difficult to accomplish this goal with such a program." [31]

(S) The RAND study went on to state that the average Vietnamese farmer was antigovernment in his sympathy. "The indications are that very negative feelings toward the US/GVN are aroused as a consequence of the spray, and a number of subjects speak of increased support for the VC resulting from such operations." The RAND report concluded that crop destruction "may be dysfunctional. As presently conducted, it is not impossible that they may have been counterproductive to the long-range US/GVN pacification effort." [32]

(S) The effects of this report were immediate. Headquarters MACV and 7th Air Force jumped to the support of a program that the SVN themselves had requested and continued to monitor. An advisory group of civilians from Hq CINCPAC headed to SVN immediately and conducted a careful review of the crop destruction activities in 1967. The results of their report, based upon captured enemy documents, and the analysis of 622 sorties flown in 1967 found crop destruction to be a vital part of economic warfare. Enemy documents revealed that the VC had suffered serious personnel losses due to the lack of food. Viet Cong normally used in fighting had to be detailed to crop raising. Extremely small plots were cultivated to make the use of UC-123 aircraft uneconomical and also to help avoid detection. In this case, the U. S. Army UH-1H and CH-47 aircraft took over the spray duties. Documents revealed that the 95th NVA regiment had to fast for one or two days at various times due to a lack of food. Some of their personnel pretended to be ill to avoid fighting when their rations were cut. The CINCPAC report concluded that crop destruction was "an integral, essential and effective part of the total effort in South Vietnam." [33]

(S) Despite these findings, the Chief of Staff of the U. S. Air Force requested a thorough study of crop destruction operations in SVN. Seventh Air Force initiated a careful study through its CHECO office to refute the RAND findings. Through the use of captured documents and interviews, and the records of the 12th ACS, a report was compiled which revealed the magnitude and careful

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organization of the crop destruction program as well as its effectiveness. In 1967, the 7th Air Force operated 17 UC-123s which sprayed 528,425 gallons of herbicide in crop-killing missions. Hq MACV had control of all missions with 7th AF acting in an advisory capacity. All targets were approved by the South Vietnamese Joint General Staff. High priority projects were undertaken in populated areas only when military advantage was very clear, when the U. S. ambassador approved, and when adequate measures were taken to warn the friendly population and provide compensation and relief in case of accidental damage.

(S) The VC made every effort to reduce the size of their cultivated plots and to conceal them inside tree lines and even in bombed-out structures. The enemy tactic was to have one unit move through an area, clear it and move on. A second unit follows to plow and plant, and a third arrives to harvest the crop. USAF crews became quite proficient in distinguishing these so-called "slash-and-burn" plots from the cultivated Montagnard areas during aerial reconnaissance at altitudes as low as 100 feet. Beginning in mid-1967, greater care was exercised in spraying to avoid damaging innocent civilian areas as much as possible. This was accomplished by 7th AF recommendations during target meetings which aided in the selection and limitation of the missions. Part of the objective of crop destruction is to separate the VC from the people, and crop destruction, by forcing refugee movements to unsprayed crop-producing areas, denied not only the food, but the people contact so essential to the guerrilla-type combat employed by the VC.

(S) Captured documents proved the efficiency of this concept. A letter signed by the Command Committee of KM10 in III Corps area informed all VC that their monthly rice ration for October 1967 was restricted to 25 liters per person due to allied operations, bombings, defoliation, and the limited contributions made by the civilian populace. Beyond reduced rations 7th AF reported crop destruction forces the enemy to abandon base camps, seek out hidden areas for planting, expend money and personnel to buy and transport food, protect food caches and to harass the local population for more food. In the An Lao valley in September 1967, prisoners reported rations dropped to one cup of rice per person per day and that it had a decided effect upon fighting morale. Another captive reported that some 247 acres upon which a large body of VC troops were depending, turned yellow and died within seven days after it was sprayed, thereby negating an entire VC company's efforts at raising food for more than a month.

(S) RANCH HAND units stated in the report that the best times for crop destruction spraying were in May-June and September-October

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since spraying just after planting and immediately before harvest tends to support crop growth whereas if the herbicide is applied during the growing period the plant is killed quickly. In the report recommendations, there was general agreement among the RANCH HAND crews and 7th AF monitors that the crop destruction program, while most effective in the less populous and less arable areas in I and II Corps sectors, was also effective in the populated coastal plains where the strategy had been to separate the VC from the civilian populace. U. S. Army elements considered the crop spraying highly significant and most of them believed that the effect would be even greater in the long run. After the mid-1967 program changes and directives, psywar and civilian reimbursement plans became much more effective in alleviating the psychological impact of the program. The report went on to state that the RAND paper was weak in two areas: (1) the period covered did not include major changes made in the program in June of 1967 and especially the very successful spray missions in the An Lao valley in September; (2) the report did not consider the important interrelation of crop destruction and the overall MACV denial strategy. The message report was sufficient to allow a continuation of the crop destruction program in 1968 and 1969, although careful restrictions have governed, and continue to govern, the entire program.[34]

(8) While the evaluations and reviews proceeded, crews and planes of the 12th ACS continued to fly the defoliation and crop destruction missions that had been targeted. In July 1967 another UC-123 was lost to enemy action during a spray run 45 miles north-east of Pleiku. Once again the entire crew was lost. It was a remarkably low loss rate considering a total of 2856 sorties were flown from July through December in which 2,676,080 gallons of herbicide were dispensed. Of those sorties mentioned, 415 were crop destruction with the remainder credited to defoliation. RANCH HAND aircraft received a total of 296 hits from enemy fire during this period of time.[35] Hq MACV published a standardizing directive, No. 525-1 dated 22 November 1967, in an effort to stabilize and bring order to the rapidly increasing number of targets and resulting sorties. It was inevitable that another increase in UC-123s would be requested, given the wide acceptance of the herbicide program and the rapidly increasing target requests.

(8) In September 1967, the 834th Air Division, parent organization of the 12th ACS simply because it too possessed C-123 aircraft, completed a 20-page study on RANCH HAND resources and accomplishments in order to assess the in-house capability to support the increased MACV requirements. The latter headquarters had set forth the delivery requirements to the 834th as follows:

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FY 68 = 612,000	gallons of herbicide per month
69 = 864,000	" " " "
70 = 864,000	" " " "

At the time of the report, the 12th ACS possessed 19 UC-123s, one of which was reserved for malaria control spraying. 11q MACV estimated another seven aircraft and supporting crews would be necessary to accomplish the missions then approved or planned. The 12th ACS had an extensive chain of command which went from their own headquarters to the 315th Air Commando Wing and then to the 834th Air Division. From there operational control was exercised by 7th Air Force through the TACC. The 12th ACS was authorized 65 officers and 27 airmen for crew duty with an additional 234 airmen for maintenance and support duties. These people were divided between the main base at Bien Hoa, a detachment at Da Nang during periods of flying in I Corps area, and 18 airmen who remained at Clark AFB for engine overhaul and buildup. Usually 12 aircraft remained at Bien Hoa while the other six operated out of Da Nang.

(S) A complicating factor for RANCH HAND crews was that the herbicides in use in SEA work best during the peak growing season. Unfortunately, this season coincides with the peak rainy period, or monsoon season. During this season the rain forces cancellation of many missions either due to poor flying weather or to the fact that the herbicide would be ineffective if applied during a pouring rain. For instance, in August 1967, a month of unusually heavy rain, 48.5 percent of the scheduled or "fragged" missions had to be cancelled. The problem was not in-commission rate for that averaged a commendable 83.33 percent for over a year.

(S) The 834th analysis of the 12th ACS capability revealed that the proposed aircraft increase of seven which MACV had requested was completely inadequate. To meet the desired 612,000 gallons per month for FY 1968, the squadron had to dispense 20,400 gallons per day. It would take 23 aircraft to do this, and when the gallons were upped to 864,000 per month (28,800 per day) the number of planes had to be increased to 32. The 834th recommended the increase in the report and also that the Vietnamese Air Force take over the crop destruction missions completely along with those of mosquito control, while gradually phasing into all defoliation missions. Since a SVN Air Force crew member had to accompany RANCH HAND crews on all crop destruction missions and the plane so used had to have Vietnamese markings rather than U.S., the transition would not be beyond reason of accomplishment once the VNAF crews got over the fear of ground fire -- a fear which had cancelled "Vietnamization" in 1964. Another suggestion was to convert

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the C-119s which the VNAF operated to spray aircraft, especially for the mosquito-control missions. The report was forwarded for the information of 7th Air Force but there is no evidence of direct action taken upon the recommendations contained in it.[36]

(5) One of the best ways to judge the effectiveness of herbicide operations is the comments of U. S. Army personnel who had to fight in and around areas that had been defoliated as well as those that had not. MACV requested field commanders' opinions as to defoliation effectiveness, and they ranged from "marginal to excellent," with the difference being chiefly the level and intensity of fighting experienced by the commentators and the type of vegetation in which that fighting took place. All agreed that visibility was improved, that fields of fire were better, that lines of communication were no longer as subject to enemy ambush, and that it was easier to discover the enemy at night with heat-detecting equipment. There was a common complaint that the spraying was not sufficiently responsive to the immediate needs of the ground personnel, a situation that would be difficult to meet at any time since foliage usually takes from three to seven days at a minimum before it would begin to fall enough to be of any use to personnel on the ground. The fact that aerial spraying so often revealed hitherto well-concealed enemy base camps, bunkers and trenches was also a subject of much comment.[37]

Operations in 1968

(8) The early part of 1968, and especially February of that year, was notable for the Tet offensive. During this crisis, all herbicide spraying was halted and the planes returned to the 315th Air Commando Wing for use in airlift capacities. The UC-123s were stripped of all herbicide equipment in 24 hours and the 12th ACS flew 2866 sorties in airlift support before the planes were reconverted and spray activities resumed. By this time the results of tests concerning the UC-123 at the Air Proving Ground at Eglin AFB, Florida, had been reviewed and approved. The tests concerned the increased reliability of the UC-123 when one engine is damaged during a spray mission. Two jet engines were attached to the wings of the aircraft and, along with other modifications, changed the aircraft designation to UC-123K. Other changes included a larger spray pump so that the volume of spray could keep pace with the increased speed at which the plane could now fly. Ceramic armor replaced the old aircrew armor, and additional armored protection was given the engines. A flow meter was installed to insure even distribution of three gallons per acre regardless of the plane's speed. All 31 aircraft earmarked for RANCH HAND were scheduled for the modification which was to begin in July 1968.[38]

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The additional safety factor provided by the armor and the additional speed of the plane provided by the jet engines reduced the crew risk and exposure over the spray areas.

(8) The year was characterized by the most searching evaluation of the herbicide program since its inception in 1961. The first comprehensive review was requested by the American Ambassador in January 1968 and lasted until a report was filed in May. The findings were, once again, on the positive side. From the military point of view the herbicide program was considered to be successful, especially in the defoliation area. On the matter of crop destruction, the review was less enthusiastic, calling for limitation of spraying in populated enemy areas, improved psywar operations to combat propaganda, and improved indemnification programs to make the use of herbicides more acceptable to the people. The committee charged with the formulation of the report went further to establish that the ecology of SVN had not been affected by the use of herbicides, and that the soil of the country had not been rendered sterile at any time. In August COMUSMACV sent another report on herbicide operations to CINCPAC which concluded, "All field commanders, without exception, state that herbicide operations have been extremely effective in assisting in the Allied combat effort." [39] Again, in September, a military evaluation was directed by COMUSMACV and the results, which were presented in October, led to that headquarters approving herbicide operation continuation as programmed.

(8) The types of missions flown during the year were the same as those of previous years. The major difference was the reduction in the number of acres sprayed and the sorties flown. This was due partially to the stand-down during the Tet offensive and to another stand-down in October of eight planes. An average of 15.3 aircraft (UC-123s) were utilized per month and 4762 sorties were flown during the entire year. An abnormally dry season which left fewer lucrative targets for crop destruction caused a drop of 52,000 tons in the amount of crops destroyed over the previous year. Efforts at cutting the chain of command for mission target approval were unsuccessful although a greater effort was made to be more responsive to the demands of field commanders. The VNAF participation in the program began increasing in 1968 in both control of target selection and in the execution of the missions. This was more in line with the original concept of herbicide operations that called for SVN control of the entire project with American advisors. The trend in target selections seemed to be more toward less populated areas, national boundaries and lines of communication, both friendly and enemy. [40]

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(8) In January of 1968 the 12th ACS was programmed to increase from 18 to 25 aircraft during FY 1969. While the number actually possessed varied from 21 to less than 16, the UE strength was finally fixed by MACV at 18. Conversion to the UC-123K version began in May and was completed in 1969. In August the 12th ACS was redesignated the 12th Special Operations Squadron (SOS). The versatility of the squadron was demonstrated when an urgent request was received from the Laotian government on 4 November to destroy a Viet Cong rice crop in the Nam Sane and Nam Pa valleys. The Viet Cong were depending upon the crop for food supplies and it was almost ready for harvest at the time of its destruction on 12 November. [41]

(8) In May 1968 the squadron had experienced the loss of a fifth aircraft to enemy ground fire, along with a significant increase in the aircraft hit rate. In order to reduce the aircraft vulnerability over areas known to have heavier antiaircraft weapons, the F-4 fighter was used experimentally to spray areas otherwise too dangerous for the UC-123Ks. A combat test of externally mounted, 370-gallon fuel tanks modified to carry 550 gallons between them, was run in January 1969 over Laos. Each F-4 was capable of covering a swath 100 feet wide and 16 kilometers long. Moving at speeds of 500 knots, the area was covered at a rate of 4.3 gallons per acre in only 70 seconds, reducing appreciably the vulnerable time-over-target of the spray aircraft. With the F-4s, no fighter cover was necessary which reduced the requirements for extensive mission coordination.

Recent Operations

(8) Herbicide operations during late 1968 and 1969 shifted their emphasis somewhat as indicated in the 1968 Combined Campaign Plan. In previous years spray missions were targeted on large areas containing enemy base camps, lines of communication, canals and crops. By the end of 1967 enough of these targets had been completed so that the shift allowed concentration on (1) Allied lines of communication, (2) enemy routes of supply and communication, (3) enemy base areas which are the object of Allied operations, and (4) the Buffer Zone along the Vietnamese borders. Considerably less emphasis is being placed upon crop destruction with missions being concentrated in the sparsely populated and remote VC-controlled areas. The crop destruction program has been successful in all respects except where there was damage to crops grown by friendly Vietnamese. In such cases the psywar program and an intensified program of indemnification conducted by the Vietnamese themselves has helped somewhat to ease the burden, but the latter seems to be plagued with administrative irregularities. Tactically, there is

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no question as to the value of the program, yet its political ramifications continue to plague the program monitors. In 1968, only five percent of all herbicide missions were for crop destruction, and the general pattern in 1969 was for a continuance of the missions at about this same level. As the year began, MACV-J2 had the question of crop destruction effectiveness under serious study once again. [42]

(8) On the operational side, Hq MACV revised its Directive 525-1 as of August 1969. The directive brought operating policy into line with the decisions set forth in the Report on Herbicide Policy Review, issued at the American Embassy after a lengthy conference on 28 August 1968. The general provisions of the report have thereby become the basis for herbicide actions in South Vietnam. Briefly they are:

- (1) Use of herbicides for defoliation or crop destruction is primarily a SVN operation with minimal U. S. support.
- (2) Subject to policy guidance by the Departments of State and Defense, COMUSMACV and the U. S. Ambassador are jointly empowered to approve U. S. support of SVN requests for herbicide activity.
- (3) COMUSMACV exercises command supervision, coordination, liaison and control of all U. S. herbicide participation.
- (4) A special interdepartmental MACV committee, the 203 committee, has been established to expedite coordination of requests for herbicide operations.

The MACV Assistant Chief of Staff J-3 maintains mission control over the 12th SOS. The 7th AF advises MACV on operational aspects, and plans, coordinates and executes the mission once the J-3 office releases the operations order to 7th AF. [43]

Vietnam Operations Summary

(8) Since its inception in 1961, the herbicide program has been the subject of intensive discussion, review and investigation at all levels of command. A basic conclusion can be drawn from all of these reviews: defoliation does provide a significant increase in horizontal and vertical visibilities and is endorsed by field commanders as being of significant value. Even the Vietnamese

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have given full approval to the program although President Thieu has requested that the American Ambassador restrict the use of defoliants to uninhabited areas and along infiltration routes. This is to counter the effectiveness of the Communist propaganda which has succeeded in having an emotional impact in some areas.

(S) Militarily, defoliation is tactically effective, but only of value when coupled with surveillance and combat power. Used in this manner it denies the enemy his lines of communication, causes him to relocate his forces and to limit his ambush tactics. The chemicals have produced defoliation ranging from 80 to 90 percent effective depending upon the vegetation sprayed. Prisoners of war have acknowledged their effectiveness in hampering movements, creating delays and dislocating units. Processing time for spray requests has been reduced to approximately two and one-half months from the initial request of the Province Chief to the first RANCH HAND flight. The majority of the time saved can be accounted for by the formation of the 203 coordinating committee which brings together the various agencies necessary for coordination on the request rather than having the request go to each sequentially. [44]

(S) Herbicide operations proceed in SVN with somewhat abated intensity, with much better management and with increased efficiency. The part the United States Air Force has played in the program, working as it has so closely with the SVN Air Force, is one of which the service can be justly proud. From the most basic of beginnings, this new phase of warfare -- the use of nonlethal chemical agents -- has progressed to an important role in the prosecution of the war. Politically handicapped from its inception due to the propaganda value associated with plant destruction and the use of chemical agents of any kind, this new concept has been subjected to the closest of scrutiny and not found wanting. It is impossible to say how many American and Allied lives the defoliation operations have saved. This alone provides a moral justification for the use of nonlethal chemicals. The use of chemicals requires a strong and constantly active psywar program to counter propaganda, and the United States should resist the temptation to abolish herbicides just because of attacks upon the program. The most recent such attack took place in the General Assembly of the United Nations when the main political committee condemned the use of tear gas and defoliants in war as being "contrary to the generally recognized rules of international war." [45] Just what effect this U. N. opinion will have upon American use of herbicides in SVN, or in any future war, is at this writing undetermined. President Nixon's earlier abandonment of CBR warfare would not normally place any restriction upon the use of herbicides. As with any new weapon of war, herbicides have experienced a painful growing period.

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The USAF can afford to be pleased with the excellent manner in which they have aided the birth pangs of a new concept in warfare.

Civilian Attitude Toward Defoliation

(U) The use of defoliant chemicals in Vietnam has been challenged within the United States for several years. According to one source there were "certain private misgivings" among American officials, especially in the State Department, who were afraid that our nation might be charged with the use of chemical and biological warfare and that defoliation was "not all that militarily effective." As early as 1962 Roger Hilsman, Director of Intelligence and Research for the State Department, was reported to be unimpressed by defoliation operations and worried by the political disadvantages.[46] Despite the doubts of Hilsman and others, the area sprayed with herbicides increased greatly each year as chemical defoliation proved itself a useful military weapon.

(U) In 1966 a number of scientists in the United States began to protest actively the military use of herbicides. Early in the year and again twice later groups of scientists petitioned President Johnson to stop the use of defoliants and crop-destroying herbicides claiming that the use was "barbarous because they were indiscriminate" and "constituted a dangerous precedent." [47]

(U) Critics of defoliation also argued that long-range effects would severely affect the ecology of South Vietnam. Much of this argument surfaced in meetings of the American Association for the Advancement of Science (AAAS). In December 1966, for example, one group demanded that the AAAS investigate the military use of chemical and biological agents in Vietnam because (these scientists believed) defoliation might be doing irreparable violence to the natural balance of the land itself. A substantial number in the AAAS, however, believing that the demand was in direct opposition to President Johnson's Vietnam policies broadened the investigation resolution to read "the uses of biological and chemical agents to modify the environment, whether for peaceful or military purposes." [48] Subsequently, the AAAS recommended to Secretary of Defense Robert McNamara that DOD "authorize and support a study by an independent scientific institution or committee of both the short- and long-range effects of the military use of chemical agents which modify the environment." [49]

(U) In reply, Dr. John S. Foster, Director, Defense Research and Engineering, noted that a "leading nonprofit research institute" (Midwest Research Institute) (MRI) had been commissioned "to

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thoroughly review and assess all current data in this area." [50] Later, on receipt of the completed MRI study, Dr. Foster asked scientists within the National Academy of Sciences - National Research Council (NAS-NRC) to review the findings of this independent effort. The NAS-NRC committee composed of four university professors, a DOW Chemical scientist and one USIA official, agreed that MRI had creditably evaluated "relevant published information," but the committee also observed that the scientific literature provided "markedly less factual information on the ecological consequences of herbicide use and particularly of repeated or heavy herbicide application." [51]

(U) In February 1968 DOD issued its own summary of the 369-page MRI report before releasing the full document to the public. The digest minimized the possibility of adverse effects of defoliation and even stated that herbicides could be ecologically "beneficial." This summary and the MRI report failed to satisfy defoliation critics who demanded "detailed long-term, on-the-spot studies" of Vietnam regions "affected by the use of herbicides." [52] In their December 1968 annual meeting in Dallas, the AAAS defoliation critics, after failing to obtain United Nations sponsorship for an on-the-spot field study, won approval for AAAS participation in study of herbicide use in Vietnam. The idea was to cooperate with other organizations, but a more effective procedure appeared to be the unofficial groups of biologists who visited Southeast Asia under State Department of foreign government sponsorship. What they found is debatable because of their own disagreement over possible long-range effects. [53]

(U) Again in 1969 certain biologists raised questions about possible direct hazards to life from 2, 4, 5-T. (Atch #1) In late October, Dr. Lee DuBridge, President Nixon's science adviser, stated that laboratory tests of mice and rats given relatively high oral doses of 2, 4, 5-T in early stages of pregnancy "showed a higher than expected number of deformities" in the offspring. As a result the government expected to "restrict the use of 2, 4, 5-T in both domestic civilian applications and military herbicidal operations." Although critics were dissatisfied with the adequacy of the DuBridge statement they had to concede that what is applicable to rats in such tests might not be applicable to human beings. [54]

(U) Nearly a month after the DuBridge statement, President Nixon announced that the United States would "renounce the use of lethal biological agents and weapons and all other methods of biological warfare." But since this policy did not include the use of herbicidal, defoliant, or crop-killing chemicals in

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Vietnam, the herbicide critics have endeavored to link defoliation and crop destruction by definition with the now-banned biological warfare. Articles, for example, have appeared in such periodicals as The New Yorker, The New York Times, and the syndicated column by Jack Anderson. [55] Despite the fact that these articles frequently contain inaccurate or misleading information they undoubtedly have an effect on the reading public. Suffice it to say that herbicide -- no matter how effective in combat -- is under serious attack from members of the scientific community.

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CONFIDENTIAL 6003

TYPES OF HERBICIDES USED IN SOUTH VIETNAM

(S) There are currently three chemicals in use in the herbicide program. Each has a code name which is the same as the color code used on the barrels for handling.

A. ORANGE: Composed of the buytl esters of 2, 4-D(2,4 - dichlorophenoxyacetic acid) and 2, 4, 5-T (2, 4, 5 - trichlorophenoxyacetic acid), two of the most widely used herbicides in agriculture and industrial vegetation control. Orange is in an oil suspension and is soluble in diesel oil, fuel oil, acetone and alcohol. It is noncorrosive to metals, nonexplosive, fire resistant and stable in storage. It is less volatile than water.

A systemic herbicide, it kills after being absorbed into the plant. It is especially effective against broadleaf plants, jungle growth and mangrove. Sprayed plants show a color change in from 7 to 10 days with maximum effectiveness after 4 to 6 weeks. It remains effective for up to 6 to 8 months.

Factory cost is \$7.00 per gallon.

B. WHITE: Composed of 2, 4-D and picloram (4 - amino - 3, 5, 6 - trichloropicolinic acid). It is an aqueous solution (soluble in water), noncorrosive, nonflammable and nonvolatile. It, too, is a systemic herbicide. Similar in action to orange, the white has no vapor drift problem and can therefore be used near rubber and tea plantations, friendly crops, and political borders. It is slower acting than orange, taking from 10 to 14 days for discoloration, and 6 to 8 weeks for effective defoliation. It remains effective for 8 to 9 months.

Factory cost is \$6.44 per gallon.

C. BLUE: Composed of cacodylic acid as its sodium salt (sodium cacodylate). Cacodylic acid is dimethyl arsenic acid. It is water soluble, slightly corrosive, nonflammable and nonvolatile. Blue is a dessicant, meaning that it kills foliage on contact by drying out the surface. It is widely used commercially to remove leaves from cotton plants for mechanical harvesting. It is used against narrow leaf vegetation such as rice or grass. Since it is not absorbed by the plant, it produces only temporary defoliation in trees. Discoloration occurs within 24 hours, with narrow leaf plants dying in 2 to 4 days.

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Factory cost is \$5.50 per gallon.

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(8) None of these chemicals are a soil sterilant, and sprayed areas must be resprayed periodically to kill regrowth. WHITE and BLUE are not compatible. If they are mixed inside the herbicide tank, a gummy precipitate forms which clogs the spray pump and valves. At least one, and preferably three loads of ORANGE should be used between loads of WHITE and BLUE to avoid this, otherwise a time-consuming flushing of the system with water is necessary. For this reason, WHITE or BLUE targets are usually run in a series to ease this problem. [56]

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FOOTNOTES

1. John A. Macready, "Report on the Use of the Airplane for Insect Extermination," (U), An Engineering Division, Air Service Report DDO.12 M1782 in Air Museum (Dayton), Technical Data Files, October 1921, pp. 1-3, cited in Eldon W. Downs and George R. Lemmer, "Origins of Aerial Crop Dusting," Agricultural History, Vol 39, No. 3 (July 1965), pp. 124-126. Hereafter cited as Downs and Lemmer, Origins.

2. For full citations on AAS pilots' reports and other related documents see Downs and Lemmer, Origins, pp. 127-134.

3. Experiments in the aerial spraying of gas did not really become important until late 1932. See ltr., Chemical Warfare Service, Office of the Chief, Washington, D. C. to Capt. Merrick G. Estabrook, Air Corps, "Dispersion of Gas from Airplanes," (U), in USAF Archives 145, 93-270, 21 December 1932, pp. 1-2.

4. Ibid., Six uses of aeriaily-sprayed gas were contemplated: casualty, harassment, denial of areas, contamination of equipment, destruction of installations and concealment (smoke).

5. AAF Board, AAF Tactical Center (Orlando), Report of Project 3690B470.6, (U), in USAF Archives 245.64, 16 November 1944.

6. DDT was used extensively in the jungles of New Guinea for malaria control. The chemical has been looked upon as one of the more positive effects of World War II. Its potency plus the ability to aeriaily spray large areas enabled excellent control of insect-borne diseases, Air Surgeon's Bulletin, (U), Vol. 2, No. 3 (March 1948), pp. 67-68, in USAF Archives 141.283.

7. Hq TAC, "military Aerial Spray Operations 1946-1960," (U), pp. 1-55, UNCLASSIFIED Archives K417.042-1. Hereafter cited as Military A.S.O.

8. CHECO Report, "Herbicide Operations in Southeast Asia July 1961-June 1967," (U), dated 11 October 1967, p. 1, SECRET. Hereafter cited as CHECO Report, Also, William F. Warren, "Review of the Herbicide Program in South Vietnam," (U), Scientific Advisory Group Working Paper No. 10-68 dated August 1968, p. 2, SECRET. Hereafter cited as Warren, Review.

9. Military A.S.O., pp. 1-55.
10. George T. Adams (Capt. USAF), "TAC Aerial Spray Flight Operations in Southeast Asia 1961-1964," (U), pp. 1-6, SECRET. Archives K417.042-3. Hereafter cited as TAC ASF Opns.
11. Laszlo Hadik, Stanley W. Dziuban and Susan Herbert, "Constraints on the Use of Weapons and Tactics in Counterinsurgency," (U), Vol. II, "Appendix A, Case Studies," p. 10, dated June 1966, SECRET. Hereafter cited as Constraints. Also TAC ASF Opns., pp. 7-10.
12. Constraints, pp. 10-11; TAC ASF Opns., p. 11; Tactical Air Command History, January 1962-June 1962, (U), Vol I (Narrative), SECRET, Archives K417.01.
13. Constraints, pp. 13-21.
14. State Department telegram Deptel 1055 dated 7 May 1963, SECRET, is quoted in CHECO Report, p. 11.
15. A very thorough discussion with references to State and Defense telegrams and details on the correspondence that flowed back and forth is found in Constraints, pp. 27-42 from which the preceding is taken. See also CHECO Report, pp. 9-12.
16. CHECO Report, pp. 4-5; Warren, Review, pp. 3-4; Constraints, p. 27.
17. Warren, Review, p. 4; TAC ASF Opns., pp. 18-19.
18. CHECO Report, pp. 6-8; Warren, Review, pp. 4-5.
19. TAC ASF Opns., pp. 25-27.
20. CHECO Report, pp. 13-15.
21. Ibid., pp. 16-18.
22. CHECO Report, pp. 18-20.
23. Hq MACV briefing for Major General C. E. Hutchins, 18 March 1966, (TS). Material used is (S), as quoted in CHECO Report, p. 24.
24. CHECO Report, pp. 24-29.

25. History, 315th Air Commando Wing (TC), 1 July-31 December 1966, (U), p. 25, SECRET, Archives K-WG-315-HI.
26. Seventh AF, "Final Report of the Operational Evaluation of Project PINK ROSE," (U), 5 May 1967, SECRET, Archives K740.8051-2; Hq 7th AF Folder, "Project PINK ROSE Test Plan, 26 December 1966," (U) SECRET, Archives K740.32266-783; CHECO Report pp. 29-31.
27. History, 834th Air Division, Vol. I: Narrative, 15 October 1966 to 30 June 1967, (U), pp. 44-45, SECRET, Archives K-Div-834-HI; 834th Air Division, "Ranch Hand Study, FYs 68-69-70, (U), dated 12 September 1967, p. 2, SECRET, Archives CH-4-12-14.
28. CHECO Report, "The War in Vietnam, January-June 1967," (U), dated 28 April 1968, pp. 59-61, SECRET, Archives K717.041. Also CHECO Report pp. 42-44. For a detailed description of the different "colors" of herbicides, see Attachment 1.
29. 7th Air Force, "Commander's Operation Command Book July 1966-July 1967," (U), SECRET, Archives K740.197.
30. 7th Air Force,, "Project RANCH HAND," (U), a mimeographed fact sheet for operational personnel, undated (probably 1967), 5 pp., CONFIDENTIAL Archives CH-5-5-1. Also, Message 11997, dated 11 April 1967 in "7th AF Collected Correspondence, Msgs," (U), Vol I, SECRET, Archives K740.8051-1 (1966-67). Later tactical changes had many C-123 missions approached at 12,000 ft. altitude followed by a steep descent to the 100-150 ft. level for spray.
31. Russell Betts and Frank Denton, "An Evaluation of Chemical Crop Destruction in Vietnam," (U), RAND Corporation, October 1967, CONFIDENTIAL, p. viii, AUL M-C 30352-9.
32. Ibid., p. 33.
33. W. F. Warren, L. L. Henry, and R. D. Johnston, "Crop Destruction Operations in RVN during CY 1967," (U), dated 23 December 1967, (SAG Working Paper No. 20-67), pp. 1-11, SECRET, AUL M-42294-1.
34. Message 7th AF to CSAF, subject: "Herbicide Crop Destruction Operations in SVN," (U) filed in supplement to History, 7th AF, 1 July-31 December 1967, SECRET. Message is CONFIDENTIAL.
35. 7th Air Force, History, 1 July-31 December 1967, Vol. I, Narrative (U), p. 56, SECRET, Archives K740.01-25.

36. 834th Air Division, "RANCH HAND STUDY," (U), 12 September 1967, pp. 1-17, SECRET, Archives CH-4-12-14.

37. CHECO Report, "War in Vietnam, January-June 1967," p. 65.

38. Message, 834th AD to 315th ACW dated 11 January 1968, in 315th SOW correspondence file "Herbicide Operations," (U), CONFIDENTIAL, Archives CH-5-5-1. Also, ltr "Modification Requirement for UC-123K Aircraft, Hq USAF, 27 May 1968, (U), in file "Improved Defoliation Capability (UC-123K Aircraft), (U); May-June 1968," SECRET, Archives CH-4-14-25.

39. Msg. COMUSMACV to CINCPAC, "Effectiveness of Herbicide Operations," (U), 30 August 1968, SECRET, Archives CH-5-4-19,

40. USMACV, "Year-End Review of Vietnam - 1968," (U), SECRET, Archives CH-16-1-9.

41. Ltr. 12th S.O.S. "Crop Destruction, Laos," (U), 16 November 1968, SECRET, Archives CH-5-4-20. During 1968, authority was granted COMUS KOREA by JCS to use defoliants as part of the vegetation control program there. The U.S. role was to be advisory, not operational. Msg. JCS to CINCPAC 4 March 68 as quoted in CINCPAC Command History 1968, Vol. II, (U), (TOP SECRET). Information used is classified SECRET, Archives TS.

42. 7th AF DOA Working Paper 69/18, "Herbicide - Defoliation Program, 7AF 1967 - February 1969," (U), pp. 49-50, 53, CONFIDENTIAL, AUL M-41780-37-C. Hereafter cited 7th AF Working Paper.

43. Hq MACV Directive 525-1, August 1969, (U), CONFIDENTIAL. This, and detailed charts, is contained in 7th AF Working Paper, pp. 7-12.

44. 7th AF Working Paper, pp. 43-49-51.

45. The Vote was 58 to 3 for condemnation with 35 abstentions. The U.S., Portugal and Australia voted against. See USAF Command Letter No. 1, (U), dated 1 January 1970, p. 7, para. 15. The letter is SECRET but the excerpt is unclassified.

46. Thomas Whiteside, "A Reporter at Large: Defoliation," (U), The New Yorker, 7 February 1970, p. 32. Hereafter cited as Whiteside, A Reporter.

47. Ibid., p. 36.
48. D. S. Greenberg, "Defoliation: . . ." (U), Science, Vol. 159, (23 February 1968), p. 857. Hereafter cited as Greenberg, Defoliation. See also "The Other War in Vietnam," (U), Newsweek, Vol. 71, (26 February 1968), p. 56.
49. Ltr., AAAS Pres. Don K. Price to Robert McNamara, (U), quoted in Greenberg, Defoliation, p. 857.
50. Ltr., Dr. John S. Foster to Don K. Price, (U), 29 September 1967, quoted in Greenberg, Defoliation, pp. 857-58. See also Don K. Price et al., "On the Use of Herbicides in Vietnam," (U), Science, Vol. 161, (19 July 1968), p. 253.
51. Quoted in Greenberg, Defoliation, p. 859.
52. Price, "On the Use of Herbicides in Vietnam," pp. 253-254.
53. Bryce Nelson, "Herbicides in Vietnam: AAAS Board Seeks Field Study," (U), Science, Vol. 163, (3 January 1969), pp. 58-59. See also Whiteside, A Reporter, pp. 37-38.
54. Whiteside, A Reporter, pp. 38, 40, 43, 50.
55. Ibid., pp. 59-60, 62, 68. For samples see Steven V. Roberts, "Deformities and Hemorrhaging Laid to Forest Spray in Arizona," The New York Times, 8 February 1970, p. 60, and Jack Anderson, "Pentagon Mum on War Deformities," Alabama Journal, 2 February 1970, p. 2.
56. 7th AF Working Paper, pp. 12-13, 18-19, 60-61.