537 SRES TESTIMONIES BEFORE SRES (NOTEBOOK)

1977-1978

SENATE RESOURCES COMMITTEE

LIST OF FILES (PAGE 1)

TESTIMONIES BEFORE SENATE RESOURCES COMMITTEE, 1977/78 (NOTEBOOK)

SB 18

SB 49

SB 58

SB 103

SB 105

SB 113

SB 128

SB 141

SB 159

SB 180

SB 181

SB 196

SB 197

SB 199

SB 220

SB 227

SB 238

SB 274

SB 393

SB 399

SB 428

SB 440

SB 477

SB 511

SB 527

1977-1978

SENATE RESOURCES COMMITTEE

LIST OF FILES (PAGE 2)

SB 557

SB 562

SCR 25

SCR 55

SCR 56

SCR 87

SJR 7

SJR 12

SJR 37

SJR 47

SJR 49

SJR 50

SJR 54

HB 2

HB 54

HB 133

HB 137

HB 192 (FILE 1 OF 3)

HB 192 (PRO) (FILE 2 OF 3)

HB 192 (CON) (FILE 3 OF 3)

HB 248

HB 264

HB 322

HB 353

HB 356

HB 359 (1979)

HB 477

1977-1978

SENATE RESOURCES COMMITTEE

LIST OF FILES (PAGE 3)

HB 588

HB 645

HB 647

HB 652

HB 657

HB 683

HB 704

HB 720

HB 763

HB 773

HB 815

HB 830

HB 854

HB 854 - DRAFTS AND NOTES

HB 907

HB 927

HB 960

HB 963

HCR 112

HCR 130

HCR 60

TESTIMONY
BEFORE
SENATE
RESOURCES
COMMITTEE
1977-1978
(NOTEBOOK)

Marc Singleton - ARCO

except for '74

Sole purpose of taxation - to fund budgetary
needs of State as deter. by leg

Since '69

Oil has spent 12 B dev. the field
& building TAPS
Has paid 2 B in royalties, bonuses
& taxes of all kinds

9,000 corp. (profit type)
← fed. income tax 36,000 M
ind ← ← 200 M

Fish
Timber
Hard rock mining

Sales Tax
Property Tax - State
Severance Tax ←

Cook Inlet - negative until a couple yrs ago
2% of total reserves for State
Marginal field - Royalties
Employment

Sustaining role - other discoveries
other developments

2/24/78

Marc Singletary

Petro-chemical - marginal

Gas line - Gas conditioning plant -
1 Bil

Arco, et al not interested in financing

Taxes only 1 factor in investment climate

Crawford Thomas

8½ yrs. Chief Counsel of Calif. Tax Bd
Non-unitary for another
Unitary for 1 purpose

Legal difficulty in changing from
multi-state pact act

Income earned - multi state tax act
Entire tax accrues in income tax

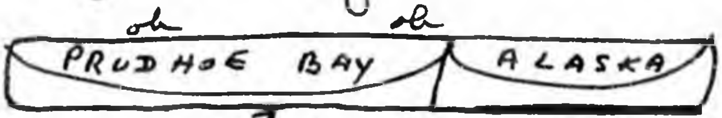
Changes in multi-state tax act must be
through tax administrator.

"Separate accounting is dead"
- according to Crawford Thomas

2/24/78

Local 9.4 Prof. Gary Boren
O & G lower? St. Louis, ~~University~~ Mo
Wash. University of Law
Intangible drilling cost
if not now - later as a capitalized asset

Property - Payroll - Sales



counterweights to Sales

Multi-State Tax Pact

Reorganize Multi-State rather than new method

USA	ALASKA
Sale Alaskan Corps	Multi
Prop	Prop
Payroll	Payroll
Sales - all in alaska	Sales - out of State

Unitary Theory - one business
formula

Questions

Administration of Separate Accounting

Kust p.34 "In practice separate accounting is impossible to administer and determine"

Lipton 4 [Mike] Richard stands as a matter of fact

"Now, its been said that this separate accounting is impossible to administer.... As I mentioned before there are two states that actually utilize separate accounting. For better or for worse, it can be done, it can be."

Equity of Tax Structure

Warren p.1 The current method ... "provides equality amongst taxpayers"

Lipton "I put it to you that you cannot through your present income tax statute get an equitable burden of income taxation upon the companies operating here in Alaska, not through the apportionment method." Cites ex. in Anderson report of 4 major producers each with greatly different tax liabilities."

Revenues

Warren p.2 Separate Accounting "would force Alaska out of the Multistate Tax Compact, would create horrendous audit problems for the Dep't of Revenue, and might even result in a net revenue loss to the State." Why? Not explained anywhere further in his paper.

Net profit interest
Amerada Hess?

Growth report – Larry Dinneen

"Treating us differently"
want to be treated like any other corp. in The State of Alaska

Pivotal in The ICC case
Oliver wants AFN to get in also

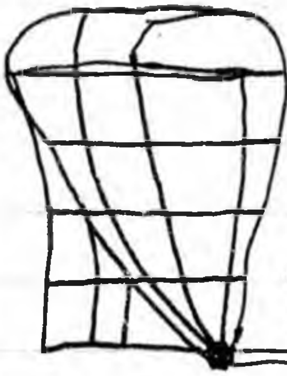
Tanny	6.40
Valdy-Sea	2.00
Pan Can	1.00
	9.40

Denies normal business exp tax privilege

Jobs
Husky
Chevron
Texaco
Union
Amoco
4 or 5 others

Trying to borrow – tax possibility making it different

Sterling Gallagher



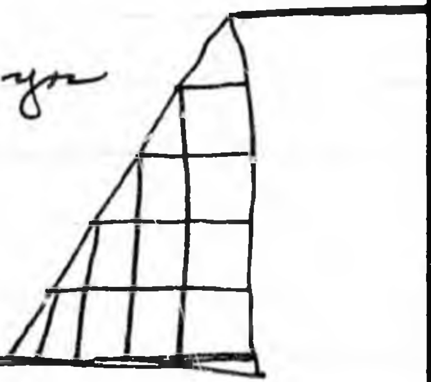
3.1 3.4 3.7 last 3 yrs

2.3 20.1 next two yrs

Solis II

20.4 77

62 78



Seeking to raise money - severance tax
income tax - traditional

John Messenger

Study - in House bill on 12 States

Same approa - ~~trade~~ Broader study

Oliver Leavitt

Tanker tariffs much higher than
anticipated

Gathering chgs - suit in court

Need oil co. expertise to discover & develop getting oil out of their area difficult

70,000 natives to share 70%

Reduction in value of native lands

Poor business climate

Harold Pomeroy - Kenai
"unconscionable profit" - then take more
US News & World Report
collision course with insolvency
viability in the future
Be careful about taking more
allow industry to be able to go deeper
& ~~father~~ farther

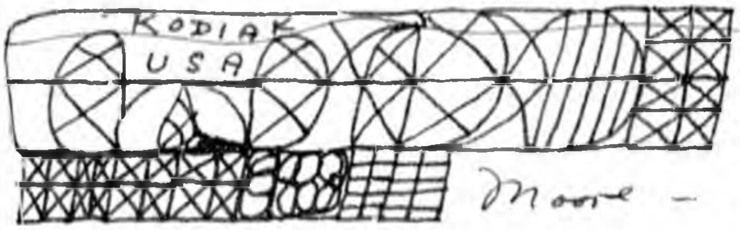
Ap 24/78

Robert L. Moore
Arthur Andersen & Co.

(1) [illegible] CI
(2) [illegible] PB a-TAPS [illegible] ×8
(3) [illegible]

(1) Cook Inlet, Gas production, Lisburne, Kuparuk Fields

Gas – no prices
cost of pipeline
Kuparuk & Lisburne – unknown uncertain



What is actually net income
Moore – Source of income is a legal questi

Legality of Bills

17. *Amoco Production Co. v. Armhold*, 213 Kan. 636, 518 P. 2d 453 (1974); *Superior Oil Co. v. Franchise Tax Board*, 60 Cal. 2d 406, 386 P. 2d 33 (1963); *Honolulu Oil Corp v. Franchise Tax Board*, 60 Cal 2d 416, 386 P. 2d 40 (1963).

18. Pierce, "The Uniform Division of Income for Tax purposes Act," 37 TAXES 747, 780 (1957).

19. Final Report, Committee on Tax Situs and Allocation, National Tax Association, 1951, published at pp. 456 et seq, Proceedings of the Forty-Fourth Annual Conference.

20. Interstate Taxation Act, Volume 2, p. 1767 (report of hearings on the Willis bill, H.R. 11798, 1966).

21. Hellerstein, "Allocation and Nexus in State Taxation of Interstate Business," 20 Tax Law Review 259, 275-276 (1965).

22. Congressional Record, Oct. 4, 1977, p. S16238.

23. 43 U.S.C.A. § 1333

24. Legal Ruling No. 366, CCH Cal. Tax Rptr. ¶205-026; Legal Ruling No. 396, op. cit. ¶205-519.

25. *Tradesmans Nat. Bank v. Oklahoma Tax Comm.*, 309 U.S. 560(1940)

26. *Complete Auto Transit Inc. v. Brady*, _______ U.S. ___________, 51 L. Ed. 2d 326 (1977)

27. See, e.g., remarks of Sen. Kennedy in Congressional Record, July 1, 1977, p. S11416

28. See, e.g., Note, "Multinational Corporations and Income Allocation Under Section 482 of the Internal Revenue Code," 89 Harv. L.R. 1202 (1976) in which the federal approach is unfavorably compared to the unitary approach used by California, Oregon, and Alaska.

29. *Donald M. Drake Co. v. Dept. of Revenue*, 236 Or. 26, 500 P. 2d 1041 (1972); *Amoco Production Co. v. Armhold*, fn. 6, supra

30. See cases cited at fn. 17, supra

TESTIMONY
OF
GARY I. BOREN

BEFORE THE
SENATE RESOURCES COMMITTEE
OF THE
ALASKA STATE LEGISLATURE

Testimony

Madam Chairman and Members of the Committee:

I am Gary Boren, Professor of Law at Washington University, in St. Louis, Missouri. I am here on behalf of the Alaska Oil and Gas Association, for which I prepared a study on proposed changes in the manner in which the State of Alaska taxes the income of corporations that produce oil and gas in the state. I understand that copies of that study have been made available to the members of this Committee.

I have been interested in the problems of state taxation of corporate income for some time, and have written a series of three articles on the subject, which have been published in various legal journals. These articles deal with the way in which the states divide the income of a corporation to determine the amount each state may tax. It is these articles that provide my qualifications for speaking here on that subject today.

The proposal which this Committee is now considering would change drastically the method currently in use in Alaska and which is in use in the overwhelming number of other states that tax corporate income. It is therefore appropriate to investigate the merits of the reasons given by those who are dissatisfied

WITH THE PRESENT SYSTEM. THE ULTIMATE CONCERN FOR THIS COMMITTEE AND THE LEGISLATURE IS WHETHER ALASKA IS GETTING ITS FAIR SHARE OF THE INCOME OF THE TAXPAYERS THAT PRODUCE OIL AND GAS IN THIS STATE. THOSE WHO BELIEVE THAT ALASKA IS NOT QUESTION THE VALIDITY OF BOTH OF THE COMPONENT PARTS OF THE SYSTEM NOW IN USE AS IT APPLIES TO THE OIL AND GAS INDUSTRY. THEY ATTACK THE METHOD OF DETERMINING THE TOTAL INCOME OF A TAXPAYER, AND THEY ALSO ATTACK THE METHOD BY WHICH ALASKA DETERMINES THE PORTION OF THE TOTAL INCOME THAT THE STATE MAY TAX.

THE UNDERLYING CLAIM OF THE PROPONANTS OF THE BILL BEFORE YOU AND OF THE BILL THAT PASSED THE HOUSE IS THAT LOCAL TAXPAYERS ARE PAYING A 9.4% EFFECTIVE RATE ON THEIR INCOME WHILE THE OIL AND GAS PRODUCERS PAY A SUBSTANTIALLY LOWER EFFECTIVE RATE ON THEIR INCOME. THAT IS A SERIOUS CHARGE, BUT AN INVESTIGATION OF THE REASONS FORWARDED TO BACK UP THAT CLAIM DEMONSTRATES THAT THE CHARGE IS UNFOUNDED. LOCAL TAXPAYERS DO NOT PAY A HIGHER EFFECTIVE RATE THAN THE OIL AND GAS INDUSTRY.

THOSE WHO PROPOSE A CHANGE RECOGNIZE, AS THEY MUST, THAT ALASKA MAY NOT TAX THE TOTAL INCOME OF A CORPORATION THAT HAS OPERATIONS IN OTHER STATES AND COUNTRIES. THE CONSTITUTION OF THE UNITED STATES PERMITS A STATE ONLY TO TAX THAT PORTION OF THE TOTAL INCOME THAT IS ATTRIBUTABLE TO THAT STATE. IF A CORPORATION HAS $100 OF INCOME FROM WORLDWIDE OPERATIONS, ALASKA MAY NOT APPLY ITS 9.4% RATE TO THAT TOTAL INCOME. THE PORTION OF

INCOME ATTRIBUTABLE TO ALASKA MUST FIRST BE DETERMINED. IT IS THE WAY IN WHICH THAT PORTION IS DETERMINED THAT IS IN DISPUTE.

THE METHOD CURRENTLY IN USE IN ALASKA BEGINS GENERALLY WITH THE TOTAL INCOME OF A CORPORATION AS REPORTED FOR PURPOSES OF THE FEDERAL INCOME TAX. THAT INCOME IS THEN DIVIDED BY A MATHEMATICAL FORMULA TO DETERMINE THE AMOUNT OF INCOME ATTRIBUTABLE TO ALASKA. THE FORMULA CONSISTS OF THREE FRACTIONS, THAT ARE CALLED FACTORS. THESE FRACTIONS ARE THE PROPORTIONS OF PROPERTY IN ALASKA TO PROPERTY WORLDWIDE, THE PROPORTIONS OF PAYROLL IN ALASKA TO PAYROLL WORLDWIDE, AND THE PROPORTION OF SALES IN ALASKA TO SALES WORLDWIDE. THE FRACTIONS ARE AVERAGED, AND THE AVERAGE FRACTION IS APPLIED TO TOTAL INCOME TO DETERMINE INCOME THAT MAY BE TAXED BY ALASKA. THIS INCOME IS THEN MULTIPLIED BY THE ALASKA TAX RATE TO GET THE AMOUNT OF TAX THAT IS PAID.

I WOULD LIKE TO DISCUSS FIRST THE TAXABLE BASE, FEDERAL TAXABLE INCOME. THE PROPOSAL BEFORE THE COMMITTEE WOULD DO AWAY WITH THIS AS THE WAY IN WHICH COMPUTATION OF THE INCOME FROM OIL AND GAS PRODUCTION AND PIPELINE TRANSPORTATION IN ALASKA BEGINS. THE OBJECTION MADE TO FEDERAL TAXABLE INCOME AS A STARTING POINT IS THAT IT IS "ERODED," FOR OIL AND GAS PRODUCERS; THAT IS, THAT IT DOES NOT REFLECT TRUE TOTAL INCOME FOR THESE TAXPAYERS. THE ARGUMENTS THAT HAVE BEEN MADE FOR THIS POSITION RELATE TO TWO ITEMS; THE IMMEDIATE DEDUCTION FOR INTANGIBLE DRILLING AND DEVELOPMENT COSTS, AN ITEM PECULIAR TO OIL AND GAS

PRODUCERS (ALTHOUGH THE MINING INDUSTRY GETS A SIMILAR IMMEDIATE DEDUCTION); AND THE CREDIT FOR FOREIGN TAXES PAID, AN ITEM AVAILABLE TO MULTINATIONALS UNDER THE FEDERAL INCOME TAX. TO THE EXTENT THAT OTHER ITEMS THAT AFFECT FEDERAL INCOME TAXES AND THROUGH ADOPTION OF THE FEDERAL SYSTEM ALSO AFFECT ALASKA TAXES ARE CONSIDERED EROSIONS, THE BENEFITS OF THOSE EROSIONS ARE SHARED BY ALL ALASKAN TAXPAYERS. THESE ITEMS, USUALLY DEDUCTIONS, THEN DO NOT AFFECT THE RELATIVE TAX BURDEN OF THE OIL AND GAS PRODUCERS AS COMPARED TO OTHER ALASKA TAXPAYERS.

THE DEDUCTION FOR INTANGIBLE DRILLING AND DEVELOPMENT EXPENDITURES PERMITS A TAXPAYER TO TAKE A CURRENT DEDUCTION FOR AN AMOUNT THAT WOULD OTHERWISE BE DEDUCTED OVER A PERIOD OF TIME. IF A CURRENT DEDUCTION WERE NOT PERMITTED, THE TAXPAYER WOULD CAPITALIZE THESE AMOUNTS AS PART OF THE COST OF THE OIL, AND WOULD RECOVER THESE AMOUNTS AS DEDUCTIONS WHEN THE OIL WAS LIFTED FROM THE GROUND AND SOLD. FOR EXAMPLE, IF A TAXPAYER INCURS $10 OF INTANGIBLE DRILLING AND DEVELOPMENT COSTS IN DRILLING A WELL, AND THE OIL IS PRODUCED IN EQUAL AMOUNTS OVER A 10 YEAR PERIOD, THE ALTERNATIVES ARE THESE. THE TAXPAYER MAY TAKE THE $10 AS A DEDUCTION IMMEDIATELY UNDER FEDERAL LAW. IF IT DID NOT, THE ALTERNATIVE FOR THE TAXPAYER WOULD BE TO TAKE A $1 DEDUCTION FOR EACH OF THE 10 YEARS OF PRODUCTION. THE TOTAL DEDUCTION IS THE SAME. TAKING THE DEDUCTION IMMEDIATELY MEANS THAT IT CANNOT BE TAKEN LATER. THE RESULT OF THE CURRENT DEDUCTION IS THAT THE STATE WILL GET ITS TAXES LATER THAN IT OTHERWISE WOULD. BUT THE STATE WILL GET THOSE TAXES.

THE AVAILABILITY OF THE CREDIT FOR FOREIGN TAXES PAID BY MULTINATIONALS APPEARS TO BE THE BASIS FOR THE POSITION TAKEN BY CONGRESSMAN VANIK OF OHIO THAT THE FEDERAL GOVERNMENT IS NOT GETTING ITS TOTAL TAXES FROM MULTINATIONAL CORPORATIONS. USING THE VANIK POSITION AS A STARTING POINT, IT HAS BEEN ARGUED THAT IF THE FEDERAL GOVERNMENT ISN'T GETTING ITS FAIR SHARE, THE STATE OF ALASKA, WHICH USES FEDERAL TAXABLE INCOME AS A STARTING POINT, MUST ALSO NOT BE GETTING ITS FAIR SHARE. REFUTATION OF THIS ARGUMENT REQUIRES AN EXPLANATION OF HOW THE FEDERAL CREDIT WORKS, AND INDEED JUST WHAT A CREDIT IS.

A CREDIT AGAINST TAXES COMES IN AT THE END OF THE PROCESS AFTER THE AMOUNT OF TAX IS DETERMINED. IT IS NOT TAKEN INTO ACCOUNT IN DETERMINING THE AMOUNT OF TAXABLE INCOME THE WAY A DEDUCTION IS. A TAXPAYER STARTS WITH ITS TOTAL TAXABLE RECEIPTS, REDUCES THAT AMOUNT BY THE PERMITTED DEDUCTIONS AND GETS ITS TAXABLE INCOME. TAXABLE INCOME IS MULTIPLIED BY THE APPROPRIATE RATE TO GET THE AMOUNT OF TAX DUE. THAT AMOUNT OF TAX IS THEN REDUCED DIRECTLY BY THE AMOUNT OF THE CREDIT ALLOWED. TO EMPHASIZE THE POINT, THE CREDIT FOR FOREIGN TAXES PAID IS NOT TAKEN INTO ACCOUNT IN COMPUTING THE AMOUNT OF FEDERAL TAXABLE INCOME -- THE CREDIT COMES INTO PLAY ONLY AFTER TAXABLE INCOME HAS BEEN DETERMINED. FOR EXAMPLE, ASSUME A MULTINATIONAL TAXPAYER WITH $150 OF WORLDWIDE RECEIPTS AND $50 OF DEDUCTIBLE EXPENSES. THE TAXPAYER HAS $100 OF TAXABLE INCOME. ASSUMING A FEDERAL INCOME TAX RATE OF 48%, THE TAX ON THE $100 IS $48.

If the taxpayer has paid foreign income taxes of $25, it is permitted to reduce its taxes owed to the United States by that amount. The result would be that the taxpayer would only pay the United States $23. It is that $23 of taxes paid in relation to the $100 of taxable income that gives rise to the position that the federal government is not getting its fair share of the taxes from these taxpayers.

There are reasons for the existence of the foreign tax credit. But the arguments for and against it are absolutely irrelevant to the question of whether federal taxable income is an appropriate starting point for computing Alaska income taxes. That is because the credit does not enter into the computations of Alaska taxable income in any way. Alaska applies its formula to federal taxable income before the credit is taken into account for federal purposes. In terms of the example given previously, Alaska starts with the $100 of total taxable income. It does not reduce that income by the credit. Nor does it give any credit of its own for foreign taxes paid. The $25 of foreign income taxes paid is never taken into account by Alaska. Alaska does not even permit it to be taken as a deduction from income. Thus, those who argue that because the federal government is getting less than half the appropriate taxes in the above example, the State of Alaska must be getting less than half of the 9.4% it should get, are simply ignoring the absolute irrelevance of the foreign tax credit to Alaska taxes.

I am not here to tell this Committee that the federal method for determining taxable income is perfection itself. Of course it is not. The system has shortcomings and is the subject of constant debate, and of change. I am only saying that the system in use does not place the oil and gas multinationals in a favored position in comparison to those corporations in Alaska that engage in other kinds of operations.

The second objection to the way in which Alaska determines the amount of income it may tax relates to the formula used to divide income. That objection is directly reflected in the bill under consideration by this Committee. It would substitute separate accounting for the use of a formula as the principal method by which income is attributed to Alaska for the oil and gas industry. The bill thus indicates a mistrust of the formula as appropriate to the task of dividing the income of oil and gas producers.

What is a formula and why have its virtues won so much acceptance for that device? The theory of the formula is that the total income of a taxpayer whose business crosses state lines is the result of the contribution of activities or items in all the states that have a connection to the income. The income produced in any one state is measured by the proportions that the items occurring in that state bear to the total of those items found everywhere.

OF THE THREE FACTORS THAT MAKE UP THE FORMULA, PROPERTY, PAYROLL, AND SALES, TWO APPEAR TO BE NONCONTROVERSIAL. NO DISSATISFACTION HAS BEEN EXPRESSED WITH THE AMOUNTS OF PROPERTY AND PAYROLL THAT THE FORMULA USES. THE HIGH COSTS OF THESE ITEMS IN ALASKA MEANS THAT PAYROLL AND PROPERTY IN ALASKA ARE RELATIVELY HIGHER THAN IN MOST OTHER JURISDICTIONS. THE PRIMARY REASON FOR MISTRUST OF THE FORMULA AS IT APPLIES TO OIL AND GAS PRODUCERS IS THE SALES FACTOR. THE OBJECTION TO THE SALES FACTOR IS THAT IT THROWS INCOME OUT OF ALASKA INTO OTHER STATES, BECAUSE RELATIVELY SMALL AMOUNTS OF OIL AND GAS ARE CONSUMED IN ALASKA.

THE SALES FACTOR, OF COURSE, DOES NOT OCCUR IN ISOLATION. IT IS BALANCED BY THE PROPERTY AND PAYROLL FACTORS. THAT BALANCING IS INTENTIONAL. THE RESULT IS THAT NO ONE FACTOR HAS TOO LARGE AN INFLUENCE ON THE RESULT. THE HIGH CONCENTRATIONS OF PROPERTY AND PAYROLL IN THE PRODUCING STATES ARE COUNTERWEIGHTS TO THE INFLUENCE OF THE SALES FACTOR. FROM THE STANDPOINT OF THE MARKET STATES, THE SALES FACTOR BALANCES THE CONCENTRATIONS OF PAYROLL AND PROPERTY THAT OCCUR IN THE PRODUCING STATES. BY AVERAGING THE THREE FACTORS, DISTORTION CAUSED BY ANY ONE IS AVOIDED. BUT THE QUESTION IS RAISED AS TO WHETHER IT IS APPROPRIATE TO HAVE A SALES FACTOR IN ANY EVENT.

THE SALES FACTOR IS USED BY ALL STATES THAT HAVE AN APPORTIONMENT FORMULA WITH THE EXCEPTION OF WEST VIRGINIA. THE SALES FACTOR IS IN SUCH WIDESPREAD USE BECAUSE IT IS GENERALLY AGREED THAT

THE MARKET STATES, THE PLACE WHERE AN ITEM IS CONSUMED, HAVE A CLAIM TO A PORTION OF THE INCOME. THE EXISTENCE OF MARKETS IN OTHER STATES CLEARLY CONTRIBUTES TO THE INCOME DERIVED FROM OIL AND GAS OPERATIONS IN ALASKA. CONSIDER HOW MUCH INCOME THERE WOULD BE TO TAX IF ALL OF THE OIL AND GAS PRODUCED IN ALASKA HAD TO BE CONSUMED IN ALASKA FOR LACK OF ANY OTHER MARKET.

THE CONTRIBUTION OF THE MARKET TO TOTAL INCOME THAT IS REFLECTED BY INCLUDING A SALES FACTOR IN THE APPORTIONMENT FORMULA IS RECOGNIZED BY OTHER PRODUCING AND MANUFACTURING STATES. NOR HAS ANY SUFFICIENT REASON BEEN FORWARDED WHY A FORMULA DOES NOT WORK FOR THE OIL AND GAS INDUSTRY. IT HAS BEEN SAID THAT THE STATE OF ALASKA IS UNIQUE BECAUSE OF THE EXTENT TO WHICH IT MUST RELY ON THE OIL AND GAS INDUSTRY FOR ITS TAX BASE. IF THAT IS TRUE, IT NEVERTHELESS DOES NOT CHANGE THE AMOUNT OF INCOME OF THE OIL AND GAS PRODUCERS THAT HAS ITS SOURCE IN ALASKA. AND ONE MAY QUESTION THE PREMISE. MICHIGAN, WHICH IS HEAVILY DEPENDENT ON THE AUTOMOBILE INDUSTRY, DOES NOT SINGLE IT OUT FOR A SPECIAL, MORE BURDENSOME, TREATMENT. THE STATE OF ALASKA, OF COURSE, IS NOT BOUND BY WHAT OTHER STATES DO. BUT BEFORE DEPARTING FROM A SYSTEM THAT HAS BEEN ADOPTED IN SO MANY OTHER JURISDICTIONS, THE LEGISLATURE MIGHT WELL CONSIDER THAT THE USE OF THE FORMULA IN OTHER STATES MAY INDICATE THAT THERE ARE GOOD REASONS FOR RETAINING THE FORMULA IN ALASKA.

ANOTHER OBJECTION TO THE FORMULA NOW IN USE THAT HAS BEEN FORWARDED BY THOSE WHO SEEK A CHANGE, IS THAT SOME OTHER METHOD WOULD PRODUCE MORE TAXES FOR ALASKA. THAT IS TRUE. INDEED, IN ESSENCE, THE BILL BEFORE YOU IS A TAX INCREASE ON THE OIL AND GAS INDUSTRY. BUT IT IS NOT RESPONSIVE TO THE QUESTION AS TO WHETHER THE CURRENT SYSTEM, OR THE ALTERNATIVE PROPOSED, GIVES ALASKA ITS FAIR SHARE OF TAXES. IF, AS I AM TRYING TO SHOW, THE CURRENT SYSTEM IS FAIR, AN INCREASE IN INCOME TAXES, IF THAT IS WHAT THE LEGISLATURE WANTS DONE, OUGHT TO BE BORNE BY ALL CORPORATE INCOME TAXPAYERS.

I SHOULD LIKE TO TURN NOW TO THE MERITS OF THE ALTERNATIVE SYSTEM EMBODIED IN THE BILL BEING CONSIDERED BY THIS COMMITTEE. THE ARGUMENT MADE TO SUPPORT THAT BILL IS THAT SEPARATE ACCOUNTING, (OR THE VARIATION OF IT CONTAINED IN THE BILL), IS A MORE ACCURATE WAY OF DETERMINING THE INCOME ATTRIBUTABLE TO ALASKA THAN IS THE USE OF AN ARBITRARY FORMULA. THE ACCURACY CLAIMED FOR SEPARATE ACCOUNTING IS DEEMED TO BE SELF-APPARENT. THE DEVICE CONSIDERS WHAT ACTUALLY GOES ON IN THE STATE IN COMPUTING THE AMOUNT OF INCOME THE STATE SHOULD TAX. THAT IS THE REASON SEPARATE ACCOUNTING WAS FIRST USED. AND SEPARATE ACCOUNTING IS STILL USED, BUT IN A SUBSTANTIALLY DIMINISHED DEGREE.

YOU HAVE HEARD IN PRIOR TESTIMONY ABOUT THE CONSIDERABLE ADMINISTRATIVE DIFFICULTIES CONNECTED WITH SEPARATE ACCOUNTING. IT REQUIRES THE MAINTENANCE BY TAXPAYERS OF EXTENSIVE RECORDS

NOT NEEDED FOR OTHER PURPOSES. AUDITS BY THE STATE WOULD BE MORE TIME CONSUMING AND HENCE MORE EXPENSIVE. THE BILL BEFORE YOU ATTEMPTS TO LIMIT THESE DIFFICULTIES, ALTHOUGH MANY REMAIN. IF THESE WERE THE ONLY REASONS AGAINST THE USE OF SEPARATE ACCOUNTING THE LEGISLATURE, AFTER WEIGHING THE EXTENT OF THE ADMINISTRATIVE BURDEN, MIGHT, OR MIGHT NOT, DECIDE THAT THE ACCURACY WAS WORTH THE TROUBLE. THAT WOULD BE FOR THE LEGISLATURE TO DETERMINE. BUT I WOULD LIKE TO DISCUSS THE UNDERLYING CLAIM, THE CLAIM THAT SEPARATE ACCOUNTING IS ACCURATE.

THE VIEW OF MOST OF THOSE WHO HAVE STUDIED THE ISSUE IS THAT SEPARATE ACCOUNTING IS NOT ACCURATE FOR BUSINESSES WHOSE OPERATIONS CROSS STATE LINES. BY FOCUSING ON WHAT GOES ON IN ONE STATE, IT IGNORES WHAT HAPPENS ELSEWHERE. BY CONSTRUCTING AN ARTIFICIAL BUSINESS THAT OPERATES ONLY IN ONE STATE, SEPARATE ACCOUNTING DISREGARDS THE REALITY OF THE BUSINESS BEING TAXED.

THE BILL BEFORE THIS COMMITTEE RECOGNIZES THIS LIMITATION. IT DOES NOT CALL FOR A COMPLETE SEPARATE ACCOUNTING. ONLY INCOME FROM OIL AND GAS PRODUCTION AND PIPELINE TRANSPORTATION IN ALASKA IS ACCOUNTED FOR SEPARATELY. ALL OTHER INCOME IS SUBJECTED TO FORMULARY APPORTIONMENT, AND THIS INCLUDES THE INCOME DERIVED FROM OIL AND GAS PRODUCTION AND PIPELINE TRANSPORTATION IN OTHER JURISDICTIONS. A TRUE SEPARATE ACCOUNTING WOULD NOT TAX PRODUCTION INCOME OUTSIDE ALASKA, NOR SEEK TO REACH ANY OTHER INCOME FROM OPERATIONS OUTSIDE ALASKA. THE

WORKINGS OF THIS BILL CAN ONLY LEAD TO THE SAME INCOME BEING TAXED TWICE, AND IN AN AMOUNT IN EXCESS OF THE DOUBLE TAXATION UNDER A TRUE SEPARATE ACCOUNTING. THAT REALITY ONLY UNDERSCORES THE UNDERLYING NATURE OF THE BILL. IT IS SIMPLY A WAY TO GET MORE TAX DOLLARS FROM THE OIL AND GAS PRODUCERS. IT IS NOT A REFORM.

THE ARTIFICIAL PROVISIONS OF THE BILL THAT CAUSE THE GREATEST DIFFICULTIES ARE THE WAY IN WHICH GROSS INCOME IS DETERMINED AND THE LIMIT ON THE DEDUCTIONS THAT ARE ALLOWED. TO USE PRODUCTION AS AN EXAMPLE, GROSS INCOME IS DETERMINED TO BE THE VALUE OF THE OIL AND GAS PRODUCED AS ESTABLISHED FOR PURPOSES OF THE SEVERANCE TAX. WITHOUT REFERENCE TO THE QUESTION WHETHER THAT VALUE IS ACCURATE AS A VALUE, I WOULD LIKE TO POINT OUT THAT THE BILL CONFUSES VALUE FOR PURPOSES OF A PROPERTY OR A SEVERANCE TAX WITH THE ISSUE OF THE SOURCES OF INCOME, WHICH IS THE QUESTION TO BE CONSIDERED IN DIVIDING INCOME AMONG THE STATES.

THE CONTRIBUTION OF OTHER STATES TO THE VALUE OF PROPERTY IS IRRELEVANT IN A PROPERTY TAX OR A SEVERANCE TAX. THOSE OTHER STATES CANNOT TAX THOSE VALUES. ONLY THE STATE IN WHICH THE PROPERTY IS LOCATED OR FROM WHOSE GROUND IT WAS SEVERED MAY DO SO. THE CONTRIBUTION OF OTHER STATES TO VALUE MAKE ALL THE DIFFERENCE IN AN INCOME TAX, BECAUSE THAT VALUE IS TRANSFORMED TO INCOME TO WHICH THOSE OTHER STATES HAVE A CLAIM. THE VALUE OF OIL AND GAS IN ALASKA IS INCREASED BECAUSE THE OIL AND GAS

WILL BE TRANSPORTED TO, AND EVENTUALLY SOLD IN, OTHER STATES. A PROPERTY TAX OR A SEVERANCE TAX IS STATIC. THE QUESTION IS VALUE IN ONE STATE AT ONE POINT IN TIME. AN INCOME TAX IS THE RESULT OF TRANSACTIONS, WHICH HERE CROSS STATE LINES.

BECAUSE OTHER STATES AGREE THAT THE USE OF A FORMULA IS APPROPRIATE FOR THE OIL AND GAS INDUSTRY, THEY WILL BE TAXING THE SAME VALUES ALASKA TAXES. IF THE PRESENT SYSTEM WERE WRONG, THERE EXISTS A MECHANISM FOR SOLVING ALASKA'S PERCEIVED PROBLEM WITHOUT SUBJECTING THE OIL AND GAS INDUSTRY TO MULTIPLE TAXATION. ALASKA IS A MEMBER OF THE MULTISTATE TAX COMPACT. THE ALASKA COMMISSIONER OF REVENUE IS AN OFFICER OF THE MULTISTATE TAX COMMISSION. HE, ON HIS OWN INITIATIVE, OR PERHAPS AT THE DIRECTION OF THE LEGISLATURE, COULD WORK WITHIN THAT BODY FOR THE ADOPTION OF UNIFORM REGULATIONS EMBODYING A NEW SYSTEM. ALASKA COULD PRESENT ITS POSITION ON THE APPROPRIATE METHOD OF DIVIDING INCOME OF OIL AND GAS PRODUCERS AND HAVE IT EVALUATED BY A GROUP COMPOSED OF THE TAX ADMINISTRATORS OF OTHER STATES. AND I RECOMMEND THAT PROCEDURE TO HIM.

THE ARTIFICIALITYOF THE BILL IS ALSO EVIDENCED BY ITS TREATMENT OF DEDUCTIONS. ONLY DIRECT EXPENSES OF EXPLORATION AND PRODUCTION, AND A LIMITED AMOUNT OF INTEREST EXPENSE ARE PERMITTED AS DEDUCTIONS FROM OIL AND GAS PRODUCTION INCOME AS DETERMINED FOR ALASKA. ALL OVERHEAD AND OTHER INDIRECT EXPENSES ARE DISALLOWED. THERE ARE, NEVERTHELESS, ACTUAL COSTS WITH A RELATIONSHIP TO

THE PRODUCTION OF OIL IN ALASKA. AGAIN, THE BILL RECOGNIZES INTERNALLY THE ARTIFICIAL NATURE OF THESE LIMITS. THOSE DEDUCTIONS DISALLOWED MAY BE TAKEN INTO ACCOUNT IN COMPUTING THE INCOME FROM OTHER OPERATIONS, AND THE NET INCOME FROM THESE COMPUTATIONS ARE SUBJECTED TO THE SPECIAL APPORTIONMENT FORMULA IN THE BILL. THE RESULT OF THIS IS THAT OVERHEAD AND OTHER INDIRECT EXPENSES RELATING TO PRODUCTION INCOME ARE ATTRIBUTED TO OTHER OPERATIONS THAT TAKE PLACE OUTSIDE THE STATE. ONLY A SMALL PROPORTION OF THOSE THAT WOULD OTHERWISE REDUCE INCOME IN ALASKA END UP AS EFFECTIVE DEDUCTIONS. WHAT YOU THEN WOULD HAVE IS SOMETHING PART WAY BETWEEN AN INCOME TAX AND A GROSS RECEIPTS TAX -- NEITHER FISH NOR FOWL -- BUT AT INCOME TAX RATES THAT FAR EXCEED RATES UNDER A GROSS RECEIPTS TAX.

I HOPE THAT I HAVE BEEN ABLE TO DEMONSTRATE FOR YOU THAT THE OIL AND GAS INDUSTRY IS NOT PAYING INCOME TAXES AT A LOWER EFFECTIVE RATE THAN LOCAL TAXPAYERS PAY, AND THAT THE ALTERNATIVE PROPOSED CREATES INEQUITY RATHER THAN ABOLISHING IT. BEFORE CLOSING, I WOULD LIKE TO RAISE BRIEFLY SOME OTHER ISSUES CONNECTED WITH THE BILL.

BEYOND THE INACCURACIES THAT RESULT FROM THE USE OF SEPARATE ACCOUNTING, THE BILL RAISES SEVERAL LEGAL QUESTIONS. THE UNITED STATES SUPREME COURT HAS RECENTLY RECOGNIZED THAT TAXES TAILORED FOR SPECIAL INDUSTRIES MAY VIOLATE THE COMMERCE CLAUSE. THE

VERY MAGNITUDE OF THE INCREASE IN TAXES OVER WHAT WOULD HAVE BEEN OWING IN A PRIOR YEAR HAS BEEN CONSIDERED OF SIGNIFICANCE BY THAT COURT IN DECIDING A QUESTION OF APPORTIONMENT UNDER A TAX ON THE ROLLING STOCK OF A RAILROAD. QUESTIONS HAVE ALSO BEEN RAISED ABOUT THE ABILITY OF THE STATE OF ALASKA TO CONTINUE ITS MEMBERSHIP IN THE MULTISTATE TAX COMMISSION. I WOULD NOT PRESUME TO ADVISE YOU ON HOW ANY OF THOSE QUESTIONS WOULD BE DECIDED. I CAN ONLY SAY THAT THE PROBLEMS ARE REAL ONES. THE UNCERTAINTIES THAT THEY RAISE ARE CERTAINLY APPROPRIATE FOR THE LEGISLATURE TO CONSIDER IN THE PROCESS OF REACHING A DECISION ON THIS BILL.

THE BILL BEFORE THIS COMMITTEE HAS A FLAW THAT GOES BEYOND THE INTERNAL DEFECTS OF THE PROPOSAL. THE BILL IS A STEP AWAY FROM THE GOAL OF UNIFORMITY THAT PROMPTED THE ENACTMENT OF THE UNIFORM DIVISION OF INCOME ACT AND THE ADOPTION OF THE MULTISTATE TAX COMPACT BY THE STATE OF ALASKA. THE LEGISLATURE MAY DECIDE THAT UNIFORMITY WITH THE LAWS OF OTHER STATES, AND THE BENEFITS TO THE STATE AND TO TAXPAYERS THAT UNIFORMITY PROVIDES MUST BE SUBORDINATED TO OTHER INTERESTS OF THE STATE OF ALASKA. BUT THE BENEFITS OF UNIFORMITY DO DESERVE TO BE WEIGHED IN THE DECISION MAKING PROCESS. IN THAT BALANCE THE DIFFICULTIES OF SEPARATE ACCOUNTING, ITS INACCURACIES, AND THE DEFECTS OF THE BILL BEFORE THIS COMMITTEE, INCLUDING THE LEGAL QUESTIONS IT RAISES ALSO DESERVE CONSIDERATION. THE PRESENT SYSTEM OF DIVIDING CORPORATE INCOME HAS SERVED ALASKA WELL UP TO THIS POINT. ITS CONTINUED USE WOULD SERVE ALASKA WELL IN THE FUTURE.

GARY I. BOREN

Biographical Information

Education:

Bachelor of Arts, University of California, Los Angeles - 1957

Bachelor of Laws, University of California, Los Angeles - 1961

Member of the Order of the Coif
Note and Comment Editor, U.C.L.A. Law Review

Professional:

Professor of Law and Director of the Graduate Tax Program, Washington University School of Law, St. Louis, Missouri

Assistant Professor - 1967-1971
Associate Professor - 1971-1975
Professor - 1975-Present

Private practice, Los Angeles, California - 1961-1967

Member State Bar of California

Major Publications:

Equitable Apportionment: Administrative Discretion and Uniformity in the Division of Corporate Income for State Tax Purposes
49 So. Cal. L. Rev. 991 (1976)

Specific Allocation of Corporate Income in California: Some Problems in the Uniform Division of Income for Tax Purposes
30 TAX. L. REV. 607 (1975)

Separate Accounting in California and Uniformity in Apportioning Corporate Income
18 U.C.L.A. L. REV. 478 (1971)

Courses Taught:

*State and Local Taxation
*Federal Income Taxation
*Federal and Estate Gift Taxation
*Seminar in Tax Policy and Current Legislation
*Seminar in Advanced Tax Research
Natural Resources

*Courses taught currently

STATEMENT

OF THE DOW CHEMICAL COMPANY

For the Hearing Conducted by the
Alaska Senate Resources Committee

Juneau, Alaska
March 18, 1977

By J. H. Davidson
Technical Advisor
Dow Chemical U.S.A.
Midland, Michigan

J. H. DAVIDSON

Mr. Chairman,

My name is John Davidson and I am a Technical Advisor in the Agricultural Products Department of Dow Chemical U.S.A. Since graduation from Michigan State University in 1937, I have been employed by Dow working in the area of research and development with agricultural chemicals, among them formulations of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) and 2,4-dichlorophenoxyacetic acid (2,4-D) which you are discussing today.

This statement expressing the position of The Dow Chemical Company regarding 2,4,5-T and 2,4-D concerns the registered uses for 2,4,5-T as given on the ESTERON 245 and ESTERON 99 Concentrate labels, copies of each are attached. These labels are registered by the United States Environmental Protection Agency as EPA Registration No. 464-205-AA and No. 464-201-AA.

The Dow Chemical Company believes that the federal EPA registration adequately covers the requirements for safe use of 2,4,5-T and 2,4-D and may be summarized in the following statements:

1. The 2,4,5-T and 2,4-D herbicide products presently registered comply with the provisions of the Federal Insecticide, Fungicide and Rodenticide Act as amended.

2. 2,4,5-T and 2,4-D herbicides will perform their intended function without unreasonable adverse effects on the environment.

3. When used in accordance with widespread and commonly recognized practice, 2,4,5-T and 2,4-D will not cause unreasonable adverse effects on the environment as defined by the Federal Insecticide, Fungicide and Rodenticide Act as amended.

4. The registrations of 2,4,5-T and 2,4-D containing herbicides should not be cancelled or any classification changed.

The prohibition of 2,4,5-T used around the home, recreation areas, on lakes, ponds and ditch banks is frequently cited as a reason for severely restricting its use in other areas. Clarification of this point by relating some of the background information may be of help.

Shortly before EPA became operative in April of 1970 a joint announcement by the Secretaries of Agriculture, Interior and Health Education and Welfare was issued suspending the use of 2,4,5-T around the home, recreation areas, on lakes, ponds, ditch banks and food crops. This was prompted primarily because 2,4,5-T was under investigation as an ingredient in a defoliant used in the Vietnam War. An objection was filed regarding suspension of 2,4,5-T on food crops but not for the use of 2,4,5-T around homes, recreation areas, on lakes, ponds, and ditch banks. At the time, these uses of 2,4,5-T were not considered important, and the benefits to be derived from questioning the suspension order apparently did not outweigh even the costs of opposing such an action. In addition, alternative and reasonably acceptable herbicides were available. Despite extensive investigation, no evidence has been developed that there is any hazard from the use of 2,4,5-T around the home, recreation areas, on lakes, ponds, ditch banks and food crops.

A brief discussion on the use of phenoxy herbicides is presented in the report entitled "Phenoxy Herbicides" recently prepared by the Council for Agricultural Science and Technology. A copy of this report is attached. The authors of this report are recognized experts in their respective fields. Several paragraphs from this report are pertinent to the issues covered in this statement and will be quoted here.

From the Summary.

The phenoxy herbicides are predominantly toxic to green plants and are much less toxic to mammals, birds, fish, reptiles, shellfish, insects, worms, fungi and bacteria. When properly used, they do not occur in soils and water at levels harmful to animals and microorganisms. They do not concentrate in food chains and do not persist from year to year in croplands. They are detectable only rarely in food and then only in insignificant amounts.

A highly poisonous kind of dioxin called TCDD is an unavoidable contaminant in commercial supplies of 2,4,5-T and silvex. The amount present in currently produced formulations of 2,4,5-T and silvex is not enough to alter the toxicological properties of these preparations or to endanger human health or to affect plants or animals in the environment.

The phenoxy herbicides are widely used because they are more efficient and usually less hazardous and less injurious to the environment than alternative methods. Use of these chemicals is estimated to reduce the cost of production of the crops on which they are used by about 5% and to reduce overall agricultural production costs in the United States by about 1%. Uses in forests and nonagricultural situations provide additional savings. If the phenoxys were no longer available, the cost of food, forest products, electric power, transportation and governmental services would be higher. These costs would be borne by consumers.

From the Residue Section, p. 17.

Residues of the phenoxy herbicides leached into the soil are bound to some extent by soil particles and are held in the upper part of the soil. They do not leach into water tables and contaminate wells and springs, nor do they move significantly into streams or to adjacent areas from surface runoff. However, wind or water erosion that carries major quantities of soil would also transport herbicide residues if any were present. The diluting effect of the soil is such that levels of the phenoxy herbicide in the root zone of plants are extremely low. Normally the levels are not sufficient to injure green plants or to affect non-green organisms such as bacteria, fungi, worms, insects and rodents.

The phenoxys are, without exception, subject to decomposition by various microorganisms that are universally present in soils. When applied to soils at typical agricultural rates, 2,4-D is usually decomposed in one to four weeks. MCPA requires about six weeks and 2,4,5-T about three months for essentially complete destruction. Silvex degradation is slightly slower than that of 2,4,5-T. Thus the phenoxy herbicides do not build up in the soil, and treatments can be applied to croplands year after without accumulation.

From the Dioxin Section, p. 19.

TCDD sprayed into waters rapidly disappears, evidently due to vapor distillation into the atmosphere and to decomposition by sunlight provided the waters contain small amounts of organic compounds. It is known that TCDD can bioaccumulate in algae, snails and fish. This property is of no practical interest, however, since there is no

> substantial supply of the chemical in the environment subject to accumulation. Analyses reveal that accumulation in food-chain organisms is not a problem. Measurable levels of TCDD have not been found in herring gulls, sea lions, eagles, cormorants, butterfish, eels, chain pickerels and large bodies of fresh and salt water. It has not been possible to detect TCDD in American supplies of food and feed and in fish meal.

In order to assure appropriate quality assurance of 2,4,5-T herbicides as produced by The Dow Chemical Company certain analyses are made on each lot of product produced. In addition to certain routine analyses on 2,4,5-T and silvex an examination of each lot is made to assure compliance with the recommendation on 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

In the "Report of the Advisory Committee on 2,4,5-T to the Administrator of the Environmental Protection Agency" submitted in May of 1971, recommendations were included regarding quality control of the manufactured product. These included a limit of 0.1 ppm TCDD in all future production and the surveillance by the EPA of products on the market. The Dow Chemical Company analyzes each lot of product containing 2,4,5-T to be certain that it complies with this recommendation. To the best of my knowledge, EPA inspectors periodically collect samples from dealer shelves and retainer samples from the manufacturer for purposes of determining compliance with this recommendation.

In June of 1974 the United States Environmental Protection Agency withdrew the formal hearing on 2,4,5-T due to lack of data. Prior to this withdrawal several conferences were held by experts from United States Environmental Protection Agency, United States Department of Agriculture, Food and Drug Administration, Environmental Defense Fund, Dow and others in which studies on toxicology, analytical methodology and environmental samples were discussed in detail. As a result of the information presented at these meetings and supplied in the preparation for the public hearing, the United States Environmental Protection Agency withdrew the intent to hold hearings on 2,4,5-T, silvex and herbicides potentially containing 2,3,7,8-tetrachlorodibenzo-p-dioxin and withdrew its cancellation of the registration of 2,4,5-T in rice fields, the only food crop use of significance. This notice of withdrawal was printed in the Federal Register, Vol. 39, No. 126, June 28, 1974. A copy is attached.

Registration requirements of the United States Environmental Protection Agency include information to support the safe use of these products when used according to label instructions. This safety information applies to humans, wildlife and livestock.

The U.S. Environmental Protection Agency has established the following maximum contaminant levels for the organic chemicals 2,4-D and silvex in community water systems:

2,4-D	0.1 milligrams per liter (ppm)
silvex	0.01 milligrams per liter (ppm)

See attached Federal Register December 24, 1975, p. 59571.

Formulations of 2,4,5-T and 2,4-D are registered for sale in all states and in all provinces of Canada.

We therefore oppose any additional restrictions on the use of 2,4-D or 2,4,5-T.

Respectfully submitted,

J. H. Davidson
Dow Chemical U.S.A.
Midland, Michigan

2,4,5-TRICHLOROPHENOXYACETIC ACID AND HERBICIDES POTENTIALLY CONTAINING TETRACHLORODIOXIN

Withdrawal of Cancellation and Withdrawal of Intent to Hold Hearings

Please take notice that pursuant to the authority vested in me by sections 6 (b)(1) and 6(b)(2) of the Federal Insecticide, Fungicide and Rodenticide Act, as amended, I hereby withdraw the order of cancellation of 2,4,5-Trichlorophenoxyacetic Acid (2,4,5-T) only insofar as it relates to rice dated August 6, 1971 (36 FR 14777, August 11, 1971) and I further withdraw (1) the notice of intent to hold hearing on all registered uses of 2,4,5-T dated July 19, 1973 (38 FR 19859–60, July 24, 1973) and (2) the notice of intent to hold hearing on all registered uses of herbicides derived from 2,4,5 Trichlorophenol, including Silvex and Erbon, dated May 10, 1974 (39 FR 17466, May 16, 1974). All suspensions of uses of 2,4,5-T remain in effect, and all cancellations of uses of 2,4,5-T for which a hearing was not requested similarly remain in effect. See also USDA-PRD, PR 70-11, April 20, 1970 and USDA-PRD, PR 70-13, May 1, 1970.

Accordingly, I hereby withdraw the proceedings initiated by the aforementioned Order and Notices (FIFRA Consolidated Docket No. 295) and the new proceeding (FIFRA Docket No. 302) initiated by the Notice dated May 10, 1974 (39 FR 17466, May 16, 1974).

I take these actions for the reasons given in the statement which accompanies this notice and without prejudice to the issuance of such orders or notices in the future if such issuance is warranted in the judgment of the appropriate officials of this Agency.

Dated: June 24, 1974.

JOHN QUARLES,
Acting Administrator.

[FR Doc.74-14920 Filed 6-27-74;8:45 am]

2,4,5-TRICHLOROPHENOXYACETIC ACID AND HERBICIDES POTENTIALLY CONTAINING TETRACHLORODIOXIN

Residue Monitoring Program

Concern over the use of 2,4,5-Trichlorophenoxyacetic Acid (2,4,5-T) in the United States initially arose when 2,4,5-T was used as a defoliant during the Vietnamese War. On August 6, 1971 this agency issued an order reaffirming cancellation of 2,4,5-T on food crops for human consumption (36 FR 14777, August 11, 1971), and on July 19, 1973 the Agency issued a notice of intent to hold hearing on all registered uses of 2,4,5-T (38 FR 19859–60, July 24, 1973) pursuant to section 6(b)(2) of the Federal Insecticide, Fungicide and Rodenticide Act, as amended. A similar section 6(b)(2) notice of intent to hold hearing on all registered herbicides derived from 2,4,5-Trichlorophenol, including Silvex and Erbon, was issued on May 10, 1974 (39 FR 17466, May 16, 1974).

All herbicides derived from 2,4,5-Trichlorophenol, including 2,4,5-T, Silvex and Erbon, have the potential of containing tetrachlorodioxin (TCDD). As study of 2,4,5-T by this Agency continued, concern focused on the contaminant TCDD. By 1973 residue monitoring devices had been developed that appeared capable of monitoring TCDD in parts per trillion (ppt), the degree of sensitivity needed for measurement of TCDD in man and the human food chain. The 1973 notice specifically delayed the hearing on 2,4,5-T until April 1974 "to permit the Agency to complete an environmental and human monitoring project on the presence of the tetrachlorodioxin impurity found in 2,4,5-T and the extent to which the dioxin may adversely affect human and animal health." (38 FR 19860, July 24, 1973). The residue monitoring program was the only means available to determine if TCDD is bioaccumulating in man and the human food chain. Without the answer to the question of bioaccumulation, the danger of TCDD cannot be assessed.

As reported by attorneys of this Agency on March 21, 1974 in FIFRA Consolidated Docket No. 295, methodological problems have delayed the TCDD residue monitoring project. Since that date, the methodological problems have not been solved. Problems at first thought to relate only to human and rice samples now are found to relate to all samples. No date for completion of the TCDD residue monitoring can be given, and in fact, completion of the project by the Agency may be two or more years away.

Under the circumstances, it does not seem appropriate to continue administrative proceedings when the evidence which would largely determine the outcome of those proceedings remains scientifically unavailable. The Agency will continue its TCDD residue monitoring program and will take such further action as it deems appropriate once the results of the monitoring project are available.

Dated: June 24, 1974.

JOHN QUARLES,
Acting Administrator.

[FR Doc.74-14921 Filed 6-27-74;8:45 am]

federal register

WEDNESDAY, DECEMBER 24, 1975

THE NATIONAL ARCHIVES OF THE UNITED STATES • 1934 •

PART IV:

ENVIRONMENTAL PROTECTION AGENCY

WATER PROGRAMS

National Interim Primary Drinking Water Regulations

Title 40—Protection of Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER D—WATER PROGRAMS

[FRL 464-7]

✓PART 141—NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS

On March 14, 1975, the Environmental Protection Agency (EPA) proposed National Interim Primary Drinking Water Regulations pursuant to sections 1412, 1414, 1415, and 1450 of the Public Health Service Act ("the Act"), as amended by the Safe Drinking Water Act ("SDWA" Pub. L. 93-523), 40 FR 11990. EPA held public hearings on the proposed regulations in Boston, Chicago, San Francisco, and Washington during the month of April. Several thousand pages of comments on the proposed regulations were received and evaluated. In addition, the Agency has received comments and information on the proposed regulations from the National Drinking Water Advisory Council, the Secretary of Health, Education, and Welfare, and from numerous others during meetings with representatives of State agencies, public interest groups and others.

The regulations deal only with the basic legal requirements. Descriptive material will be provided in a guidance manual for use by public water systems and the States.

The purpose of this preamble to the final regulations is to summarize the most significant changes made in the proposed regulations as a result of comments received and the further consideration of available information. A more detailed discussion of the comments and of changes in the proposed regulations is attached as Appendix A.

✓ WATER SYSTEMS COVERED

The Safe Drinking Water Act applies to each "public water system," which is defined in Section 1401(4) of the Act as "a system for the provision to the public of piped water for human consumption, if such system has at least fifteen service connections or regularly serves at least twenty-five individuals." Privately owned as well as publicly owned systems are covered. Service "to the public" is interpreted by EPA to include factories and private housing developments. (See generally, House Report, pp. 16-17.)

The definition of "public water system" proposed in the Interim Primary Drinking Water Regulations sought to explain the meaning of the statutory reference to "regular" service. It was proposed to interpret this term as including service for as much as three months during the year. Because the proposed definition would have excluded many large campgrounds, lodges, and other public accommodations which serve large numbers of tourists but which are open for slightly less than three months each year, the definition in the final version covers systems serving an average of at least twenty-five individuals at least 60 days out of the year. The use of a minimum number of days rather than months also makes clear that a system may qualify as a public water system even if it is not open every day during a given month.

Once "public water system" has been defined, it is necessary to define the two major types of public water systems—those serving residents and those serving transients or intermittent users. The possible health effects of a contaminant in drinking water in many cases are quite different for a person drinking the water for a long period of time than for a person drinking the water only briefly or intermittently. Different regulatory considerations may in some cases apply to systems which serve residents as opposed to systems which serve transients or intermittent users. Accordingly, § 141.2(e) makes clear that all "public water systems" fall within either the category of "community water systems" or the category of "non-community water systems." To make clear which regulatory requirements apply to which type of system, the category covered is specifically indicated throughout the regulations.

The proposed regulations defined a "community water system" as "a public water system which serves a population of which 70 percent or greater are residents." Reliance in the proposed definition on the percentage of water system users who are residents would result in treating some fairly large resort communities with many year-round residents as non-community systems. Therefore, the definition of "community water system" has been changed to cover any system which serves at least 15 service connections used by year-round residents or serves at least 25 year-round residents.

SMALL COMMUNITY WATER SYSTEMS

Many community water systems in the country are quite small. Since it is the intention of the Act to provide basically the same level of health protection to residents of small communities as to residents of large cities, and since a number of advanced water treatment techniques are made feasible only by economies of scale, the cost of compliance with the requirements of the Act may pose a serious problem for many small communities. The regulations seek to recognize the financial problems of small communities by requiring more realistic monitoring for systems serving fewer than 1,000 persons. Variances and exemptions authorized by the Act can also assist in dealing with economic problems of small community systems in appropriate cases, at least temporarily. EPA will provide technical assistance on effective treatment techniques which can be used by small systems.

These methods of dealing with the financial problems of some small community systems may not be sufficient in specific instances to make compliance with all applicable regulatory requirements feasible. EPA is commencing a study of potential problems faced by small community systems in meeting applicable requirements under the Act and these regulations, and, if necessary, will make additional adjustments in the Interim Primary Drinking Water Regulations prior to their effective date.

NON-COMMUNITY SYSTEMS

"Non-community systems" are basically those systems which serve transients. They include hotels, motels, restaurants, campgrounds, service stations, and other public accommodations which have their own water system and which have at least 15 service connections or serve water to a daily average of at least 25 persons. Some schools, factories and churches are also included in this category. It is conservatively estimated that there are over 200,000 non-community water systems in the country. However, it should be recognized that while their number is large, they normally are not the principal source of water for the people they serve.

The regulations as proposed would have applied all maximum contaminant levels to non-community systems as well as to community systems. This approach failed to take into account the fact that the proposed maximum contaminant levels for organic chemicals and most inorganic chemicals were based on the potential health effects of long-term exposure. Those levels are not necessary to protect transients or intermittent users. Therefore, the final regulations provide that maximum contaminant levels for organic chemicals, and for inorganic chemicals other than nitrates, are not applicable to non-community systems. An exception was made for nitrates because they can have an adverse health effect on susceptible infants in a short period of time.

Even without monitoring for organic chemicals or most inorganic chemicals, in the initial stages of implementation of the drinking water regulations, monitoring results from tens of thousands of non-community systems could overwhelm laboratory capabilities and other resources. This could delay effective implementation of the regulations with respect to the community systems which provide the water which Americans drink every day. To avoid this result, non-community systems will be given two years after the effective date of the regulations to commence monitoring. In the meantime, non-community systems which already monitor their water are encouraged to continue to do so, and the States are encouraged to take appropriate measures to test or require monitoring for non-community systems that serve large numbers of people.

Of course, non-community systems which pose a threat to health should be dealt with as quickly as possible. The maximum contaminant levels applicable to non-community water systems therefore will take effect 18 months after promulgation, at the same time as levels applicable to community systems. Inspection and enforcement authority will apply to non-community systems at the same time as to community systems.

SANITARY SURVEYS

EPA encourages the States to conduct sanitary surveys on a systematic basis.

AUTHORITY: Secs. 1412, 1414, 1445, and 1450 of the Public Health Service Act, 88 Stat. 1660 (42 U.S.C. 300g-1, 300g-3, 300j-4, and 300j-9).

Subpart A—General

§ 141.1 Applicability.

This part establishes primary drinking water regulations pursuant to section 1412 of the Public Health Service Act, as amended by the Safe Drinking Water Act (Pub. L. 93-523); and related regulations applicable to public water systems.

§ 141.2 Definitions.

As used in this part, the term:

(a) "Act" means the Public Health Service Act, as amended by the Safe Drinking Water Act, Pub. L. 93-523.

(b) "Contaminant" means any physical, chemical, biological, or radiological substance or matter in water.

(c) "Maximum contaminant level" means the maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a public water system, except in the case of turbidity where the maximum permissible level is measured at the point of entry to the distribution system. Contaminants added to the water under circumstances controlled by the user, except those resulting from corrosion of piping and plumbing caused by water quality, are excluded from this definition.

(d) "Person" means an individual, corporation, company, association, partnership, State, municipality, or Federal agency.

(e) "Public water system" means a system for the provision to the public of piped water for human consumption, if such system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least 60 days out of the year. Such term includes (1) any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system, and (2) any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system. A public water system is either a "community water system" or a "non-community water system."

(i) "Community water system" means a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

(ii) "Non-community water system" means a public water system that is not a community water system.

(f) "Sanitary survey" means an on-site review of the water source, facilities, equipment, operation and maintenance of a public water system for the purpose of evaluating the adequacy of such source, facilities, equipment, operation and maintenance for producing and distributing safe drinking water.

(g) "Standard sample" means the aliquot of finished drinking water that is examined for the presence of coliform bacteria.

(h) "State" means the agency of the State government which has jurisdiction over public water systems. During any period when a State does not have primary enforcement responsibility pursuant to Section 1413 of the Act, the term "State" means the Regional Administrator, U.S. Environmental Protection Agency.

(i) "Supplier of water" means any person who owns or operates a public water system.

§ 141.3 Coverage.

This part shall apply to each public water system, unless the public water system meets all of the following conditions:

(a) Consists only of distribution and storage facilities (and does not have any collection and treatment facilities);

(b) Obtains all of its water from, but is not owned or operated by, a public water system to which such regulations apply;

(c) Does not sell water to any person; and

(d) Is not a carrier which conveys passengers in interstate commerce.

§ 141.4 Variances and exemptions.

Variances or exemptions from certain provisions of these regulations may be granted pursuant to Sections 1415 and 1416 of the Act by the entity with primary enforcement responsibility. Provisions under Part 142, *National Interim Primary Drinking Water Regulations Implementation*—subpart E (Variances) and subpart F (Exemptions)—apply where EPA has primary enforcement responsibility.

§ 141.5 Siting requirements.

Before a person may enter into a financial commitment for or initiate construction of a new public water system or increase the capacity of an existing public water system, he shall notify the State and, to the extent practicable, avoid locating part or all of the new or expanded facility at a site which:

(a) Is subject to a significant risk from earthquakes, floods, fires or other disasters which could cause a breakdown of the public water system or a portion thereof; or

(b) Except for intake structures, is within the floodplain of a 100-year flood or is lower than any recorded high tide where appropriate records exist.

The U.S. Environmental Protection Agency will not seek to override land use decisions affecting public water systems siting which are made at the State or local government levels.

§ 141.6 Effective date.

The regulations set forth in this part shall take effect 18 months after the date of promulgation.

Subpart B—Maximum Contaminant Levels

§ 141.11 Maximum contaminant levels for inorganic chemicals.

(a) The maximum contaminant level for nitrate is applicable to both community water systems and non-community water systems. The levels for the other inorganic chemicals apply only to community water systems. Compliance with maximum contaminant levels for inorganic chemicals is calculated pursuant to § 141.23.

(b) The following are the maximum contaminant levels for inorganic chemicals other than fluoride:

Contaminant	*Level, milligrams per liter*
Arsenic	0.05
Barium	1.
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as N)	10.
Selenium	0.01
Silver	0.05

(c) When the annual average of the maximum daily air temperatures for the location in which the community water system is situated is the following, the maximum contaminant levels for fluoride are:

Temperature Degrees Fahrenheit	Degrees Celsius	Level, milligrams per liter
53.7 and below	12.0 and below	2.4
53.8 to 58.3	12.1 to 14.6	2.2
58.4 to 63.8	14.7 to 17.6	2.0
63.9 to 70.6	17.7 to 21.4	1.8
70.7 to 79.2	21.5 to 26.2	1.6
79.3 to 90.5	26.3 to 32.5	1.4

§ 141.12 Maximum contaminant levels for organic chemicals.

The following are the maximum contaminant levels for organic chemicals. They apply only to community water systems. Compliance with maximum contaminant levels for organic chemicals is calculated pursuant to § 141.24.

	Level, milligrams per liter
(a) Chlorinated hydrocarbons:	
Endrin (1,2,3,4,10, 10-hexachloro-6,7-epoxy-1,4, 4a,5,6,7,8,8a-octahydro-1,4-endo, endo-5,8 - dimethano naphthalene).	0.0002
Lindane (1,2,3,4,5,6-hexachloro-cyclohexane, gamma isomer).	0.004
Methoxychlor (1,1,1-Trichloro-2, 2 - bis [p-methoxyphenyl] ethane).	0.1
Toxaphene ($C_{10}H_{10}Cl_8$-Technical chlorinated camphene, 67-69 percent chlorine).	0.005

(b) Chlorophenoxys:

2,4 - D, (2,4-Dichlorophenoxyacetic acid)	0.1
2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid).	0.01

§ 141.13 Maximum contaminant levels for turbidity.

The maximum contaminant levels for turbidity are applicable to both community water systems and non-community water systems using surface water sources in whole or in part. The maximum contaminant levels for turbidity in drinking water, measured at a representative entry point(s) to the distribution system, are:

(a) One turbidity unit (TU), as determined by a monthly average pursuant to § 141.22, except that five or fewer turbidity units may be allowed if the supplier of water can demonstrate to the State that the higher turbidity does not do any of the following:

(1) Interfere with disinfection;

(2) Prevent maintenance of an effective disinfectant agent throughout the distribution system; or

(3) Interfere with microbiological determinations.

(b) Five turbidity units based on an average for two consecutive days pursuant to § 141.22.

§ 141.14 Maximum microbiological contaminant levels.

The maximum contaminant levels for coliform bacteria, applicable to community water systems and non-community water systems, are as follows:

(a) When the membrane filter technique pursuant to § 141.21(a) is used, the number of coliform bacteria shall not exceed any of the following:

(1) One per 100 milliliters as the arithmetic mean of all samples examined per month pursuant to § 141.21 (b) or (c);

(2) Four per 100 milliliters in more than one sample when less than 20 are examined per month; or

(3) Four per 100 milliliters in more than five percent of the samples when 20 or more are examined per month.

(b)(1) When the fermentation tube method and 10 milliliter standard portions pursuant to § 141.21(a) are used, coliform bacteria shall not be present in any of the following:

(i) more than 10 percent of the portions in any month pursuant to § 141.21 (b) or (c);

(ii) three or more portions in more than one sample when less than 20 samples are examined per month; or

(iii) three or more portions in more than five percent of the samples when 20 or more samples are examined per month.

(2) When the fermentation tube method and 100 milliliter standard portions pursuant to § 141.21(a) are used, coliform bacteria shall not be present in any of the following:

(i) more than 60 percent of the portions in any month pursuant to § 141.21 (b) or (c);

(ii) five portions in more than one sample when less than five samples are examined per month; or

(iii) five portions in more than 20 percent of the samples when five or more samples are examined per month.

(c) For community or non-community systems that are required to sample at a rate of less than 4 per month, compliance with paragraphs (a), (b)(1), or (b)(2) of this section shall be based upon sampling during a 3 month period, except that, at the discretion of the State, compliance may be based upon sampling during a one-month period.

Subpart C—Monitoring and Analytical Requirements

§ 141.21 Microbiological contaminant sampling and analytical requirements.

(a) Suppliers of water for community water systems and non-community water systems shall analyze for coliform bacteria for the purpose of determining compliance with § 141.14. Analyses shall be conducted in accordance with the analytical recommendations set forth in "Standard Methods for the Examination of Water and Wastewater," American Public Health Association, 13th Edition, pp. 662–688, except that a standard sample size shall be employed. The standard sample used in the membrane filter procedure shall be 100 milliliters. The standard sample used in the 5 tube most probable number (MPN) procedure (fermentation tube method) shall be 5 times the standard portion. The standard portion is either 10 milliliters or 100 milliliters as described in § 141.14 (b) and (c). The samples shall be taken at points which are representative of the conditions within the distribution system.

(b) The supplier of water for a community water system shall take coliform density samples at regular time intervals, and in number proportionate to the population served by the system. In no event shall the frequency be less than as set forth below:

Population served:	*Minimum number of samples per month*
25 to 1,000	1
1,001 to 2,500	2
2,501 to 3,300	3
3,301 to 4,100	4
4,101 to 4,900	5
4,901 to 5,800	6
5,801 to 6,700	7
6,701 to 7,600	8
7,601 to 8,500	9
8,501 to 9,400	10
9,401 to 10,300	11
10,301 to 11,100	12
11,101 to 12,000	13
12,001 to 12,900	14
12,901 to 13,700	15
13,701 to 14,600	16
14,601 to 15,500	17
15,501 to 16,300	18
16,301 to 17,200	19
17,201 to 18,100	20
18,101 to 18,900	21
18,901 to 19,800	22
19,801 to 20,700	23
20,701 to 21,500	24
21,501 to 22,300	25
22,301 to 23,200	26
23,201 to 24,000	27
24,001 to 24,900	28
24,901 to 25,000	29
25,001 to 28,000	30
28,001 to 33,000	35
33,001 to 37,000	40
37,001 to 41,000	45
41,001 to 46,000	50
46,001 to 50,000	55
50,001 to 54,000	60
54,001 to 59,000	65
59,001 to 64,000	70
64,001 to 70,000	75
70,001 to 76,000	80
76,001 to 83,000	85
83,001 to 90,000	90
90,001 to 96,000	95
96,001 to 111,000	100
111,001 to 130,000	110
130,001 to 160,000	120
160,001 to 190,000	130
190,001 to 220,000	140
220,001 to 250,000	150
250,001 to 290,000	160
290,001 to 320,000	170
320,001 to 360,000	180
360,001 to 410,000	190
410,001 to 450,000	200
450,001 to 500,000	210
500,001 to 550,000	220
550,001 to 600,000	230
600,001 to 660,000	240
660,001 to 720,000	250
720,001 to 780,000	260
780,001 to 840,000	270
840,001 to 910,000	280
910,001 to 970,000	290
970,001 to 1,050,000	300
1,050,001 to 1,140,000	310
1,140,001 to 1,230,000	320
1,230,001 to 1,320,000	330
1,320,001 to 1,420,000	340
1,420,001 to 1,520,000	350
1,520,001 to 1,630,000	360
1,630,001 to 1,730,000	370
1,730,001 to 1,850,000	380
1,850,001 to 1,970,000	390
1,970,001 to 2,060,000	400
2,060,001 to 2,270,000	410
2,270,001 to 2,510,000	420
2,510,001 to 2,750,000	430
2,750,001 to 3,020,000	440
3,020,001 to 3,320,000	450
3,320,001 to 3,620,000	460
3,620,001 to 3,960,000	470
3,960,001 to 4,310,000	480
4,310,001 to 4,690,000	490
4,690,001 or more	500

Based on a history of no coliform bacterial contamination and on a sanitary survey by the State showing the water system to be supplied solely by a protected ground water source and free of sanitary defects, a community water system serving 25 to 1,000 persons, with written permission from the State, may reduce this sampling frequency except that in no case shall it be reduced to less than one per quarter.

(c) The supplier of water for a non-community water system shall sample for coliform bacteria in each calendar quarter during which the system provides water to the public. Such sampling shall begin within two years after the effective date of this part. If the State, on the basis of a sanitary survey, determines that some other frequency is more appropriate, that frequency shall be the frequency required under these regulations. Such frequency shall be confirmed or changed on the basis of subsequent surveys.

(d)(1) When the coliform bacteria in a single sample exceed four per 100 milliliters (§ 141.14(a)), at least two consecutive daily check samples shall be collected and examined from the same sampling point. Additional check samples shall be collected daily, or at a frequency estabmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(2) Barium—Atomic Absorption Method, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes," pp. 97-98, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(3) Cadmium—Atomic Absorption Method, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes," pp. 101-103, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(4) Chromium—Atomic Absorption Method, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes," pp. 105-106, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(5) Lead—Atomic Absorption Method, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes," pp. 112-113, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(6) Mercury—Flameless Atomic Absorption Method, "Methods for Chemical Analysis of Water and Wastes," pp. 118-126, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(7) Nitrate—Brucine Colorimetric Method, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 461-464, or Cadmium Reduction Method, "Methods for Chemical Analysis of Water and Wastes," pp. 201-206, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(8) Selenium—Atomic Absorption Method, "Methods for Chemical Analysis of Water and Wastes," p. 145, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(9) Silver—Atomic Absorption Method, "Standard Methods for the Examination of Water and Wastewater", 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes", p. 146, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(10) Fluoride—Electrode Method, "Standard Methods for the Examination of Water and Wastewater", 13th Edition, pp. 172-174, or "Methods for Chemical Analysis of Water and Wastes," pp. 65-67, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974, or Colorimetric Method with Preliminary Distillation, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 171-172 and 174-176, or "Methods for Chemical Analysis of Water and Wastes," pp. 59-60, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

§ 141.24 Organic chemical sampling and analytical requirements.

(a) An analysis of substances for the purpose of determining compliance with § 141.12 shall be made as follows:

(1) For all community water systems utilizing surface water sources, analyses shall be completed within one year following the effective date of this part. Samples analyzed shall be collected during the period of the year designated by the State as the period when contamination by pesticides is most likely to occur. These analyses shall be repeated at intervals specified by the State but in no event less frequently than at three year intervals.

(2) For community water systems utilizing only ground water sources, analyses shall be completed by those systems specified by the State.

(b) If the result of an analysis made pursuant to paragraph (a) of this section indicates that the level of any contaminant listed in § 141.12 exceeds the maximum contaminant level, the supplier of water shall report to the State within 7 days and initiate three additional analyses within one month.

(c) When the average of four analyses made pursuant to paragraph (b) of this section, rounded to the same number of significant figures as the maximum contaminant level for the substance in question, exceeds the maximum contaminant level, the supplier of water shall report to the State pursuant to § 141.31 and give notice to the public pursuant to § 141.32. Monitoring after public notification shall be at a frequency designated by the State and shall continue until the maximum contaminant level has not been exceeded in two successive samples or until a monitoring schedule as a condition to a variance, exemption or enforcement action shall become effective.

(d) For the initial analysis required by paragraph (a) (1) and (2) of this section, data for surface water acquired within one year prior to the effective date of this part and data for ground water acquired within three years prior to the effective date of this part may be substituted at the discretion of the State.

(e) Analyses made to determine compliance with § 141.12(a) shall be made in accordance with "Method for Organochlorine Pesticides in Industrial Effluents," MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.

(f) Analyses made to determine compliance with § 141.12(b) shall be conducted in accordance with "Methods for Chlorinated Phenoxy Acid Herbicides in Industrial Effluents," MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.

§ 141.27 Alternative analytical techniques.

With the written permission of the State, concurred in by the Administrator of the U.S. Environmental Protection Agency, an alternative analytical technique may be employed. An alternative technique shall be acceptable only if it is substantially equivalent to the prescribed test in both precision and accuracy as it relates to the determination of compliance with any maximum contaminant level. The use of the alternative analytical technique shall not decrease the frequency of monitoring required by this part.

§ 141.28 Approved laboratories.

For the purpose of determining compliance with § 141.21 through § 141.27, samples may be considered only if they have been analyzed by a laboratory approved by the State except that measurements for turbidity and free chlorine residual may be performed by any person acceptable to the State.

§ 141.29 Monitoring of consecutive public water systems.

When a public water system supplies water to one or more other public water systems, the State may modify the monitoring requirements imposed by this part to the extent that the interconnection of the sysems jusifies treating them as a single system for monitoring purposes. Any modified monitoring shall be conducted pursuant to a schedule specified by the State and concurred in by the Administrator of the U.S. Environmental Protection Agency.

Subpart D—Reporting, Public Notification and Record Keeping

§ 141.31 Reporting requirements.

(a) Except where a shorter reporting period is specified in this part, the supplier of water shall report to the State within 40 days following a test, measurement or analysis required to be made by this part, the results of that test, measurement or analysis.

(b) The supplier of water shall report to the State within 48 hours the failure to comply with any primary drinking water regulation (including failure to comply with monitoring requirements) set forth in this part.

(c) The supplier of water is not required to report analytical results to the State in cases where a State laboratory performs the analysis and reports the results to the State office which would normally receive such notification from the supplier.

§ 141.32 Public notification.

(a) If a community water system fails to comply with an applicable maximum contaminant level established in Subpart B, fails to comply with an applicable testing procedure established in Subpart C of this part, is granted a variance or an exemption from an applicable maximum contaminant level, fails to comply with the requirements of any schedule prescribed pursuant to a variance or exemption, or fails to perform any monitoring required pursuant to Section 1445(a) of the Act, the supplier of water shall notify persons served by the system of the failure or grant by inclusion of a notice in the first set of water bills of the system issued after the failure or grant veys and the NAS study. CCE was initially used as a means of taste and odor control. As concern over adverse health effects of organic chemicals grew, CCE was turned to as a rough surrogate for organics to be used as a health-based standard rather than as an esthetic standard. Unfortunately, as more is learned about organic chemical pollution of drinking water, CCE looks less and less effective as a surrogate for harmful organics.

The principal difficulty with CCE is that it includes only about one-tenth of the total organic content of the volume of water sampled and it does not measure organic compounds of greatest concern, such as the volatile halomethanes. Thus, a high CCE test result does not necessarily mean that the water tested may pose a hazard to health, and a low CCE test result may be obtained from water with a high level of potentially harmful organic compounds. In short, there is no sound basis of correlation between CCE test results and the level of harmful organic chemicals in the water tested.

To establish a maximum contaminant level under these circumstances would almost certainly do more harm than good. It could give a false sense of security to persons served by systems which are within the established level and a false sense of alarm to persons served by systems which exceed the level. It also would divert resources and attention from efforts to find more effective ways of dealing with the organic chemical problem.

Total organic carbon (TOC) and chemical oxygen demand (COD) are surrogates that have been considered, but they have limitations also. TOC has the advantage of being quicker and cheaper (on a per sample basis) than CCE, but the availability of sensitive instruments for this measurement is questionable. More investigation of the significance of any TOC number as a health effects limit is also needed. COD is easily determined with readily available laboratory equipment, but COD is not limited to organic compounds, and besides a COD number also cannot be adequately related to health significance at this time.

EPA is diverting substantial resources to research into the health effects of specific organic chemicals and groups of organic chemicals. Also, it is expected that the study of the National Academy of Sciences will produce further data on health effects. However, in view of the significance of the potential health problem, it is not enough to wait for this additional health effects data. EPA therefore will undertake to identify one or more surrogate tests for organic chemicals or organic chemical groups, and will also study in depth the presence of specific organic chemicals in drinking water supplies. It is anticipated that this effort will result in the development of an additional MCL or MCL's for organic chemicals by amendment of the Interim Primary Drinking Water Regulations without having to wait for a more complete resolution of the organic chemicals question in the Revised Regulations.

Accordingly, EPA is adopting regulations on organic chemical monitoring, using the authority of Sections 1445 and 1450 of the Act. The regulations require that over 100 selected public water systems serving substantial populations collect samples of raw and treated water for submission to EPA for organics analysis. EPA will analyze the samples for a number of general organic parameters, including CCE, TOC (volatile and nonvolatile), NVOC, Total Organic Chlorine (TOCl), ultraviolet absorbancy, and fluorescence. In addition, the water will be analyzed for 21 specific organic compounds. These laboratory analyses will be used to evaluate the extent and nature of organic chemical contamination of drinking water, to evaluate the validity of the general organic parameters as surrogates for measures of harmful organic chemicals, and to determine whether there is an adequate basis for establishing maximum contaminant levels for specific organics or groups of organics.

In addition, EPA is embarking on an intensive research program to find more definitive answers to the following four questions:

1. What are the effects of commonly occurring organic compounds on human health?

2. What analytical procedures should be used to monitor finished drinking water to assure that any primary drinking water regulations dealing with organics are met?

3. Because some of these organic compounds are formed during water treatment, what changes in treatment practices are required to minimize the formation of the compounds in treated water?

4. What treatment technology must be applied to reduce contaminant levels to the concentrations that may be specified in the regulations?

This research will involve health-effects and epidemiological studies, investigations of analytical methodology, and pilot plant and field studies of organic removal unit processes. Some phases of the research are to be completed by this fall, while much of the remainder is to be completed within the next calendar year.

As soon as sufficient information is derived from the monitoring program and related research, primary drinking water regulations will be amended so that the organic chemicals problem can be dealt with without delay. The monitoring program will be completed within one year.

During the interim period while satisfactory MCL's for organic contamination in drinking water are being developed, EPA will act in specific cases where appropriate to deal with organic contamination. If the EPA monitoring program reveals serious specific cases of contamination, EPA will work with State and local authorities to identify the source and nature of the problem and to take remedial action. EPA will also aid the States in identifying additional community water supplies that require analysis.

✓ 2. *Pesticides.* Proposed § 141.13 contained MCL's for several organic pesticides. Most of the comments on § 141.13 (out of a total of 140) requested that the MCL's for pesticides either be raised or deleted entirely. There were two requests for inclusion of limits for 2,4,5-T, one request for an organophosphate insecticide limit, one for a limit on dioxin, and requests for limits for aldrin, dieldrin, DDT and chlordane (etc.) Other comments suggested that pesticide limits be restricted to emergencies or spills, or at least only to surface water during periods of pesticide use. There were also requests for research on carcinogenic risk and bioamplification.

These proposed pesticides levels were carefully considered by the Advisory Committee and have been reviewed in light of available data on the health effects of these pesticides and their incidence in drinking water supplies. The levels established are adequately supported by the authorities cited in the Statement of Basis and Purpose.

A limit for 2,4,5-T was tentatively proposed by the Advisory Committee but was deleted from the Committee's final report in 1973 on the grounds that EPA's ban on the use of 2,4,5-T for aquatic uses made a drinking water limit unnecessary. That ban has now been in effect for about five years, and it is highly unlikely that this herbicide exists in drinking water except perhaps in extremely rare cases in trace amounts. EPA is now investigating reports of 2,4,5-T in some waterways in Northern Louisiana, and will reconsider the desirability of an MCL for 2,4,5-T if new data indicate that the pesticide is appearing in drinking water supplies at a significant rate. Dioxin is a minor contaminant of 2,4,5-T, and the same basic considerations apply to it.

The desirability of an MCL for organophosphorus insecticides, which was recommended in 1973 by the Advisory Committee, was carefully considered by EPA. It was decided not to adopt such a level, because although these pesticides would pose a serious health risk if they were present at the consumer's tap, the fact is that there is no evidence that such pesticides reach the consumer's tap. This was discussed in the preamble to the proposed primary drinking water standards, at 40 FR 11992. As noted there, these pesticides reach water sources usually only by accident or indirectly, and their tendency to degrade rapidly apparently has prevented problems which might occur when they do reach drinking water sources. The principal threat from these pesticides is from accidental spills in water sources. The appropriate way to deal with such spills is by emergency action when they occur, not by periodic monitoring which would not catch the problem in time.

With respect to aldrin, dieldrin and DDT, EPA's national survey of the presence of these pesticides in drinking water supplies has not been completed. If the results of that survey indicate that those pesticides are present in a significant number of water supplies, an appropriate amendment of the Interim Primary Drinking Water Regulations will be proposed.

The proposed MCL's for chlordane, heptachlor, and heptachlor epoxide have been deleted because EPA is currently involved in suspension and cancellation hearings for these pesticides. MCL's will be reconsidered at a later date.

Current research on pesticides, including both surveys of their incidence in water supplies and their health effects, will be continued and expanded.

3. *Monitoring Requirements.* There were over 250 comments on § 141.24, dealing with monitoring for compliance with the MCL's for CCE and pesticides. However, most of these comments were more related to the merits of the MCL's than to the monitoring requirements. The CCE limit has been discussed above, and that discussion will not be repeated here.

A number of comments on § 141.24 suggested that monitoring requirements for pesticides be eliminated, or at least that the responsibility for such monitoring be assumed by EPA or the States rather than by public water system. Concern was expressed over the cost of monitoring for pesticides, and the absence of pesticides in public water systems in some areas.

EPA agrees that regular monitoring for pesticides is not needed for all public water systems using only ground water sources. Pesticides are rarely found in significant levels in ground water. Accordingly, the proposed § 141.24 has been amended to provide that for a system using only ground water, monitoring shall be required only when specified by the entity with primary enforcement responsibility. This will more reasonably limit monitoring for pesticides in systems using only ground water to those instances when the State or EPA has reason to suspect the possibility of contamination.

In the case of surface waters, the greater incidence of these pesticides requires monitoring across-the-board. For all community water systems using surface water sources for all or part of their water, monitoring for pesticides will be required within one year of the effective date of the regulations. This monitoring shall be repeated at intervals specified by the State and in no event less frequently than at three year intervals.

Section 141.24 has also been amended to require that samples to be analyzed for pesticides must be collected during a period of the year designated by the entity with pri-

DOW*

SPECIMEN LABEL
REDUCED TO 75%

ESTERON* 245
HERBICIDE

FOR THE CONTROL OF TREES, BRUSH AND BROADLEAF WEEDS

Low-Volatile Brush and Weed Herbicide for
Industrial, Forestry, Rangeland and Pasture Uses

ACTIVE INGREDIENT:
2,4,5-Trichlorophenoxyacetic Acid,
Propylene Glycol Butyl Ether Esters 69.2%
2,4,5-Trichlorophenoxyacetic Acid Equivalent — 45.0%
4 Pounds per Gallon
INERT INGREDIENTS: 30.8%
E.P.A. Registration No. 464-205-AA E.P.A. Est. 464-MI-1

AGRICULTURAL CHEMICAL
Do Not Ship or Store with Food, Feeds, or Clothing

PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.
TRANSLATION: (TO THE USER: If you cannot read English, do not use this product until the label has been fully explained to you.)

CAUTION
KEEP OUT OF REACH OF CHILDREN
MAY BE HARMFUL IF SWALLOWED • MAY CAUSE IRRITATION
Avoid Contact with Eyes, Skin and Clothing

18.9 L/5 GAL

86-1064 PRINTED IN U.S.A. IN NOVEMBER, 1976.

REPLACES SPECIMEN LABEL 86-1064 PRINTED JUNE, 1976.
DISCARD PREVIOUS SPECIMEN LABELS
REVISIONS INCLUDE: NO NEW LABEL COPY: FRONT PANEL FORMAT REVISED

SPECIMEN LABEL
(BACK)
REDUCED TO 75%

DOW

ESTERON 245 HERBICIDE

Contains Propylene Glycol Butyl Ether Esters of 2,4,5-T • Acid Equivalent: 4 Pounds per Gallon

DIRECTIONS

ESTERON 245 herbicide is recommended for industrial vegetation control in forest areas; on right-of-ways, such as communication lines, electrical powerlines, pipelines, highways, and railroads; fence rows, and on rangelands and pastures. This herbicide controls herbaceous and woody plants including such 2,4-D resistant species as—ash, black gum, brambles, groundcherry, hawthorn, horsenettle, maple, mesquite, oak, osageorange, palmetto, poison ivy, pricklypear cactus, redbay, salmonberry, sweetgum, wild blackberry, wild rose, and certain species of Ribes. **Do not apply ESTERON 245 where spray drift may contact nearby 2,4,5-T susceptible crops or other desirable plants or may contaminate water intended for irrigation or domestic purposes. Read and follow all Use Precautions given on this label.**

PREPARING THE SPRAY

Use only diesel oil, No. 1 or No. 2 fuel oil or kerosene where oil is recommended in the spray mixture.

Oil Sprays: Add ESTERON 245 to the required amount of oil in the spray tank or mixing tank and mix thoroughly. This mixture can be made at any time before actual use and no separation will occur. Do not let any water, or oil-water mixture sprays get into the ESTERON 245 or into the finished mixture, as it may form a gel.

Water Sprays: Fill the spray tank about half full with clean water, add the required amount of ESTERON 245 and complete filling the tank. Mix thoroughly and continue agitation while spraying. **Caution: See NOTE in paragraph on Oil-Water Mixture Sprays.**

Oil-Water Mixture Sprays: When vigorous agitation is used, 1 gallon of ESTERON 245 will emulsify up to 10 gallons of oil in 100 gallons of spray mixture. First, premix the ESTERON 245 and oil in a separate container. Do not allow any water or mixtures containing water to get into the ESTERON 245 or the premix. Fill the spray tank about half full with water, then slowly add the premix with continuous agitation and complete filling the tank with water. If the premix is put in the tank without any water, the first water added may form a thick "invert" (water in oil) emulsion which will be hard to break. As an alternate procedure, the oil may be added **after** the ESTERON 245 is mixed in the water, but highly vigorous mechanical agitation is required and a poor emulsion may be formed. The premix method is preferred.

NOTE: ESTERON 245 in water or oil-water sprays forms an emulsion, not a solution, and separation may take place unless sprays are agitated continuously. Mechanical agitation is recommended.

INDUSTRIAL BRUSH AND WEED CONTROL INCLUDING FORESTRY USES

HIGH VOLUME SPRAYS

Foliage Treatment: For control of woody vegetation up to 8 feet tall, apply when foliage is well developed and plants are actively growing. Spraying during prolonged hot, dry weather or after leaves have lost their normal green color and vigor may not give satisfactory control. Use 3 to 4 quarts of ESTERON 245 in 100 gallons of water and apply as a full coverage spray. Usually 100 to 200 gallons per acre will be required, although dense stands of brush may require up to 400 gallons per acre. Completely wet all plant parts including leaves, stems and bark. Poison ivy, some brambles and many broadleaf weeds may be controlled using 2 quarts of ESTERON 245 in 100 gallons of water.

To control grasses as well as broadleaf weeds and woody plants on conifer forest planting sites, ESTERON 245 may be used in a tank mixture with DOWPON* grass herbicide. Consult label directions and precautions for DOWPON to determine recommended use of this product.

Basal Bark Treatment: Brush and small trees can be controlled by spraying the basal parts of brush stems and tree trunks to a height of 12 to 15 inches from the ground line. Use a solution of 3 gallons of ESTERON 245 in 100 gallons (1 pint in 4 gallons) of oil. With certain resistant species, 4 gallons of ESTERON 245 in 100 gallons (1 pint in 3 gallons) of oil, is effective. As only the basal portions of the brush are treated on a spot basis, the total amount sprayed per acre would not be expected to exceed 100 gallons. Knapsack or power equipment may be used, but complete wetting of the indicated area is necessary, particularly at the ground line. This means spraying until run-down or run-off to the ground line is noticeable. Old or rough bark requires more spray than young or smooth bark. Low pressures are desirable. Apply at any time, including the winter months, except when snow, ice or water prevent spraying to the ground line. Often delayed response and killing can be expected.

Dormant Brush: Treat any time after brush is dormant and most of the foliage has dropped. Spray should be concentrated at the base of stems and in addition, the upper parts of the stems should be broadcast sprayed enough to wet them. Under rootsuckering species such as sumac, persimmon, sassafras and locust, also spray the ground area to control small root suckers that may not be readily visible. Mix 1½ gallons of ESTERON 245 in 100 gallons of oil. Brush of average density and 4 to 6 feet high may take up to 150 gallons of spray mixture per acre.

Stump Treatment: Where growth is more than 6 to 8 feet tall, cut it close to the ground and spray the freshly cut stumps and stubs with 3 gallons of ESTERON 245 in 100 gallons (1 pint in 4 gallons) of oil, mixed thoroughly. For more resistant species, use 4 gallons of ESTERON 245 in 100 gallons (1 pint in 3 gallons) of oil. Wet thoroughly all exposed bark, as well as cut surfaces. This means spraying until run-down or run-off to the ground line is noticeable. Old or rough bark requires more spray volume than young or smooth bark. Apply at any time, including the winter months, except when ice, snow or water prevent spraying to the ground line. Best results are obtained on freshly cut stumps two inches across or larger. Adequate coverage normally requires from 10 to 100 gallons per acre depending on density of stumps and stubs.

"Frill" Treatment: For large trees, make a singlehack girdle or "frill" of overlapping axe cuts completely around the tree as close to the ground as feasible. Spray the frill thoroughly using a mixture of 2 gallons of ESTERON 245 in 100 gallons (½ pint in 3 gallons) of oil.

Spot Foliage Treatment: Use ¼ pint of ESTERON 245 in 3 gallons of water and spray to wet all foliage, shoots, stems and bark without runoff.

LOW VOLUME SPRAYS

Apply low volume sprays containing ESTERON 245 when foliage is well developed and plants are actively growing. For best results on woody species, soil moisture should be sufficient to promote foliar growth. Spraying during prolonged hot, dry weather or after leaves have lost their normal green color and vigor may not give satisfactory control. Apply low volume sprays by air or ground equipment only when spray drift will not be a problem — note use precautions.

Right-of-Ways and Forest Site Preparation

Foliage Treatment: Use 1 to 3 gallons of ESTERON 245 in enough water to make 10 to 30 gallons of total spray per acre. If desired, oil can be added to the spray in accordance with directions for "Oil-Water Mixture Sprays" given under **PREPARING THE SPRAY.**

Use With TORDON 101 Mixture: ESTERON 245 may be used with TORDON* 101 Mixture herbicide in a tank mix combination spray applied by aircraft for improved control of root suckering species and other species often not adequately controlled with 2,4,5-T. Use 1 to 2½ gallons of ESTERON 245 Herbicide plus 1½ to 2½ gallons of TORDON 101 Mixture per acre by diluting with water to a total spray volume of 10 to 30 gallons per acre. Use the higher rates where resistant species such as red maple, sourwood, ash, oaks, hawthorn and cedar are prevalent and especially during unfavorable conditions for plant growth such as drought. Do not add oil or NORBAK* particulating agent to the spray. Aerial applications of the tank mixture should be made only with a helicopter mounted Microfoil applicator or an equipment system providing equivalent drift control.

Read the directions and all the Use Precautions on both labels before using this tank mix.

Note: Do not plant conifer seedlings on treated areas for at least 6 months after applying 2 gallons or more of TORDON 101 per acre in such a tank mix.

Basal Treatment Using Powered Knapsack Sprayer—Mix 1½ to 2 gallons of ESTERON 245 with fuel oil or kerosene to make 20 gallons of total spray solution. Apply with a portable knapsack mistblower to all sides of lower brush stems including the root collar. Good coverage of the root collar is essential for best results. Run mistblower at ¼ to ⅓ throttle for best spray delivery and coverage. For maximum drift control use a basal nozzle attachment and do not raise nozzle above the horizontal position.

Forest Conifer Release by Air or Ground Sprays

Oil Spray—Apply 2 to 3 quarts of ESTERON 245 in about 10 gallons of oil per acre to control undesired hardwoods in dormant Douglas fir, true fir, hemlock and spruce. Rates higher than 2 quarts may cause conifer injury. Do not use this spray on pines (note section below for pine recommendation). Apply **before** conifer bud break during late dormancy, usually February and March in the northwest. Application of this spray after conifer bud break can injure the conifers.

Water Spray—Apply 2 to 3 quarts of ESTERON 245 in 10 to 15 gallons of water per acre to control hardwood species in conifers including pines. Apply during the summer **after** the conifers cease spring growth and have "hardened off". Rates higher than 2 quarts may cause conifer injury.

Consult your State, Regional or Extension Forester for recommendations to fit local conditions.

RANGELAND AND PASTURES

RANGELAND—AIR APPLICATION FOR BRUSH CONTROL

Consult the Agricultural Experiment Station, your local Extension Service Weed or Range specialist for best time to treat and need for re-treatment in your area. Do not use from early boot to milk stage where grass seed production is desired.

Mesquite: Use 1 pint of ESTERON 245 plus ½ to 1 gallon of oil in enough water to make 4 gallons of total spray per acre. Apply 40 to 90 days after first leaves appear.

Sand Shinnery Oak: Use ½ to 1 quart of ESTERON 245 plus 1 gallon of oil in enough water to make 4 gallons of total spray per acre.

Post and Blackjack Oaks: Use 2 quarts of ESTERON 245 plus 1 gallon of oil in enough water to make 4 to 6 gallons of total spray per acre.

PASTURE—FOR BROADLEAF WEED CONTROL

Use 2 to 3 quarts of ESTERON 245 per acre by aircraft or ground equipment in the amount of water needed to obtain uniform application. Apply when weeds are in full leaf and after grass is well established. Do not apply on stoloniferous grasses such as bent and bermuda or on forage legumes because these can be injured or killed. Do not apply on newly seeded areas, and do not use from early boot to milk stage where grass seed production is desired. **Note:** Do not graze dairy animals on treated areas within 6 weeks after application. Do not graze meat animals on treated areas within 2 weeks of slaughter.

USE PRECAUTIONS

AVOID CONTACT WITH 2,4,5-T SUSCEPTIBLE CROPS AND OTHER DESIRABLE BROADLEAF PLANTS—ESTERON 245 Herbicide is injurious to most broadleaf plants. Therefore, do not apply directly to or otherwise permit even minute amounts to contact cotton, grapes, tobacco, fruit trees, vegetables, flowers, ornamentals or other desirable plants susceptible to 2,4,5-T. Do not use in or near a greenhouse.

DO NOT APPLY IN THE VICINITY OF COTTON, GRAPES, TOBACCO, TOMATOES OR OTHER DESIRABLE 2,4,5-T SUSCEPTIBLE CROPS OR ORNAMENTAL PLANTS.

DO NOT SPRAY WHEN WIND IS BLOWING TOWARDS SUSCEPTIBLE CROPS OR ORNAMENTAL PLANTS

AVOID SPRAY DRIFT—Applications should be made only when there is no hazard from spray drift since very small quantities of the spray, which may not be visible, may severely injure susceptible crops during both growing and dormant periods. Use coarse sprays to minimize drift since, under adverse weather conditions, fine spray droplets may drift a mile or more. The spray thickening agent, NALCO-TROL[1], may be used with this product to aid in reducing spray drift. If used follow all use recommendations and precautions on the product label.

[1] NALCO-TROL—Trademark of NALCO Chemical Company

GROUND EQUIPMENT—With ground equipment, spray drift can be lessened by keeping the spray boom as low as possible; by applying 20 gallons or more of spray per acre; by using no more than 20 pounds spraying pressure with large droplet producing nozzle tips; by spraying when wind velocity is 8 miles per hour or less. Do not apply with hollow cone-type insecticide or other nozzles that produce a fine-droplet spray.

AERIAL APPLICATION—With aircraft, drift can be lessened by applying a coarse spray; by using no more than 20 pounds spray pressure at the nozzles; by using straight stream nozzles directed straight back; by using a spray boom no longer than ¾ the wing span of the aircraft; and by spraying only when wind velocity is less than 6 mph.

DO NOT APPLY BY AIRCRAFT WHEN AN AIR TEMPERATURE INVERSION EXISTS. Such a condition is characterized by little or no wind and with air temperature lower near the ground than at higher levels. The use of a continuous smoke column at or near site of application is suggested to indicate direction and velocity of air movement, and to indicate a temperature inversion by layering of the smoke.

At high temperatures (above 95 F) vapors from this product may injure susceptible plants growing nearby. Do not use in or near a greenhouse. Excessive amounts of this herbicide in the soil may temporarily inhibit seed germination or plant growth.

Do not use around the home, recreation areas or similar sites. Do not use on susceptible grasses, such as bent, except for spot spraying, nor on freshly seeded areas until grass has become well established. (Most legumes are usually damaged or killed).

This product is toxic to fish. Keep out of lakes, streams, and ponds. Do not apply where run-off is likely to occur. Do not contaminate water by cleaning of equipment or disposal of wastes.

Do not contaminate irrigation ditches or water used for irrigation or domestic purposes. This product can be stored in an unheated building but if exposed to subfreezing temperatures, should be warmed to at least 40 F and mixed thoroughly before using. Do not store near fertilizers, seeds, insecticides or fungicides. Do not reuse containers. To avoid injury to desirable plants, do not store, handle or apply other agricultural chemicals with the same containers or equipment used with ESTERON 245 except as specified on this label.

Rinse equipment and containers and dispose of waste by burying in non-crop lands away from water supplies. Containers should be disposed by punching holes in them and burying with waste or follow official local recommendations for container disposal.

Local conditions may affect the use of herbicides. Consult your State Agricultural Experiment Station or Extension Service weed specialist for advice in selecting treatments from this label to best fit local conditions. Be sure that use of this product conforms to all applicable regulations. Apply this product only as specified on this label.

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, express or implied, extends to the use of this product contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.

10586-049-5 P676

THE DOW CHEMICAL COMPANY
AND SUBSIDIARIES
MIDLAND, MICHIGAN 48640, USA   ZURICH, SWITZERLAND   HONG KONG, BCC
CORAL GABLES, FLORIDA 33134, USA   SARNIA, ONTARIO, CANADA
* Trademark of THE DOW CHEMICAL COMPANY

DOW*

SPECIMEN LABEL
REDUCED TO 75%

ESTERON* 99* CONCENTRATE

LOW-VOLATILE HERBICIDE

CONTAINS PROPYLENE GLYCOL BUTYL ETHER ESTERS OF 2,4-D
2,4-D Acid Equivalent: 4 pounds per gallon

For the Control of Many Broadleaf Weeds, Herbaceous Perennials and Woody Plants Susceptible to 2,4-D in Grass Pastures, Certain Crops and Non-Crop Areas.

ACTIVE INGREDIENT:
2,4-Dichlorophenoxyacetic Acid, Propylene Glycol Butyl Ether Esters 72.8%
INERT INGREDIENTS: 27.2%
2,4-D Acid Equivalent 44.9%—4 pounds per gallon
E.P.A. Registration No. 464-201-AA E.P.A. Est. 464-MI-1

AGRICULTURAL CHEMICAL

Do Not Ship or Store with Food, Feeds, or Clothing

PRECAUCION AL USUARIO: Si usted no lee inglés, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.

TRANSLATION: (TO THE USER: If you cannot read English, do not use this product until the label has been fully explained to you.)

CAUTION

KEEP OUT OF REACH OF CHILDREN
HARMFUL IF SWALLOWED
MAY CAUSE IRRITATION
Avoid Contact with Eyes, Skin and Clothing

18.9 L / 5 GAL

86-1062 PRINTED IN U.S.A. IN APRIL, 1976.
REPLACES SPECIMEN LABEL 86-1062 PRINTED MARCH, 1976.
DISCARD PREVIOUS SPECIMEN LABELS.
REVISIONS INCLUDE:
(1) CONTROL OF WILD GARLIC IN STUBBLE GRAIN FIELDS ADDED
(2) FOREST CONIFER RELEASE ADDED
(3) RESTRICTION ON USING CORN FODDER ADDED TO WEED CONTROL IN CORN.

SPECIMEN LABEL
(BACK)
REDUCED TO 75%

ESTERON* 99* CONCENTRATE

WEED LIST

ESTERON 99 Concentrate herbicide is recommended for control of numerous broadleaf weeds and certain 2,4-D susceptible woody plants without injury to most established grasses. Species controlled include the following, plus many others:

beggarticks • bitterweed • blueweed, Texas • broomweed • buckbrush • buckwheat, wild burdock • burhead • carpetweed • catnip • chamise • chicory • cocklebur • coffeeweed cornflower • coyotebrush • croton • dandelion • docks • dogfennel • elderberry • fanweed galinsoga • garlic, wild • goatsbeard • halogeton • hemp, wild • jewelweed • jimsonweed lambsquarter • loco, bigbend • mallow, Venice • manzanita • marshelder • milkvetch morningglory, annual • mustards • nettles • onion, wild • pennycress • pepperweed, field pigweed • plantains • poorjoe • rabbitbrush • radish, wild • ragweed • rape, wild • redstem sage, coastal • sagebrush, big • sagebrush, sand • salsify • sand shinnery oak • shepherdspurse • sicklepod • smartweed • sneezeweed, bitter • sowthistle, annual • spanishneedles • sumac • sunflower • sweetclover • tansymustard • tansyragwort • thistle, bull thistle, musk • thistle, Russian • tumbleweed • velvetleaf • vervains • vetch • water plantain willow • witchweed • wormwood • yellow rocket • yellow starthistle

USE DIRECTIONS

Apply ESTERON 99 Concentrate as water or oil spray during warm weather when weeds or brush are actively growing. Application under drought conditions often will give poor results. Use low spray pressure to minimize drift. On cropland and along roadsides, do not exceed 20 psi pressure. Apply enough spray volume to provide uniform coverage of weeds and brush, usually 5 to 20 gallons per acre by ground equipment and 3 to 5 gallons by aircraft. Higher gallonage may be used if desired to improve spray coverage. Generally, the lower dosages recommended on this label will be satisfactory for young, succulent growth of sensitive weed species. For less sensitive species and under conditions where control is more difficult, the higher dosages will be needed. For crop uses, do not mix with oil or other adjuvants unless specifically recommended on this label. Deep-rooted perennial weeds such as Canada thistle and field bindweed and many woody plants usually require repeated applications for maximum control. **Do not apply ESTERON 99 Concentrate where spray drift may contact nearby susceptible crops or other desirable plants or may contaminate water for irrigation or domestic use. Read and follow all Use Precautions given on this label.**

NOTE: If there are uncertainties concerning special local use situations or specific crop variety tolerances to 2,4-D, consult your State Agricultural Experiment Station or local Extension Service weed specialists for advice.

TO PREPARE THE SPRAY: (1) Fill the spray tank about half full with water, then add the required amount of ESTERON 99 Concentrate, with agitation, and finally the rest of the water. NOTE: ESTERON 99 Concentrate in water forms an emulsion which tends to separate unless the mixture is kept agitated. (2) If oil is added, first mix the ESTERON 99 Concentrate and the oil and then add this mixture to the water. However, with adequate agitation, the oil can be added after the ESTERON 99 Concentrate is mixed in the water. (3) If straight oil is used, a solution is formed and separation does not occur. Do not allow any water to get into the oil-herbicide mixture to avoid formation of an invert emulsion.

USE IN LIQUID NITROGEN FERTILIZER: ESTERON 99 Concentrate may be combined with liquid nitrogen fertilizer suitable for foliar application to accomplish weeding and feeding of corn, small grains or grass pastures in one operation. Use ESTERON 99 Concentrate in accordance with recommendations for these crops as given on this label. Use liquid fertilizer at rates recommended by supplier or Extension Service Specialist. Fill the spray tank about half full with the liquid fertilizer, then add the ESTERON 99 Concentrate with agitation and complete filling the tank with fertilizer. Apply immediately and continue agitation in the spray tank during application. Application during very cold weather (near freezing) is not advisable. Do not store the spray mixture.

WEED CONTROL IN SMALL GRAINS NOT UNDERSEEDED WITH A LEGUME: NOTE: Do not permit dairy animals or meat animals being finished for slaughter to forage or graze treated grain fields within 2 weeks after treatment.

Spring Wheat and Barley: Apply ½ to 1 pint per acre. Spray when grain is in full tiller stage (usually 4 to 8 inches tall) but before the boot stage and when weeds are small. Do not apply before the tiller stage nor from early boot to the dough stage. Higher rates, up to 2 pints per acre, may be needed to handle difficult weed problems in certain areas such as under dry conditions especially in western areas. **However, do not use unless possible crop injury will be acceptable.**

Winter Wheat and Rye: Apply ⅓ to ⅔ pint per acre in the spring at the full tiller stage but before the early boot stage. For improved control of difficult weeds including wild garlic and wild onion, apply 1 to 2 pints per acre. Since these rates may injure the crop, do not use unless possible crop injury will be acceptable. For the high rates on spring wheat and barley as well as winter wheat and rye consult State Agricultural Experiment Station or Extension Service Weed Specialists for recommendations or suggestions to fit local conditions.

Spring Seeded Oats: Apply ½ pint per acre at the full tiller stage but before the early boot stage. Oats are less tolerant to 2,4-D than wheat or barley and are more likely to suffer some injury.

Fall Seeded Oats (Southern) Grown for Grain: Apply ¾ to 1¼ pints per acre after full tillering but before the early boot stage. Some difficult weeds may require higher rates for maximum control but crop injury may result. Do not spray during or immediately following cold weather.

Preharvest Treatment: Apply 1 to 2 pints per acre when grains are in the hard dough stage to control large weeds that may interfere with harvest. Best results will be obtained when soil moisture is sufficient to cause succulent weed growth. **NOTE:** Do not feed treated straw to livestock.

WEED CONTROL IN CORN: Use one of the following three programs. **Preemergence:** Apply 1 to 2 quarts per acre to soil anytime after planting but before corn emerges. Do not use on light sandy soil. **Emergence:** Apply 1 pint per acre just as corn plants are breaking ground. **Postemergence:** After emergence of corn, use ½ pint per acre. Application of ¾ to 1 pint per acre may be needed for maximum control of some weeds but such rates are more likely to injure the corn. If corn is over 8 inches tall, use drop nozzles to keep the spray off the corn foliage as much as possible. Do not apply from the tasseling to dough stage. Do not use with oil, atrazine or other adjuvants. Crop injury is more likely to occur if corn is growing rapidly under high temperature and high soil moisture conditions. To reduce breakage of stalks from temporary brittleness caused by 2,4-D, delay cultivation for 8 to 10 days after treatment. Do not forage or feed corn fodder for 7 days following application. NOTE: Hybrids vary in response to 2,4-D and some are easily injured. Spray only varieties known to be tolerant to 2,4-D. Contact seed company or your Agricultural Experiment Station or Extension Service weed specialists for this information.

PREHARVEST CORN TREATMENT: After the hard dough or denting stage, apply 1 to 2 pints per acre by air or ground equipment to suppress perennial weeds, decrease weed seed production, and control tall weeds such as bindweed, cocklebur, dogbane, jimsonweed, ragweed, sunflower, velvetleaf and vines that interfere with harvesting. Do not forage or feed corn fodder for 7 days following application.

CONTROL OF WILD GARLIC IN STUBBLE GRAIN FIELDS: Following the harvest of small grain or corn, wild garlic often produces new fall growth. This should be sprayed with 2 to 3 quarts per acre of ESTERON 99 Concentrate. This is a useful practice as one part of a wild garlic control program. Do not forage for 7 days following application.

WEED CONTROL IN SORGHUM (MILO): Apply ½ pint per acre when sorghum is 5 to 15 inches tall. A higher rate of ¾ to 1 pint per acre may be needed to control some weeds but the chance for crop injury is likewise increased. Do not use with oil. Do not treat before the sorghum is 5 inches tall nor during the boot, flowering or early dough stages. If sorghum is taller than 8 inches, use drop nozzles to keep the spray off the foliage as much as possible. Temporary crop injury may occur under conditions of high soil moisture and high air temperatures. Varieties vary in tolerance to 2,4-D and some hybrids are quite sensitive. Spray only varieties known to be tolerant to 2,4-D. Contact seed company or your Agricultural Experiment Station or Extension Service weed specialists for this information.

GRASS SEED CROPS: Use 1 to 1½ pints per acre in the amount of water required for uniform application by air or ground equipment. Apply to established stands in spring from the tiller to early boot stage. Do not spray in boot stage. New spring seedings may be treated with the lower rate after the grasses have at least five leaves. Perennial weed regrowth may be treated in the fall.

WEED AND BRUSH CONTROL IN RANGELAND AND GRASS PASTURES: NOTE: Do not graze dairy animals on treated areas within 7 days after application. Do not use on bent grass, alfalfa, clover, or other legumes. Do not use on newly seeded areas until grass is well established. Do not use from early boot to milk stage where grass seed production is desired.

Bitterweed, Broomweed, Croton, Docks, Kochia, Marshelder, Muskthistle and Other Broadleaf Weeds: Use 2 quarts of ESTERON 99 Concentrate per acre in the amount of water needed for uniform application. If the weeds are young and growing actively, 1 quart per acre will provide control of some species. Deeprooted perennial weeds may require repeated treatments in the same year or in subsequent years.

Wild Garlic and Wild Onion: Apply 2 to 3 quarts per acre, making three applications (fall-spring-fall or spring-fall-spring) starting in late fall or early spring.

Weed Control in Newly Sprigged Coastal Bermudagrass: Apply 1 to 2 quarts per acre preemergence and/or postemergence.

Sand Shinnery Oak and Sand Sagebrush: On the oak, use 1 quart in 5 gallons of oil or in 4 gallons of water plus 1 gallon of oil per acre. Apply by aircraft between May 15 and June 15. On the sagebrush, use 1 quart in 3 gallons of oil per acre and apply by aircraft when foliage is fully expanded and the brush is actively growing.

Big Sagebrush and Rabbitbrush: Use 2 to 3 quarts per acre in 2 to 3 gallons of oil or in 3 to 5 gallons of oil-water emulsion spray. For rabbitbrush, the 3 quart rate is usually required. Brush should be leafed out and growing actively when treated. Retreatment may be needed.

Chemise, Manzanita, Buckbrush, Coastal Sage, Coyotebrush and Certain Other Chaparral Species: Use 2 to 3 quarts per acre in 5 to 10 gallons of water. One gallon of fuel oil may be included in the spray mixture for added effectiveness. Make applications by aircraft or ground equipment to obtain uniform spray coverage. For effective control, the brush must be fully leafed out and growing actively when sprayed. Retreatment may be needed.

WOODY PLANT CONTROL IN NON-CROP AREAS: To control species susceptible to 2,4-D in rights-of-way, fencerows, roadsides, and along drainage ditchbanks, spray brush up to 6 to 8 feet tall after spring foliage is well developed, using 3 to 4 quarts of ESTERON 99 Concentrate in 100 gallons of water and wetting all parts of the brush including foliage, stems and bark. This may require up to 400 gallons of spray per acre for adequate coverage of solid stand of brush. Make application in such a way as to prevent drift of the spray off the area being treated. Spraying can be effective at any time up to 3 weeks before frost as long as soil moisture is sufficient for active growth of the brush. Control will be less effective in midsummer during hot dry weather when soil moisture is deficient and plants are not actively growing. Oil or wetting agent may be added to the spray, if needed for increased effectiveness.

FOREST CONIFER RELEASE: After northern conifers jack pine, red pine, black spruce, and white spruce cease growth and "harden off" in late summer, a spray of 1½ to 3 quarts of ESTERON 99 Concentrate in 8 to 25 gallons of water per acre may be applied by air to control certain competing hardwood species such as alder, aspen, birch, hazel and willow. Since this treatment may cause occasional conifer injury, do not use if such injury cannot be tolerated. Consult your regional or extension forester or state herbicide specialist for recommendations to fit local conditions.

WEED CONTROL IN NON-CROP AREAS SUCH AS LAWNS, GOLF COURSES, CEMETERIES, PARKS, AIRFIELDS, ROADSIDES, VACANT LOTS, DRAINAGE DITCH BANKS: Apply 1 to 3 quarts of ESTERON 99 Concentrate per acre in the amount of water needed for uniform application. Usually 2 quarts per acre provides good weed control under average conditions. Treat when weeds are young and growing well. Do not use on golf greens nor on dichondra or other broadleaf herbaceous ground covers. Do not use on creeping grasses such as bent and St. Augustine except for spot treating, nor on newly seeded turf until grass is well established.

Reseeding of treated areas should be delayed following treatment. With spring application, reseed in the fall; with fall application, reseed in the spring.

Legumes are usually damaged or killed so do not treat areas where the legumes are desired. Deep-rooted perennial weeds may require repeated treatments in the same season or in subsequent years.

TULE (BULRUSH) AND OTHER RUSHES: Mix 2 quarts of ESTERON 99 Concentrate and 1 gallon of diesel oil or kerosene, then add this mixture to 100 gallons of water. Spray to wet all foliage (400-800 gallons per acre). Addition of a wetting agent may be advisable. Apply in the spring during flower head emergence. Respray if needed when regrowth is 3 to 5 feet tall.

SPOT TREATMENT: To control broadleaf weeds in small non-cropland areas with a hand sprayer, use ¼ pint of ESTERON 99 Concentrate in 3 gallons of water and spray to thoroughly wet all weed foliage. Keep spray mixture agitated to prevent separation.

STORAGE: May be stored in unheated building.

MISCELLANEOUS USES: Low-Bush Blueberries: Contact Agricultural Sales, The Dow Chemical Company, P.O. Box 1706, Midland, Michigan 48640 for use directions.

USE PRECAUTIONS

AVOID CONTACT WITH 2,4-D SUSCEPTIBLE CROPS AND OTHER DESIRABLE BROADLEAF PLANTS: ESTERON 99 Concentrate herbicide is injurious to most broadleaf plants. Therefore, do not apply directly to or otherwise permit even minute amounts to contact cotton, grapes, tobacco, fruit trees, vegetables, flowers, ornamentals or other desirable plants susceptible to 2,4-D. Do not use in or near a greenhouse.

DO NOT APPLY IN THE VICINITY of COTTON, GRAPES, TOBACCO, TOMATOES OR OTHER DESIRABLE 2,4-D SUSCEPTIBLE CROPS or ORNAMENTAL PLANTS.

DO NOT SPRAY WHEN WIND IS BLOWING TOWARDS SUSCEPTIBLE CROPS OR ORNAMENTAL PLANTS.

AVOID SPRAY DRIFT: Applications should be made only when there is no hazard from spray drift since very small quantities of the spray, which may not be visible, may severely injure susceptible crops during both growing and dormant periods. Use coarse sprays to minimize drift since, under adverse weather conditions, fine spray droplets may drift a mile or more. The spray thickening agent, NALCO-TROL[1] may be used with this product to aid in reducing spray drift. If used follow all use recommendations and precautions on the product label.

[1] NALCO-TROL — Trademark of NALCO Chemical Company

GROUND EQUIPMENT: With ground equipment, spray drift can be lessened by keeping the spray boom as low as possible; by applying 20 gallons or more of spray per acre; by using no more than 20 pounds spraying pressure with large droplet producing nozzle tips; by spraying when wind velocity is low; and by stopping all spraying when wind exceeds 6 to 7 miles per hour. Do not apply with hollow cone-type insecticide or other nozzles that produce a fine-droplet spray.

AERIAL APPLICATION: With aircraft, drift can be lessened by applying a coarse spray; by using no more than 20 pounds spray pressure at the nozzles; by using straight stream nozzles directed straight back; by using a spray boom no longer than ¾ the wing span of the aircraft; and by spraying only when wind velocity is less than 6 mph.

DO NOT APPLY BY AIRCRAFT WHEN AN AIR TEMPERATURE INVERSION EXISTS. Such a condition is characterized by little or no wind and with air temperature lower near the ground than at higher levels. The use of a continuous smoke column at or near site of application is suggested to indicate direction and velocity of air movement, and to indicate a temperature inversion by layering of the smoke.

Violent windstorms may move soil particles. If 2,4-D is on soil particles and they are blown onto susceptible plants, visible symptoms may appear. Serious injury is unlikely. The hazard of movement of 2,4-D on dust is reduced if treated fields are irrigated or if rain occurs shortly after application.

At high temperatures (above 95°F) vapors from this product may injure susceptible plants growing nearby. Do not use in a greenhouse. Excessive amounts of this herbicide in the soil may temporarily inhibit seed germination or plant growth.

This product is toxic to fish. Keep out of lakes, streams, or ponds. Do not apply where runoff is likely to occur. Do not contaminate water by cleaning of equipment, or disposal of wastes. Do not contaminate irrigation ditches or water used for irrigation or domestic purposes.

To avoid injury to desirable plants, do not handle or apply other agricultural chemicals with the same equipment used for ESTERON 99 Concentrate except as specified on this label. This product can be stored in an unheated building but do not store near fertilizers, seeds, insecticides or fungicides. Do not reuse containers. Dispose of empty containers by punching holes in them and burying with waste in non-cropland away from water supplies or follow official local recommendations for container disposal.

Local conditions may affect the use of herbicides. Consult your State Agricultural Experiment Station or Extension Service weed specialists for advice in selecting treatments from this label to best fit local conditions. **Be sure that use of this product conforms to all applicable regulations. Apply this product only as specified on this label.**

MONEY BACK GUARANTEE

ESTERON 99 Concentrate herbicide is guaranteed by The Dow Chemical Company to the full extent of the purchase price:

1. **To give satisfactory control of weed and brush species listed on container when used as recommended.**
2. **To form a suitable spray mixture in any water fit for spray use.**
3. **To store satisfactorily at temperatures as low as −40°F.**

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, express or implied, extends to the use of this product contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.

10686-067-4 8478

THE DOW CHEMICAL COMPANY
AND SUBSIDIARIES
MIDLAND, MICHIGAN 48640, USA ZURICH, SWITZERLAND HONG KONG, BCC
CORAL GABLES, FLORIDA 33134, USA SARNIA, ONTARIO, CANADA
*Trademark of THE DOW CHEMICAL COMPANY

MISCELLANEOUS: CONTROL OF WOODY WEEDS IN LOW-BUSH BLUEBERRY FIELDS IN MAINE: How to use: Mount a drum 8 to 10 feet long or some other suitable length, and 1½ to 2 feet in diameter on an axle such as an old hay rake frame. Cover the drum with water absorbent yet tough cloth which will resist rapid wear and tear. Draw the cloth-covered drum across the blueberry field and at the same time spray evenly onto the full length of the top of the cloth-covered drum a spray mixture made by diluting 1 quart of ESTERON 99 Concentrate in 50 gallons of water per acre. Have the drum mounted so that as it revolves on its axis it is high enough to miss most of the low bush blueberry stems, yet low enough to forcibly brush the spray-saturated cloth-covered drum against the higher woody weeds, principally sweet fern, wild cherry and poplar. Keep the cloth wet enough to provide top coverage of the weeds, yet not so wet as to allow runoff of the liquid which could cause injury to the blueberry plants.

When to Use: Apply during June and July when weed tops have emerged sufficiently above the blueberry stems to allow treatment of the weeds and not the blueberry plants. Apply only during the year before the first burn. To use this method of weed control, two-year burns should be extended to three years.

Caution: Do not allow the spray being applied to the cloth-covered drum to be directed onto the blueberries. Do not harvest-rake field during the herbicide treatment year or until a two-year interval thereafter.

CAST

THE PHENOXY HERBICIDES

Council for

Agricultural Science and Technology

Report No. 39

February, 1975

COUNCIL FOR AGRICULTURAL SCIENCE AND TECHNOLOGY

Member Societies

American Forage and Grassland Council

American Meterological Society

American Society for Horticultural Science

American Society of Agricultural Engineers

American Society of Agronomy

American Society of Animal Science

Association of Official Seed Analysts

Council on Soil Testing and Plant Analysis

Crop Science Society of America

Poultry Science Association

Society of Nematologists

Soil Science Society of America

Weed Science Society of America

Headquarters Office: Department of Agronomy
Iowa State University, Ames, Iowa 50010
Telephone 515-294-2036

FOREWORD

"The Phenoxy Herbicides" was developed to meet the need for an accurate, objective, and authoritative statement of the properties, uses, and effects of this important class of herbicides and the alternatives to their use. The report was prepared by a task force of seventeen scientists representing the states of Maryland, Alabama, Indiana, Wisconsin, Illinois, Missouri, Arkansas, Texas, Arizona, Oregon, and California. Subject-matter areas of the various scientists included agricultural economics, agricultural engineering, agronomy, botany, forestry, horticulture, pesticide chemistry, plant pathology, plant physiology, range science, toxicology, and weed science. The task force met in Denver from November 20 to 22 to prepare a draft of the report. The draft was subsequently revised by the chairman, returned to members of the task force and others for comment, revised again, edited, and reproduced for distribution.

CONTENTS

SUMMARY

The phenoxy herbicides, 2,4-D, 2,4,5-T, MCPA, silvex and related materials, are selective herbicides widely used in crop production and in the management of forests, ranges and industrial, urban and aquatic sites. These chemicals are related to naturally occurring plant growth regulators. They kill plants by causing malfunctions in growth processes. Broad-leaved plants are generally susceptible to the phenoxy herbicides, whereas most grasses, coniferous trees and certain legumes are relatively resistant.

The phenoxy herbicides are used to control broad-leaved weeds in wheat, barley, rice, oats, rye, corn, grain sorghums and certain legumes. Such uses increase yields, improve product quality and reduce production costs. The phenoxy herbicides are used in forests to suppress unwanted hardwood trees and brush, to reduce competition with conifers already established or to prepare sites for the regeneration of conifers. They are used on grazing lands to control unpalatable and noxious plants and to kill brush and small trees that reduce the productivity of pastures and ranges. 2,4-D and other phenoxys are used in canals, ponds, lakes and waterways to kill floating weeds such as water hyacinth, submerged weeds such as pondweeds, and emergent and shoreline plants such as cattails and willows. Industrial and urban uses include control of brush on utility and transportation rights of way, control of dandelions, plantains and other weeds in turf and suppression of ragweed, poison ivy and other plants of public health importance.

The principal hazard in the use of the phenoxys is to crops and other valuable plants either within the treated area or nearby. Treated crops and forest trees can be injured through accidental overdosing, improper timing of treatments, unusual weather conditions and other causes. Injury to nearby crops and ornamentals can result from drift of droplets or vapors of the spray. Such losses are largely preventable through the use of proper formulations and spray equipment and the exercise of good judgment.

The phenoxy herbicides are predominantly toxic to green plants and are much less toxic to mammals, birds, fish, reptiles, shellfish, insects, worms, fungi and bacteria. When properly used, they do not occur in soils and water at levels harmful to animals and microorganisms. They do not concentrate in food chains and do not persist from year to year in croplands. They are detectable only rarely in food and then only in insignificant amounts.

A highly poisonous kind of dioxin called TCDD is an unavoidable contaminant in commercial supplies of 2,4,5-T and silvex. The amount present in currently produced formulations of 2,4,5-T and silvex is not enough to alter the toxicological properties of these preparations or to endanger human health or to affect plants or animals in the environment.

The phenoxy herbicides are widely used because they are more efficient and usually less hazardous and less injurious to the environment than alternative methods. Use of these chemicals is estimated to reduce the cost of production of the crops on which they are used by about 5% and to reduce overall agricultural production costs in the United States by about 1%. Uses in forests and nonagricul-

tural situations provide additional savings. If the phenoxys were no longer available, the cost of food, forest products, electric power, transportation and governmental services would be higher. These costs would be borne by consumers.

INTRODUCTION

The phenoxy herbicides were discovered over thirty years ago, incidental to research on naturally occurring plant hormones. As the chemical nature of these substances became known, related compounds were synthesized and tested for effects on plant growth. Certain phenoxy acetic acids, including 2,4-D, were found to be plant growth regulators and in due course were discovered independently in the United States and Britain to be active herbicides capable of selectively killing many broad-leaved weeds in cereal grains, grasslands and coniferous forests. Further research led to the commercial use of several phenoxy herbicides, including 2,4-D, 2,4,5-T, MCPA and silvex. These pioneer accomplishments have now expanded into a world-wide effort by industry and public research agencies that has discovered a wide array of useful herbicides, most of which are chemically and functionally unrelated to the phenoxys.

Despite the development of many other herbicides, the phenoxys remain major tools in vegetation management. Although replaced by newer materials in some instances, the phenoxys continue to find additional and expanded uses, such that 2,4-D is currently in critically short supply in world commerce. An important development for the tropical nations has been the recent discovery that a wide range of weeds can be prevented in paddy rice by applying 2,4-D to the water three or four days after transplanting. This and other developments forecast expanded usefulness for 2,4-D and related chemicals in the management of such diverse resources as croplands, forests, ranges, waterways, industrial lands, public utility properties, wildlife habitats, urban parks, athletic fields and landscape plantings.

The phenoxy herbicides are weak acids that are only slightly soluble in water and petroleum oils. Although the acid is the active form, they are normally converted to water-soluble amines or oil-soluble esters for convenience in handling and application. These are mixed with other ingredients, such as solvents, emulsifiers, thickeners, and wetting agents, to make commercial formulations for specific uses. The amine forms are diluted with water and sprayed on foliage or injected undiluted into trees. Esters are sprayed as oil solutions or as emulsions with water. One class of amine salts of the phenoxys is soluble in oil rather than in water. The strength of commercial formulations is expressed in terms of the equivalent content of the parent acid. However, different products are not equally effective even on this basis. Esters generally have greater herbicidal activity than the amine forms but are more expensive. Esters may evaporate from foliage after application, releasing fumes that can move outside the treated area and cause injury to sensitive plants. This hazard can be reduced by the use of low-volatile esters, but these cost more than the high-volatile esters and are less effective as herbicides in some situations. There is no single best formulation for all purposes, and this is reflected in the availability of a wide variety of commercial products for a multitude of uses. Available products include mixtures of phenoxy herbicides and mixtures of these herbicides with unrelated herbicides, fertilizers and other materials.

Many phenoxy acids have herbicidal activity. They form a family of compounds that have similar chemical and biological properties but differ in details that affect their activity on individual plants, their cost and other characteristics. The ones presently used in the United States include 2,4-D, 2,4,5-T, MCPA, silvex, 2,4-DB, MCPB, dichloroprop, mecoprop, 2,4-DEP and erbon. 2,4-D is by far the predominant compound. It is without equal in cost and effectiveness for routine control of most broad-leaved weeds in the presence of grasses. Other phenoxys find use only where they control weeds resistant to 2,4-D or where crops are less sensitive to them than to 2,4-D. In 1971 the amounts of 2,4-D, 2,4,5-T and silvex produced in the United States were, respectively, 45, 6 and 3 millions pounds, representing over 90 percent of all phenoxy production. MCPA, 2,4-DB, MCPB, dichloroprop and mecoprop have important but limited special uses. 2,4-DEP and erbon are chemicals closely related to 2,4-D and 2,4,5-T that act primarily through the soil. They are not extensively used.

Mixtures of 2,4-D and 2,4,5-T related to commercial brush killers were employed as "defoliants" in the war in Indochina, causing partisans in this conflict to denounce this use as "chemical warfare." It was claimed that, in addition to killing plants, the materials killed people, livestock and wild animals and caused human birth defects. These charges have been exhaustively investigated by scientists and argued emotionally in the press and elsewhere. The evidence is that in Southeast Asia, as elsewhere, these chemicals have little biological activity beyond their great effectiveness as herbicides, and that whatever environmental effects they have result from their action on vegetation. However, it is not the purpose of this report to renew this largely political controversy, but to take note that formulations, rates of application, methods of application and other factors differed greatly from accepted agricultural practice. Conclusions in the one instance, theref[illegible]ay not apply in the other.

HERBICIDAL PROPERTIES

The phenoxy herbicides are absorbed by plant foliage, roots and soft stem tissue. When applied as a drench in diesel oil, they can soak through the dry bark of trees and enter living tissues by this means. Once absorbed, the phenoxys move within the plant along the pathways that carry food and water. They tend to accumulate in the actively growing parts of roots and stems. As the herbicide distributes through the plant, the leaves and buds twist and curl, followed by malformed new growth of stems and leaves. Sensitive young plants may die in a few days. Hardy shrubs and trees may succumb only after weeks or months or may survive without evident injury.

The phenoxy herbicides appear to enter in an imperfect and uncontrolled way into the regulation of growth processes normally governed by the natural growth hormones. There is interference with cell division and enlargement, with food utilization and with a wide array of other vital processes. The exact mechanism of these actions is not known, and indeed the exact workings of natural plant growth regulators are equally obscure. Phenoxy herbicides are far more toxic to green plants than to animals because the kinds of materials that have growth regulating activity in plants do not act in the same way in animals.

The phenoxys in addition to their use as herbicides, also find limited use as plant growth regulators for crops. For example, they can be used to control the ripening of bananas. 2,4-D is sprayed on orange trees to increase fruit size and prevent fruit and leaf drop. Silvex is sprayed on apples to enhance coloring and prevent premature fruit drop. Although popularly miscalled "defoliants," the phenoxys are, in fact, antidefoliants and act at low concentrations to prevent the shedding of leaves and fruit. They enhance blossom retention and increase fruit set. At low concentrations the phenoxys promote the rooting of cuttings and presumably could be used for this purpose in plant propagation. Although these are useful properties, the great toxicity of the phenoxy herbicides to plants limits their employment as purely plant growth regulators. Ordinarily such needs are met by other hormone derivatives that are less active as herbicides and are marketed specifically for plant regulatory purposes.

PRACTICAL USES

The phenoxy herbicides are used in land and water management wherever their particular selective properties coincide with the desired changes in vegetation. The most common uses are suppression of broad-leaved plants in the presence of grasses, conifers or certain legumes. The situations in which management objectives are served by this kind of selectivity are extraordinarily diverse, ranging from essentially wilderness areas to intensive urban horticulture. Each use is governed by the known response to the herbicide of each kind of plant present. Such general rules as "broad-leaved plants are susceptible while grasses and conifers are resistant" have important exceptions, and nothing short of thorough knowledge of the response of each kind of plant under prevailing conditions has made possible the effective use of these chemicals.

Herbicides are most useful when employed in coordination with other practices in vegetation management systems. The aim is to create conditions favorable to the crop, forest trees, range grasses and other preferred species and unfavorable to unwanted plants. The total set of manipulations constitutes the management system in each case. The phenoxy herbicides function in a wide variety of systems ranging from forest and wild-land management and cereal and forage production to industrial land uses. Management objectives are diverse, including primarily the production of food, forest products and other commodities and also the management of fish and game habitats, suppression of allergenic and poisonous plants, maintenance of navigable and recreational waterways and many others.

Cropland

Four-fifths of the total amount of phenoxy herbicides used in the United States is applied to cropland and rangeland. In 1971, 38 million pounds of these chemicals were used on food and feed crops. The principal crops treated are the grains, wheat, corn, barley, oats and rice. The usual treatment is with 2,4-D at a rate of less than one pound per acre.

The small grains are always infested to some extent with annual and perennial weeds that can be controlled by the phenoxy herbicides. If not controlled, these weeds reduce crop yield, interfere with harvesting and reduce grain quality. For example, wild garlic bulblets harvested with the wheat cause a garlic taste in flour milled from the grain, making it virtually worthless. 2,4-D is the principal herbicide used in this country for control of broad-leaved weeds in cereal grains. Approximately 27 million acres of these crops are treated with this compound annually. The recommended rate of application depends on the specific weed problem and crop resistance but generally ranges from 1/4 to 1 pound per acre. Under some conditions, 2,4-D is not adequately selective in the small grains, and it is common practice in such cases to use MCPA instead. Although MCPA is appreciably more expensive than 2,4-D, about 7 millions acres of small grains are treated with it annually. A substantial portion of the U.S. rice acreage also receives 2,4-D, 2,4,5-T or MCPA treatment for control of broad-leaved weeds. 2,4,5-T and silvex are often used in rice in the southern states, where curly indigo and other weeds resistant to 2,4-D and MCPA are widespread.

Few alternative practices are available for control of broad-leaved weeds in cereal grains. Mechanical and hand tillage following planting are hopelessly impractical. Of the other selective herbicides used for special weed problems in small grains, none can be considered as general substitutes for the phenoxys. For example, dicamba can be used to control some annual and perennial broad-leaved weeds in oats and wheat (not barley), but this material does not control weedy mustards and other important weeds. Moreover, dicamba is relatively toxic to small-seeded legumes and thus cannot be used in the central and eastern areas of the United States where small-seeded legumes are commonly intersown with small grains. Bromoxynil controls many annual broad-leaved weeds in small grains, but it is not effective against most perennials and cannot be used in winter grains and where small-seeded legumes are intersown. Present practice in some areas is to combine dicamba or bromoxynil at low rates with 2,4-D or MCPA to broaden the spectrum of weeds controlled. Dinoseb is another alternative herbicide which controls primarily annual broad-leaved weeds in small grains. It is not a translocated herbicide and is thus less effective on perennials than the phenoxys. There are essentially no alternatives to the phenoxy herbicides in rice production.

2,4-D is used to control broad-leaved weeds in corn and sorghum. This use has decreased since the introduction of the triazines and other effective preplant and preemergence herbicides that kill not only broad-leaved plants but weedy grasses as well. However, increased use of these newer herbicides has not been without problems. Deep-rooted perennial weeds are generally resistant to these materials, and their populations increase in the absence of periodic treatments with 2,4-D. Thus, 2,4-D continues to retain a place in corn and sorghum culture, with approximately 20 million acres of these crops being treated with 2,4-D annually. The rate of application ranges from 1/4 to 1/2 pound per acre. Dicamba is a partial alternative to 2,4-D; however, it does not control all of the species controlled by 2,4-D and is best used in mixtures with 2,4-D to extend the spectrum of weeds controlled.

Cultivation supplemented by hoeing is an alternative to 2,4-D in production of corn and sorghum. Indeed, cultivation is still widely practiced with these crops, either alone or in combination with herbicides. However, cultivation cannot remove weeds occurring directly in the crop row. It can provide partial weed control at low cost but must be supplemented with hand work at costs that are presently prohibitive.

MCPB and 2,4-DB can be used for control of broad-leaved weeds in legumes. MCPB and 2,4-DB are not themselves herbicides but are precursors of the herbicides, MCPA and 2,4-D, respectively. They can be safely used to control certain broad-leaved weeds in green peas, soybeans, peanuts and small-seeded forage legumes because these crops have less ability to convert them to MCPA and 2,4-D than do the weeds. The total amount of MCPB and 2,4-DB used is small, but they make possible the control of certain yield-limiting weeds in important leguminous crops. In most instances, no other herbicide is equally effective for this purpose.

Alternatives to the use of 2,4-DB and MCPB in legumes are limited. Dinoseb can be used as a postemergence treatment on some small-seeded forage legumes, green peas and peanuts for control of broad-leaved annuals, but this material is less effective on perennials and cannot be used on late emerging weeds without risk of crop damage. Chloroxuron and bentazon are possible substitutes for postemergence control of broad-leaved annual weeds in soybeans; however, these herbicides are several times more costly than 2,4-DB. Cultivation after planting continues as a recognized weed control practice in the larger-seeded legumes grown as row crops, but this practice has the limitations described earlier for corn and sorghum.

Phenoxy herbicides are used to control susceptible weeds in such crops as apples, asparagus, blueberries, cranberries, flax, pears, potatoes, strawberries and sugarcane. Each crop has specific requirements for weed control, including in some instances special formulations and unusual methods of application. In orchards and vineyards the herbicide need not be truly selective since it can be applied selectively to the weeds and not to the trees and vines.

The diversity and versatility of the phenoxy herbicides also provide the agriculturist with many options for weed control around the farm in noncrop situations. Such uses are coordinated with preventive and cultural practices, such as proper seedbed preparation, to make up efficient production systems. Post harvest and preplanting tillage followed by careful seedbed preparation can weaken perennial weeds and provide clean ground for the new crops. The purpose of later phenoxy treatments is to control susceptible weeds which begin growth with the crop or later.

An important advantage of having a variety of herbicides and other practices is that it makes possible the alternation and rotation of control measures in successive years. When the same methods are used year after year, special populations of weeds tolerant to the conditions created build up. Rotations to different herbicides or to other crops, each with its partiaiar herbicides and cultural methods, and the use of combinations of herbicides or combinations of herbicides with other methods are the stock-in-trade means of combatting weeds in croplands. Thus the phenoxys are not only production tools in the crops in which they are directly used but also in the crops that are produced in rotation with them.

Pastures and Ranges

Pastures and ranges are lands producing grasses or other forage plants that are harvested by grazing with domesticated animals. Pastures are grazing lands that are intensively managed, often by periodic cultivation, irrigation or rotation with crops. Rangelands are less intensively managed and are often arid or rough lands little altered from their natural state.

The central problem inherent in all grazing lands is the fact that livestock consume forage plants and leave weedy plants untouched and uninjured. The result is that valuable species are suppressed while unpalatable or noxious ones remain undamaged and free to prosper under reduced competition. Thus, the very nature of grazing is to provide an overwhelming competitive advantage to weedy species. The advantage is so great that, in the absence of proper management, weeds come to predominate in nearly all situations, often to the nearly complete exclusion of forage species.

Weedy vegetation can be held in check to some extent and forage yield maintained by the proper timing and rotation of grazing and by avoiding excessive grazing. Pastures can be plowed and replanted. Ranges can be reseeded or seeded with improved species. Fertilizers can be applied and pests controlled. Such positive measures are useful and necessary for increasing forage production; however, effective management systems must sooner or later face up to the necessity of taking direct destructive action against weeds. Available methods for controlling pasture and range weeds include chemical and mechanical methods and fire.

The phenoxys are the principal herbicides used on grazing lands. Their low cost, high activity, suitability for low-volume application and ability to kill most broadleaved plants, including woody species such as mesquite and sagebrush, without injury to grasses and certain legumes, make them widely useful in pasture and range management. As early as 1951, 500,000 acres of rangelands were treated with 2,4-D and 2,4,5-T. By 1966, over 10 million pounds of phenoxy herbicides, largely 2,4-D, were being applied annually to privately owned pastures and rangelands in the 48 contiguous states, amounting to nearly one-fourth of the total domestic consumption of phenoxy herbicides at that time. In 1971, 7.9 million pounds of phenoxy herbicides were applied to privately owned pastures and rangelands. Again the largest amount used was 2,4-D applied to 6 million acres of land. Slightly less than 1 million pounds of 2,4,5-T was applied to 1.1 million acres of land, much of it for control of mesquite, a task for which this chemical is uniquely adapted.

At present, most of the 2,4-D used on grazing lands is being applied to pastures. Treatment in 1971 amounted to 5 million acres or approximately 5 percent of the present 100 million acres of pastures in the United States. Of the 530 million acres of rangeland, only about 2.1 million acres, amounting to 0.4 percent of the total, are treated with phenoxy herbicides each year. One reason for this difference is that pastures are treated annually and rangelands only every 6 to 10 years. Another factor is that woody plants on rangelands reach levels requiring treatment on only 150 to 200 million acres and are then treated only when returns justify the expenditure. Although treating rangelands with phenoxy herbicides often increases forage production several fold, the land may be so arid or otherwise unproductive that this level of increase is not enough to yield an adequate return on treatments costing as little as $3 per acre.

Alternatives to phenoxy herbicides are more limited on rangelands than on pastures. Economic constraints on rangelands are dictated by the inherently low productivity of these lands. Drastic treatment such as bulldozing, ripping, or rootplowing followed by seeding may cost six times as much as treatment with phenoxy herbicides. These procedures destroy existing forage and disturb the soil, making it susceptible to wind and water erosion. Such alternatives are attractive only on sites with high productive potential that can be revegetated quickly.

Before rangelands were managed as they are now, natural fires apparently were able to reduce brush and coarse weeds to levels that were in balance with forage species. Man has largely eliminated fire, presumably to prevent loss of forage and to reduce the danger of wildfire. This, in part, accounts for a general increase in weeds on rangelands and suggests a reevaluation of our attitudes toward fire in range management. Fire on range and pasture lands is clearly an alternative to the use of phenoxy herbicides in some situations, particularly for brushlands. The smoke resulting from range or pasture burning, the destructive appearance of the fires, the difficulty of keeping fires from spreading and the hazard to wildlife are factors discouraging the use of burning and leading to the proliferation of laws restricting the employment of fire in range and pasture management.

Forests

Forests cover a full third of the United States, or 750 million acres. Two-thirds of this, 500 million acres, is productive enough to be managed for commercial timber. The remainder is either too low in productivity for timber, or has been withdrawn for other uses such as water yield, grazing, wildlife or recreation.

Three-fifths of the commercial timberland (about 300 million acres) is producing forest products at less than two-thirds of capacity due primarily to competing undesired vegetation. Over 100 million acres of this area is productive land that is supporting virtually no timber despite a history of high-value growth. These are the principal areas on which phenoxy herbicides, mostly 2,4-D, 2,4,5-T and silvex, are being used to help restore a desired forest cover.

The use of phenoxy herbicides in forestry, as elsewhere, is to discriminate between desired and undesired plants. In some cases, defective trees or undesired species have become dominant, whereas in others there are not enough trees to form a stand because of weed, brush or vine competition. In another, and less common, situation forests fail to regenerate because wildlife habitats have become altered in ways that support destructive populations of animals.

Traditional forestry methods emphasize hand-cutting for thinning and culling of forest stands. Such methods may be satisfactory and economically sound, particularly where cut material is utilized. However, high costs and the sheer magnitude of the problem on a nationwide basis make it evident that large-scale forest improvement simply will not be achieved by manual means. Herbicides are being used increasingly as a substitute for hand cutting.

The phenoxy herbicides are used for preparation of sites for tree establishment and release of preferred species from competing woody plants. Herbicides are applied by aircraft, by ground broadcast sprays and by treating individual trees. Rates of herbicide application for both aerial and ground broadcast treatments generally range from 2 to 4 pounds of 2,4,5-T or 2,4-D/2,4,5-T mixture per acre. Broadcast applications for conifer release are based on the greater resistance of the principal conifer species than of hardwoods to the phenoxys. Individual tree injections are made through spaced incisions around the trunk using about one milliliter of 2,4-D per cut. Limited use is also made of basal sprays and stem frills, with phenoxy herbicides being applied in oil solution to the bases of tree trunks or to cuts on the stems. Such treatments have lasting effects and usually need be used only once or twice in a 30- to 80-year forest rotation cycle. Many areas do not develop conditions requiring treatment; others, once initial conditions are corrected, should never need re-treatment if properly managed.

On forest land, as on cropland and rangeland, the phenoxys should be used in concert with other management practices and other herbicides to secure objectives beyond the simple suppression of unwanted plants. There are many alternative procedures for both timber stand improvement and complete rehabilitation. These employ both chemical and nonchemical procedures, including the option to take no action at all.

Culling and thinning may be accomplished by injecting organic arsenicals, picloram or dicamba. Injection does not expose other trees to the herbicide nor entail significant contamination of the general environment. However, costs generally favor use of the phenoxy herbicides, often by several dollars per acre.

Site preparation may be accomplished with picloram, dicamba and amitrole in place of, or in addition to, the phenoxys. These chemicals are relatively less selective among woody species than the phenoxys, and amitrole also kills grasses. Residues of picloram and dicamba are more persistent and active than are those of phenoxys. They can often be used effectively despite this problem, but at a cost of $10 to $40 per acre more than for site preparation based on the phenoxys. Generally, fewer problems are encountered with phenoxys than with substitutes. The use of other materials is usually warranted only when there is a need to control species resistant to the phenoxys.

Mechanical equipment can be used for forest weed control, but usually at greater cost and hazard. Power saws are more costly to operate in most circumstances than are injectors. Operator hazard from the use of saws is high, both directly from the equipment and indirectly from falling trees. Girdling requires much labor and entails a delay of a year or longer for weed trees to die. Bulldozers may be used to clear land for planting, and rolling choppers can incorporate brush and woody residues into soil. Such extreme methods are costly and disruptive to the soil, and they may lead to erosion and sedimentation in streams.

Fire is an important cultural tool that may be used independently or in conjunction with herbicides and mechanical methods. However, objectionable smoke and the difficulties of fire control restrict the use of fire. Herbicides are often used to desiccate vegetation, so that smoke is reduced, and to allow areas to be burned when adjacent areas are green and low in flammability.

The decision to make no treatment may be justified in some instances; however, such a decision is more often made through neglect rather than through planned action. Alterations to vegetation resulting from past malpractices are not automatically self-repairing. Trees and shrubs present on a site tend to remain dominant unless removed or killed. If forest composition is poor for any reason, it will likely remain poor. If game habitat is poor in such a stand, it will remain poor. Each selective removal of forest products will increase the proportion of undesirable growing stock. The effect of no treatment is therefore likely to persist indefinitely and to perpetuate the degradation of stands conditioned by past and present utilization practices.

Aquatic Habitats

Aquatic vegetation is present in all surface waters of reasonable quality. It is responsible for all food production in water and thus provides the nutritional basis for all aquatic life, ranging from microorganisms to game fish and water fowl. Under certain circumstances there is a buildup of overwhelming masses of aquatic weeds that may clog streams, lakes, reservoirs and canals, causing flooding, interfering with the flow of irrigation and drainage water, restricting navigation, interfering with recreation, and impairing fish and wildlife habitats.

The growth forms of aquatic plants range from single-celled algae to floating mats of such flowering plants as alligatorweed and water hyacinth that completely cover the water surface. Submersed plants, such as the pondweeds, are rooted to the bottom and grow entirely under water. Others, such as cattails and bulrushes, are rooted to the bottom in shallow water and rise above the water surface.

Most of the many desirable attributes of water may be served at one time or another by the judicious use of herbicides. Domestic water reservoirs are often treated on a regular basis with copper salts to suppress algae, and in other situations various chemicals, including phenoxy herbicides, are added to the water or sprayed on floating or emergent vegetation.

2,4-D can be used at rates of 1 to 2 pounds per acre for control of water hyacinth and at rates up to 4 pounds for control of many other floating or emergent species. Alligatorweed is resistant to 2,4-D but may be controlled with silvex. 2,4-D is frequently used in the form of granules or pellets which, after being spread over the water surface, sink to the bottom to kill rooted submersed weeds. Silvex is similarly used to control weeds more resistant to 2,4-D. Both 2,4-D and silvex are put in water in liquid form at 1.5 to 2 ppm or 5 pounds per acre foot of water for control of some weeds. Bulrushes, cattails, water lilies and most shoreline and emergent weeds are controlled with oil-water emulsion of 2,4-D esters at rates of 4 to 6 pounds per acre.

There are some alternatives to phenoxy herbicides for chemical control of aquatic weeds. Diquat can be used to control water hyacinth, water lettuce and duckweed. Acrolein and aromatic solvents are effective for control of submersed weeds, but both are highly toxic to aquatic animals. Endothall, dichlobenil, diquat, and fenac are alternatives to the use of phenoxy herbicides for certain weeds and under some conditions. There are no suitable chemical alternatives to 2,4-D and silvex for control of most shoreline or emergent weeds. Mechanical alternatives include underwater cutters for rooted weeds and swath cutters for floating mats. Dredging, draglining, and underwater dragging of chains and other devices may be used on suitably accessible waterways. The cost of mechanical methods for control of water hyacinth ranges from $150 to $1600 per acre compared with $5 to $60 per acre for treatments with the phenoxy herbicides. Costs of more than $100 per acre may be expected with the use of alternative herbicides.

The most extensive use of phenoxy herbicides in aquatic environments is in the production of rice. In view of the worldwide importance of this most critical food crop, the use in rice culture may eventually become the most important use of these versatile herbicides. The uses in rice and in noncrop aquatic situations have much in common, including the existence of few economical alternative methods.

Industrial Lands

Industrial vegetation management is directed primarily at modifying plant cover so that it does not interfere with industrial operations. Effects on the general environment and on aesthetic values must also be considered. Management actions range from minor tree pruning, for protection of power lines and structures, to the total suppression of all plants in such installations as railroad tracks, substations and storage yards. Industrial areas requiring total vegetation control are usually treated with soil sterilants rather than phenoxy herbicides. Industrial lands in the United States subject to management of plant cover are in excess of 50 million acres. This total includes nearly 4 million miles of highway, 200,000 miles of railroad and about 2 million miles of overhead electric lines, of which 300,000 miles are high-capacity circuits occupying 4 million acres.

Mos utility, highway and railroad rights-of-way are initially cleared by mechanical means, the cost of clearing in wooded areas varying widely with the nature of the terrain, labor costs and other factors. On power and communication line rights-of-way, subsequent control commonly entails the use of 2,4-D and 2,4,5-T. Newly constructed lines cleared with mechanical equipment often require two herbicide applications in succession to control sprouts; subsequent treatments are needed less frequently, depending upon the agressiveness of invading species. Maintenance operations may involve: (1) selective basal sprays of 2,4,5-T or 2,4-D/2,4,5-T esters at rates of 12 to 16 lb per 100 gallons of oil; (2) foliage or stem-foliage sprays of 2,4,5-T or 2,4-D/2,4,5-T mixtures in water applied with ground equipment at rates of 3 to 4 lb of chemical per 100 gallons of spray mixture; and (3) aircraft applications of 2,4,5-T or 2,4-D/2,4,5-T mixture at rates up to 12 lb per acre, often as invert emulsions or combined with a thickening agent to reduce spray drift. Other treatments include tree injections of the kind used in forests. Silvex and dichloroprop are used as foliage sprays at rates similar to those used with other phenoxy herbicides. These compounds kill certain species not controlled by 2,4-D and 2,4,5-T, but otherwise they affect a more limited spectrum of plants.

The preferred vegetation on highway and utility rights-of-way is usually grass and other short vegetation. The proper management of vegetation on roadsides is important to safety by providing adequate sight distances on curves and at junctions and intersections. Also, tall weeds can cause hazardous snowdrifts. Before the use of phenoxys, mowing, plowing, hand cutting and burning were about the only control methods available. 2,4-D, 2,4,5-T and other herbicides have eliminated the need for plowing, hand cutting and burning and also permit fewer mowings per year. Chemicals are particularly useful on steep slopes, wet areas and areas obstructed by guard rails and other structures and not accessible to mowing machines. The use of phenoxy herbicides on rights-of-way is sometimes restricted by the proximity of desirable vegetation susceptible to herbicide injury.

Alternative measures for utility rights-of-way maintenance include such chemicals as ammonium sulfamate, picloram, amitrole and dicamba. Ammonium sulfamate is effective for control of many woody plants. However, since it must be applied as high-volume sprays, it is not suited to helicopter applications. Ammonium sulfamate appears to be environmentally safe for wildlife and free of residue problems. Ammonium sulfamate kills grass and is thus not suitable for broadcast treatments where ground cover is wanted. Picloram is highly effective on many woody plants and can be applied as foliage sprays or to the soil in granular form. It is relatively persistent in the soil and must be used with due regard for this characteristic. Amitrole, dicamba and other foliar herbicides have important uses in industrial weed control, but unfortunately none of them duplicate the highly useful selectivity pattern of the phenoxy herbicides.

Alternative management systems on most rights-of-way in wooded areas are similar to those used in forestry and include: (1) periodic hand cutting, (2) mowing, and (3) mechanical clearing by plowing or bulldozing. Terrain limitations greatly restrict the use of ground equipment as replacements for aerial applications which are currently used on more than 2.2 million acres of right-of-way annually.

Urban Lands

Urban vegetation is principally lawn and turf, supplemented with shade trees and shrubbery. The central management effort is directed toward maintaining high-quality, weed-free turf. There are 15 million acres of turf in the United States, of which one-tenth is golf courses and one-third is home lawns.

2,4-D, 2,4,5-T, silvex, MCPA and dichloroprop are used on turf to control dandelions, plantains, garlic, chickweed and other nongrass weeds. This is standard practice by the home owner, greenskeeper and park manager throughout the world. Other herbicides used in turf management include DCPA, benefin, bensulide, arsonates, siduron and others that control crabgrass and certain other annual grasses. DCPA and dicamba are effective also on selected annual grasses and some phenoxy-tolerant broad-leaved weeds. Dicamba is readily absorbed by roots from soil and can injure shrubs and shade trees by this means. The use of alternative herbicides to the exclusion of phenoxy herbicides would greatly reduce the control of broad-leaved weeds critical in turf management.

The phenoxy herbicides are also widely used in public health programs to suppress poison ivy and allergenic plants such as ragweed.

HAZARDS

All chemicals, including ordinary household materials and the common ingredients of foodstuffs, are to some extent hazardous to man and other living things. A chemical may be a fire hazard, stain clothing, cause the floor to be slippery when spilled, or be poisonous and cause illness or death. In the case of poisoning, the hazard is compounded of two variables: the inherent toxicity of the chemical and the degree of exposure to it. High toxicity with little exposure presents low hazard, whereas high exposure to materials that are not highly poisonous may have serious consequences.

The toxicity of the phenoxy herbicides is known with reasonable accuracy on hundreds of species of plants and animals under a variety of conditions. The levels of herbicide present in the environment as a result of normal use and under conditions representing possible misuse are also known for a wide variety of situations. These facts form the basis for the assessment of hazards resulting from the use of the phenoxy herbicides. The scientific data are exhaustive, comprising more than 35,000 scientific papers and technical reports over a 30-year period. The phenoxys are relatively old materials in terms of research and accumulated experience in their use. It is possible not only to assess risks projected on the basis of experimental data but also to confirm or deny these projections on the basis of hazards that have developed or failed to develop from a quarter-century of extensive use throughout the world.

The phenoxy herbicides are powerful plant killers, and the principal hazards from their use accrue from this fact. The hazard is almost entirely to plants. The danger is either from failures in selectivity, leading to injury of the crop or other valuable plants in the treated area, or from spray drift or the movement of herbicide vapors, leading to injury of plants outside the treated area. There is a preponderance of evidence that the phenoxy herbicides are not significantly hazardous to animal life and microorganisms under normal conditions of use and indeed under conditions of substantial misuse. There may be injury to animals indirectly as a result of the changes in vegetation. This, however, is a consequence of the chosen vegetation management plan and not of the means taken to accomplish it.

Losses to crops due to failures in selectivity can result from overdosing due to mismeasurement of chemicals, poorly calibrated spray equipment, overlapping of spray swaths causing double coverage, and climatic variations that affect crop resistance. Rice, for example, is susceptible to 2,4-D injury at certain stages of growth, and many normally resistant plants are subject to injury during flowering and fruiting. Conifers are less resistant to the phenoxys when in rapid growth. Such injury is widely recognized by farmers and foresters throughout the world, and the means of preventing major losses are well known but, unfortunately, are not always practiced.

Spray Drift

The most serious hazard in the use of the phenoxy herbicides is drift of the chemical to nontarget vegetation during or after application. Phenoxy herbicides are extremely toxic to cotton and grapes. Beans, tomatoes, melons and many ornamental plants are also easily damaged. The hazard is related to the susceptibility of the plants, their stage of development and whether they are actively growing or not. Other factors are the distance from treated areas to susceptible plants, the amount of herbicide applied on a given day and the nature of the herbicide formulation used. The proportion of driftable small drops in the emitted spray and the height of the application (air or by ground) above the surface also affect spray drift. Wind velocity and direction and the degreee of turbulent mixing can greatly increase or decrease downwind transport and deposition of the spray in the susceptible crop area. Air temperature and humidity alter crop response and affect spray evaporation.

The herbicide can move as spray droplets, or it can evaporate and move as vapors. The ester forms of phenoxy herbicides can evaporate from droplets in the air or from plants and other surfaces after spraying. The vapors can then drift in the air to sensitive crops and other susceptible plants outside treated areas. This behavior is mainly a property of the high-volatile esters. Low-volatile esters are essentially free of this hazard except under conditions of very high temperatures and the close proximity of sensitive crops. In such events, the amine salt formulations provide still further protection against the hazard of spray drift.

Drift of herbicides as droplets can be greatly reduced by spraying the material in the form of larger and heavier droplets that tend to settle rapidly in the target area. Droplet size can be increased by using higher spray volume, lower pressures, coarse nozzles, nozzles of special design, or special systems for aircraft that give close control of droplet size. Thickening agents can be added to the spray mixture to cause it to form larger drops rather than fine particles.

Application machines and techniques have improved significantly in the past few years. It is no longer necessary in hazardous situations to apply phenoxys with equipment and formulations not specifically designed to reduce drift. Although a larger number of smaller drops may be more effective, larger spray drops of 500 to 1500 microns settle rapidly and provide safer and, over the long run, more economical control.

With use of the best available technology, it is routinely possible to deposit 97 to 99 percent of the released spray within ordinary target areas by either aircraft or ground equipment. Although such precision is not without its measure of added cost, in hazardous situations the additional expense is clearly worthwhile. Even more effective means are being developed which will permit use of phenoxy herbicides with significantly less drift than possible with present methods.

In hazardous situations, phenoxy herbicides should be applied only when a positive and firm wind is blowing away from nearby susceptible crops. They should not be applied when a temperature inversion, or a warm layer of air, is overhead under 1500 ft elevation. Absence of wind or an inversion ceiling reduce turbulent mixing or ventilation and promote build-up of small drops and vapor in the air that can drift as a concentrated mass to sensitive crops.

A final means of protecting from drift is to recognize situations that are beyond normal protective measures and not spray at all. When highly susceptible crops such as cotton and grapes are grown within 3 to 5 miles of large-scale spray operations (over 100 acres per day), crop injury may occur despite normal precautions. Several states have regulations that apply to such situations. They forbid use of specified herbicides at certain times of the year and may require special permits for exceptionally hazardous uses, or they may allow application only under regulatory supervision.

It is an important factor in the detection and prevention of drift that the effect of the phenoxys on plants is not insidious. When plants are injured, the symptoms are pronounced and unmistakable, and indeed the symptoms often appear more serious at first than is ultimately the case. The pattern of injured vegetation in relation to the primary treatment is ordinarily such that the source of spray drift is readily apparent.

Toxicity

Toxicity is the degree that a substance is poisonous. It is commonly expressed as the lethal dose, or lethal concentration, to 50 percent of the test animals (LD_{50} or LC_{50}). Dose is usually stated in milligrams of chemical per kilogram of body weight (mg/kg). Concentration is expressed as parts per million (ppm) of toxicant in food, water or air.

The acute oral toxicity of a single dose of the phenoxy herbicides to mammals ranges from 100 mg/kg to 2000 mg/kg, depending upon the test animal and the particular chemical or formulation. The herbicides are absorbed after ingestion, transported via the plasma, concentrated in the kidneys and rapidly eliminated in the urine. For 2,4-D or 2,4,5-T, the acute oral LD_{50} is upwards of 300 mg/kg for rats, mice, guinea pigs, hamsters, rabbits, primates and various livestock and large game animals. This is equivalent to a dose of 3/4 ounce of chemical for a human weighing 164 pounds. The dog has lower capacity to excrete the phenoxys, and as a result these chemicals are about three times more toxic to dogs than to other test animals.

It is known that man excretes the phenoxy herbicides rapidly via the urine.

In long-term feeding trials, test animals tolerate doses of as much as 25 percent to as little as 0.4 percent of the acute oral LD_{50} fed daily on a continuing basis without ill effects. Signs of poisoning include loss of appetite, loss of weight, weakness, lack of coordination, alterations of the liver and other internal organs, and in some instances defective offspring. 2,4,5-T is known to be a teratogen (cause birth defects) when administered at high doses to mice under some circumstances. The same may be true for the other phenoxys as well, since presumably all biologically active chemicals can be shown to have this effect under some conditions of exposure. When gestating animals are poisoned by massive doses of any substance, effects on the developing offspring are inevitable.

The phenoxy herbicides are generally less toxic to birds than to mammals. The acute oral LD_{50} for 2,4-D and 2,4,5-T for poultry, mallards, pheasants, pigeons and quail ranges from 300 to 5000 mg/kg. The LC_{50} for these chemicals in feed for birds is upwards of 2500 ppm and is typically greater than 5000 ppm. The toxicity to fish is highly variable. LC_{50} values range from less than 1 ppm to more than 1000 ppm in water. These values are equivalent to treatments of 10 pounds to 10,000 pounds of phenoxy herbicide per acre in a pond 4 feet deep. Toxicity is largely associated with the ester and oil-soluble amine formulations. The water-soluble amine salts are to all intents nontoxic to fish. Oysters, crabs, mussels and a wide variety of other invertebrates are not directly affected by the phenoxy herbicides applied in lakes, ponds and estuaries for aquatic weed control. The phenoxys are essentially nontoxic to insects and related organisms and are not significantly fungicidal or bactericidal.

Residues

When the phenoxy herbicides are sprayed on vegetation, a residue of the herbicide is deposited on plant foliage, on soil, on fences, poles and structures, and often into surface waters. Of the herbicide deposits on leaves, some is absorbed into the living tissues, often killing the plant. The residue remaining in the tissues of dead plants is largely decomposed as the plant material rots; however, some is released into the soil. The herbicide remaining in surviving plants is broken down over a period of a few days to a few weeks. Forage from pastures and ranges treated with 2,4-D, 2,4,5-T, MCPA or silvex has initial residues in and on the plant material of about 100 ppm per pound of chemical applied per acre. Residues in and on forage rarely exceed 300 ppm, and this only on sparse vegetation from the heaviest allowable rates of use on grazing lands. Forage residues decline with a half-life of one to two weeks. Thus, within two to four weeks, levels have fallen into the range of one-half to one-sixteenth of the initial value.

Since domestic and wild grazing animals tolerate up to 2000 ppm of phenoxy herbicides continuously in feed and larger amounts for short periods, there is no hazard to animals from forage residue even from treatment of ranges and pastures at exaggerated rates. No residues appear in the milk of cows consuming rations containing up to 300 ppm of 2,4-D, MCPA or silvex and up to 30 ppm of 2,4,5-T. Thus residues could possibly appear in milk following grazing in areas treated with practical rates of 2,4,5-T. To guard against this, there are stipulated waiting periods for milking or slaughter of animals grazed on ranges and pastures treated with herbicides.

In monitoring programs, no residues of 2,4-D or silvex were detected by the U.S. Food and Drug Administration in 13,000 samples of milk and 12,000 samples of meat from market channels analyzed for these compounds from 1963 to 1969. Trace amounts of 2,4,5-T were found in several samples. About 12 percent of more than 8,000 samples of meat analyzed by F.D.A. over a three-year period were reported to contain an average of 0.02 ppm of MCPA in the fat. This finding, although of no health significance, is nevertheless perplexing since such residues cannot be experimentally induced in cattle and sheep from continuous feeding at rates up to 500 ppm of MCPA in the ration. Residues of the phenoxy herbicides are also occasionally detectable in plant products used as food, although at levels so low as to be of no medical interest.

Residues of the phenoxy herbicides leached into the soil are bound to some extent by soil particles and are held in the upper part of the soil. They do not leach into water tables and contaminate wells and springs, nor do they move significantly into streams or to adjacent areas from surface runoff. However, wind or water erosion that carries major quantities of soil would also transport herbicide residues if any were present. The diluting effect of the soil is such that levels of the phenoxy herbicide in the root zone of plants are extremely low. Normally the levels are not sufficient to injure green plants or to affect non-green organisms such as bacteria, fungi, worms, insects and rodents.

The phenoxys are, without exception, subject to decomposition by various microorganisms that are universally present in soils. When applied to soils at typical agricultural rates, 2,4-D is usually decomposed in one to four weeks. MCPA requires about six weeks and 2,4,5-T about three months for essentially complete destruction. Silvex degradation is slightly slower than that of 2,4,5-T. Thus the phenoxy herbicides do not build up in the soil, and treatments can be applied to croplands year after year without accumulation.

Detectable residues of the phenoxy herbicides do not appear in surface waters unless the chemicals are directly added to the water or fall there incidental to spraying of rice or shoreline and forest vegetation or unless the chemicals are added as a water treatment for the control of aquatic vegetation. In practice the greatest residues in streams and lakes resulting from range and forest uses are less than 0.1 ppm. The concentration in water from treatment of rice and the spraying of floating and emergent aquatic weeds rarely exceeds 0.1 ppm. Treatments equivalent to several parts per million of 2,4-D are used to control such submersed aquatic weeds as water milfoil. These are added as slow-release granules containing phenoxy esters or water-soluble amines. Rates and application practices are designed to keep water residues below the approved 0.1 ppm level.

Residues in running water are subject to dilution through stream flow, adsorption by bottom mud and decomposition by sunlight. The concentration in streams after forest and shoreline treatments usually falls below detectable levels in a few days. In shallow waters such as rice paddies or stagnant, swampy areas, residues are decomposed by microorganisms and destroyed by sunlight. Residues decline at about the same rate as in soils. The decomposition of the phenoxys is rapid in most waters. The rate is reduced only under conditions of oxygen deficiency.

Dioxin

A dioxin contaminant referred to as TCDD is formed in the manufacture of the phenol used to make 2,4,5-T and silvex. The presence and significance of this impurity have become known only in recent years. 2,4,5-T formerly contained from 1 to 80 ppm of TCDD, concentrations sufficient to cause skin eruptions called chloracne in industrial workers. Although it has not been feasible to eliminate this contaminant entirely, present production methods are able to reduce the dioxin level to less than 0.1 ppm.

To have reduced to a fraction of one percent of its original content an impurity in a chemical already widely used and recognized as safe to the public would appear to be a sufficient solution of a routine problem. However, as more data were obtained, it became apparent that TCDD is one of the most toxic chemicals known. The hazard posed by the presence of a very very small amount of this very very toxic substance has therefore been of concern. As in other cases, the hazard must be evaluated in terms of toxicity and degree of exposure.

TCDD is toxic to laboratory animals at all stages of life, and it also causes birth defects. The acute oral LD_{50} ranges from 0.0006 mg/kg (0.6 μg/kg) in male guinea pigs to 115 μg/kg in rabbits. Dogs are less sensitive to TCDD than rabbits. Toxicity is about equal in the rabbit whether the compound is ingested or applied to the skin.

The effects are skin damage, liver damage, hemorrhage and reduced ability to cope with disease organisms. Death from a lethal dose is often delayed several weeks. Following ingestion by the rat, TCDD is absorbed from the gut, localized in the liver and fat, and eliminated largely via the feces but to some extent through the urine. A small amount is metabolized to harmless materials. About half of the ingested material is eliminated from the body in the first 17 days.

Birth defects develop when the chemical is administered during the time of pregnancy when foetal organs are forming. The effect is directly upon the developing pup rather than on the genetics of the mother. TCDD is more of a toxicant than a teratogen. It usually causes death rather than a wide range of abnormalities.

TCDD is from 5000 to 500,000 times more toxic to mammals than 2,4,5-T. The content of TCDD in commercial 2,4,5-T is less than one part in ten million. On this basis, a single toxic dose of TCDD would be contained in from 20 to 2,000 toxic doses of 2,4,5-T. Thus, the presence of 0.1 ppm of TCDD in 2,4,5-T does not contribute significantly to the toxicity of herbicidal preparations of 2,4,5-T.

For a person or animal to be poisoned with TCDD without first being poisoned with 2,4,5-T would require the existence of a mechanism in nature that would separate TCDD from 2,4,5-T, concentrate it and make it accessible for consumption in food or feed. Any postulated mechanism must recognize available facts about the environmental fate of dioxin.

The amount of TCDD distributed in the United States in 2,4,5-T is probably no more than eight ounces annually. This material is distributed over approximately five million acres at the rate of about 50 micrograms per acre, an amount equal to an acute lethal dose for a large animal, assuming it to be somewhat more sensitive to TCDD than the most susceptible known test animal. The material falling on the foliage is not absorbed appreciably by plants but gradually disappears from the leaves by decomposition due to the action of sunlight, evaporation into the atmosphere and washing from the leaves into the soil by rainfall. In addition to the loss by degradation, it should be noted that losses from volatility and washing into the soil serve further to dilute rather than to concentrate the remaining residues.

Once in the soil, residues become firmly bound to soil particles and are not appreciably taken up by plants. The TCDD does not leach downward but remains localized in the surface soil. The concentration at this time is less than one part in 10 trillion, a dilution ratio equivalent to a distance of an inch in 200 million miles (roughly twice the distance to the sun). Microbial degradation then comes into play and decomposes the remaining chemical to basic materials over a period of probably a year or two.

TCDD sprayed into waters rapidly disappears, evidently due to vapor distillation into the atmosphere and to decomposition by sunlight provided the waters contain small amounts of organic compounds. It is known that TCDD can bioaccumulate in algae, snails and fish. This property is of no practical interest, however, since there is no substantial supply of the chemical in the environment subject to accumulation. Analyses reveal that accumulation in food-chain organisms is not a problem. Measurable levels of TCDD have not been found in herring gulls, sea lions, eagles, corcorants, butterfish, eels, chain pickerels and large bodies of fresh and salt water. It has not been possible to detect TCDD in American supplies of food and feed and in fish meal.

TCDD does indeed become set free from 2,4,5-T and silvex in the soil as a result of the more rapid decomposition of the herbicides. However, in the process the dioxin becomes diluted beyond any possibility of doing harm. Evaluating the hazard of TCDD in the environment is largely a problem of comprehending numerical values far removed from common experience. One is at first likely to be so overwhelmed by the enormity of the toxicity of the compound that he fails to comprehend the infinitesimal levels of exposure.

Present evidence indicates that the dioxin contaminant in 2,4,5-T and silvex is a matter of academic rather than practical interest. It is quite literally an academic problem in the sense that many questions remain unanswered about TCDD, and research should be continued until all aspects of the toxicity, occurrence and environmental fate of this chemical are thoroughly understood.

Socioeconomic Factors

The fact that phenoxy herbicides are widely used in cropland agriculture, on rangelands and pasture, on private forests and public forest watersheds, and in a variety of industrial and urban uses is ample evidence that they are efficient inputs into production processes relative to available alternatives. If these herbicides were not relatively efficient and inexpensive, they would not be in use.

There are alternatives to the use of phenoxy herbicides, but each would cost more to achieve the same objective. Alternatives are almost always available in production processes. The relevant questions are (1) how much do the alternatives cost; (2) who would pay the additional cost; and (3) why should the low-cost method be discarded in the first place?

This report has shown that, with proper application and with current standards of production, phenoxy herbicides do not have serious unintentional side effects.

Indeed, where control of weeds or woody plants is advantageous, these herbicides usually have less harmful side effects on the environment than alternative methods of control.

It is clear that reduced use of the phenoxy herbicides on farms would result in increased costs to consumers. Some producers would gain at the expense of others, hired agricultural labor might gain marginally and nonpaid farm family labor would likely lose. There would be both short-run gains and losses followed by long-run gains and losses. The net effect would be loss. The effects of restriction on forest and industrial uses have not been analyzed in detail. However, one effect would surely be increased prices of forest products. Costs to household users would be mostly increased trouble and labor.

The costs of a possible ban on all phenoxy herbicides on agricultural uses have been estimated[1] in terms of the reduction in net U.S. farm and ranch income that would occur if alternative means of weed control were used to maintain current levels of agricultural output. The estimates were for the late 1960's, but the general conclusions would hold today. While both prices and input costs have risen, cost-price ratios have remained fairly constant. Therefore, results expressed as percentages or ratios should remain reasonably valid.

The estimates show that the costs of alternative weed control measures would total about 1 percent of the farm value of all crops and about 5 percent of the farm value of the crops actually affected. The percentages of the total increase in cost borne by individual crops would be: corn, 37; wheat, 17; rice, 3; other small grains, 10; grain sorghum, 4; pastures, 11; rangelands, 12; and other crops, 6. One cost would be about 20 million more man-hours of labor to maintain production.

If total output were to remain constant, the costs of such a ban would fall mostly on the producers of the affected crops in those areas of the nation where phenoxys had been used. Net farm income would not be reduced as greatly as gross farm income since farmers would naturally make their adjustments in fields and areas where control problems are the least. Consumers would not be affected under the assumption of constant total output. The demand for farm labor would rise, and farm wages could rise -- a gain to labor and a cost to farmers.

Although the assumption of constant output is useful for the purpose of estimating alternative control costs, the actual adjustments would be more complex. With increased production costs, farm output in the affected crops would tend to fall. One would expect a decline of less than 5 percent--probably 2 to 3 percent. Since the products involved are price inelastic, a decline in output would generate a more than proportional increase in price. Total revenue to farmers producing the affected crops would probably rise, and net income to these same farmers probably would fall--but by less than 5 percent. The price of farm labor might rise slightly; the prices of products to users would rise. Since most of the effects would be in feed-grain crops, much of the rise in consumer prices would probably be felt in prices of meat. Cattle feeders and range cattlemen would probably be affected

---

[1] ERS and ARS Agricultural Economic Report No. 194, November 1970.

more than the crop producers themselves, since crop producers would be receiving higher crop prices and could make adjustments in their cropping practices and cropping patterns that would aid in maintaining farm income.

Different areas of the county would be affected in different ways. For example, there would be a rather severe income decline in the rice producing region of Louisiana, balanced by net income increases in the rice producing areas of California where growers are less dependent upon phenoxy herbicides.

All short-run adjustments end up as increases in prices of food, lumber, paper, and other commodities to consumers. The long-run effects of banning a particular management technique in crop, range and forest production are difficult to forecast. New technologies are developed to cope with changing situations, and managers shift from one technique to another to meet changing needs and to get the advantages of new ways of doing things. The costs of production using phenoxy herbicides cannot be forecast in comparison with the costs of new technology that might arise in the future.

MEMBERS OF THE TASK FORCE ON THE PHENOXY HERBICIDES

Dr. Boysie Day (Chairman of the task force), Professor, Department of Plant Pathology, University of California, Berkeley, California 94720 (Telephone 415-642-4701)

Prof. Norman B. Akesson, Professor, Department of Agricultural Engineering, University of California, Davis, California 95615 (Telephone 916-752-1439)

Dr. L. E. Bode, Assistant Professor, Department of Agricultural Engineering, University of Illinois, Urbana, Illinois 61801 (Telephone 217-333-2854)

Dr. Rodney W. Bovey, Research Leader, ARS, USDA, Department of Range Science, Texas A & M University, College Station, Texas 77843 (Telephone 713-846-8821, Extension 238)

Dr. W. R. Byrnes, Professor, Department of Forestry and Conservation, Purdue University, Lafayette, Indiana 47907 (Telephone 317-494-1715)

Dr. Robert A. Darrow, Research Leader, Weed Physiology and Growth Regulator Research, ARS, USDA, P. O. Box 1209, Frederick, Maryland 21701 (Telephone 301-663-7132)

Dr. Donald E. Davis, Professor, Department of Botany and Microbiology, Auburn University, Auburn, Alabama 36830 (Telephone 205-826-4830)

Dr. R. E. Doersch, Professor, Department of Agronomy, University of Wisconsin, Madison, Wisconsin 53706 (Telephone 608-262-1392)

Dr. Harvey A. Holt, Assistant Professor, Department of Horticulture and Forestry, University of Arkansas, Fayetteville, Arkansas 72701 (Telephone 501-575-2604)

Dr. Charles L. Leinweber, Director, Environmental Quality Program, Faculty Exchange Box 119, Texas A & M University, College Station, Texas 77843 (Telephone 713-845-2673)

Dr. William E. Martin, Professor, Department of Agricultural Economics, University of Arizona, Tucson, Arizona 85721 (Telephone 602-884-1794)

Dr. Michael Newton, Associate Professor, Department of Forest Management, Oregon State University, Corvallis, Oregon 97331 (Telephone 503-753-9166)

Dr. Gary D. Osweiler, Associate Professor, Department of Veterinary Anatomy-Physiology, University of Missouri, Columbia, Missouri 65201 (Telephone 314-882-7049)

Dr. Jack S. Palmer, Veterinary Medical Officer, U. S. Livestock Insects Laboratory, ARS, USDA, P. O. Box 232, Kerrville, Texas 73028 (Telephone 512-257-3566)

Dr. Jack Plimmer, Research Chemist, Pesticide Degradation Laboratory, ARS, USDA, Beltsville, Maryland 20705 (Telephone 301-344-3076)

STATEMENT OF LARRY DINNEEN
ARCTIC SLOPE REGIONAL CORPORATION
BEFORE THE
SENATE RESOURCES COMMITTEE
STATE OF ALASKA
FEBRUARY 22, 1978

I am not here today to play the numbers game related to the corporate income tax legislation before your Committee. But I have a few points to make, based on my years of experience in developing business ventures in several states and working for the Arctic Slope Regional Corporation (ASRC) in Alaska.

The "bottom line" of my statement is this: the enactment of the separate accounting bill or the franchise bill -- or anything in between -- would be bad for Alaskans. Although the intent of both bills my be simply to extract more dollars out of the major oil corporations in Alaska, the effect will be damaging to ASRC, to some 70,000 Native Alaskans and to the future viability of the economy of the State of Alaska. First, I would like to call your attention to some of the specifics in the proposed legislation.

JUST THE OIL COMPANIES?

It is evident from some of the language in both bills that the intent is to exempt the Native Regional Corporations from the provisions of the bills. I believe that in either case, litigation could prove that Native Regional Corporations would not be exempt. This is especially true with regard to the separate accounting bill as the actual amending language in Section 2 relates directly to "income of any corporation derived in Alaska." Additionally, it appears deductible costs would not include the costs of the consultants that we have had to hire in Seattle, Washington, D.C. and elsewhere to deal with the myriad of government problems that are facing us . and to ensure that we are getting the most expert advice on our business matters. Since the Committee is addressing the separate accounting bill in particular, we felt that it was important to bring out these two points.

But the major point is that we do not feel that it is in Alaska's interest --and particularly with respect to ASRC and other Native Regional Corporations -- to change the corporate income tax laws affecting the major oil companies or anyone else, particularly at this time in Alaska's history. Even if we were exempted ultimately from the language of the corporate income tax legislation, the effects of raising taxes on the oil industry in Alaska would be directly damaging to ASRC and thousands of other Alaskans. Although I will develop this point further in my testimony, I want to mention now that ASRC and other corporations are engaged in a great deal of contract work for the major oil companies. And, while no one expects the Prudhoe Bay companies to leave the State altogether, there is no doubt but that the amount of exploratory work going on in Alaska could and should be much higher. And with exploratory and development work comes jobs for Native Alaskans in the form of contract work. Yet this is only one important aspect of the tax issue that I would like to call to your attention.

THE BILLION BARREL OIL FIELDS PROBLEM

Last year, Revenue Commissioner Sterling Gallagher spoke about our problem to the Federal Energy Administration officials dealing with North Slope oil pricing in discussing the Lisburne and Kuparuk oil pools:

> "The Lisburne and Kupaluk pools are illustrative of the case for most-likely discoveries on Alaska Native lands selected under the Alaskan Native Claims Settlement Act. It is far more probable that any discoveries on Native lands will be in the 1 to 2 billion-barrel range like Lisburne-Kuparuk, than in the 8 to 10 billion-barrel range like the main Prudhoe pool." 1/

The problem for ASRC is that we need to raise capital in order to find these fields and we need oil company expertise both to find and develop them. But the future is not PRUDHOE-BAY SIZED FIELDS.

Costs in Alaska are extremely high, and there are many other places still left in the world -- including the North Sea -- where drilling operations are more profitable than they have been and especially will be in Alaska. The wellhead value, after subtracting transportation, etc, is only about $3 these days, and with smaller sized fields as the likely prospect for future discoveries, we can not afford to continue raising taxes on the oil industry without directly reducing the likelihood of finding and developing marginal fields. Needless to say, this is of some concern to ASRC in particular, but all 70,000 Natives are also directly affected...

1/ Statement of Commissioner Sterling Gallagher, Department of Revenue, State of Alaska to the Federal Energy Administraion Regarding Alaska North Slope Crude Oil Price and Entitlements Issues, Washington, D.C., March 21, 1977, p. 3.

ALASKA NATIVES: THE LOWERING OF EXPECTATIONS

With the enactment of the Alaska Native Claims Settlement Act, it was hoped that the Alaskan Native might at last be able to have more of what some have called The American Dream. More choices in terms of employment and lifestyle. And a strong economic base from which to build for their children and grandchildren.

But problems with the Federal Government have multiplied, causing long delays in land transfer and incredible costs. The importance of the D2 issue cannot be overstated. The threat to village lifestyles and subsistence living is very great. Yet few seem to realize that the State government is another direct threat.

If either of the corporate income tax bills were to pass, there would be an immediate effect, not only on the oil companies but also on every Native in Alaska. There would be an immediate reduction in the value of Native land to the Natives who have made their selections in large measure for resource value. All Natives are affected because of Section 7(i) of the Act which provides that 70% of the revenues received by an Native Corporation for hard rock minerals or oil and gas discovered on the Corporation's land will be shared with the other Corporations.

Thus, if ASRC cannot get a billion barrel field developed or more fields found, every other Native Corporation and its stockholders will also be adversely affected. Not to mention the adverse affect on the State of Alaska itself over the long term.

THE THIRD ALTERNATIVE

In conclusion, I would like to highlight a number of important points that Milton Lipton made in addressing this Committee on January 25th. First, despite any perceived "deficiency" in Alaska's corporate oil income tax laws, Lipton endorsed the Arthur Andersen study and stated that the figures are "revealing." Lipton also pointed out that the Legislature should note that "the deficiency in your corporate income tax receipts from the oil and gas producing industry is at least and probably more than made up by higher severance and ad valorem taxation which the Legislature has already imposed upon the industry."

Additionally, Lipton took a good bit of time expressing the importance of perceptions. He stated that the impression which the State of Alaska presents "may be even more important in discouraging investment than the fact of the tax burden per se." He spoke also about the dangers of giving the impression of having an "ad hoc taxing policy" which increases taxes year to year "dedicated to the budgetary needs, revenue deficiences, or whatever the case may be." As a businessman, not an economist, I have noted that the perception of Alaska as a good plce to invest is already poor.

And Lipton seriously presented what he called the Third Alternative: not to amend the income tax statute. It seems to me that the two corporate income tax bills may make more dollars and cents for the State in the near term but that it makes much more sense for Alaska at this point to stop changing the oil and gas tax laws.

Prudhoe Bay production will begin to decline in about eight years. Once a new field is discovered in Alaska, it takes about eight years to get it into production. We need much more exploration now and many more discoveries in the future to replace the income from Prudhoe Bay. A tax hike now could mean the loss of far greater revenues in the future for the State from the development of the remaining smaller fields. And we must face the fact that there probably will not be any more Prudhoe Bays in Alaska.

The Native interest in this matter is clearly the value of our land, revenue and jobs. But the importance of the perception of Alaska is important to all Alaskans. With billions of dollars of surplus revenues projected by the State for the future, we do have time. The passage of these bills would not just reduce oil companies' profitability. Either one would be damaging to the economic aspirations of all Alaskans and particularly Alaskan Natives.

* * *