

ACCEPTED  
June 25, 1975  
FEDERAL INSECTICIDE  
HERBICIDE ACT  
EPA REG. NO. 28472-9

ETHYLENE  
FOR USE AS A HERBICIDE  
AND PLANT GROWTH REGULATOR

**C<sub>2</sub>H<sub>4</sub> (TECH GRADE) HERBICIDE AND PLANT GROWTH REGULATOR**

**ETHYLENE**

**Air Products**  
AIR PRODUCTS & CHEMICALS, INC. - SPECIALTY GAS DEPT.  
P.O. BOX 351 - TAMAQUA, PENNSYLVANIA 18252

**DANGER!**  
KEEP OUT OF REACH OF CHILDREN  
Extremely flammable. Gas under high pressure. Exposure to temperatures above 125°F may cause bursting. Keep away from heat, sparks and open flame. Gas reduces oxygen available for breathing. Do not enter storage areas unless they are adequately ventilated. Instructions for use are in Accompanying Ethylene Brochure

ACTIVE INGREDIENT	98.5%
Ethylene	1.5%
INERT INGREDIENTS	100%
NET CONTENTS	30lb.
E.P.A. REG. NO.	28472-9
E.P.A. EST.	28472-PA-1

 *Air Products and Chemicals*  
INC.

RECEIVED  
JUN 6 1975  
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PESTICIDES, EPA

2548

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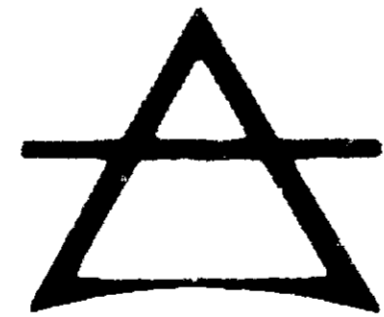
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AIR PRODUCTS & CHEMICALS, INC. SPECIALTY GAS DEPT.  
P.O. BOX 351 - TAMMQUA, PENNSYLVANIA 18252

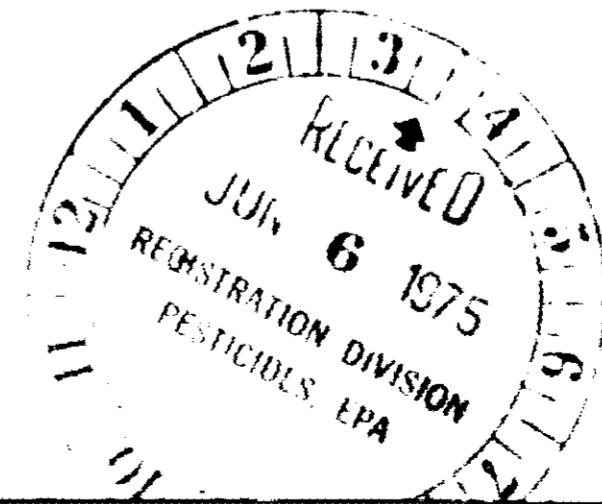
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*Air Products and Chemicals*  
INC.



AIR PRODUCTS AND CHEMICALS, INC.

SPECIALTY GAS DEPARTMENT

733 WEST BROAD STREET

EMMAUS, PENNSYLVANIA 18049

## INTRODUCTION

The purpose of this brochure is to provide the individual who uses ethylene as a herbicide for witchweed control or as a plant growth regulator with an explanation of the properties of the gas and recommendations for the safe handling and effective use of ethylene.

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Safety Considerations

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    Safe Handling Literature

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ETHYLENE FOR WITCHWEED CONTROL IN CORN, COTTON, PEANUTS AND SOYBEANS

    Witchweed Seed Germination

    The Application of Ethylene

ETHYLENE FOR THE RIPENING AND DEGREENING OF FRUITS

    Explanation Of The Ripening Process

    The Application of Ethylene

## SPECIFICATIONS

Technical Grade . . . . 98.5%

## PHYSICAL PROPERTIES

Molecular Weight	23.054
Boiling Point	-154.66°F
Color	Colorless
Corrosiveness	Noncorrosive
Critical Density	17.9 lb./cu.ft.
Critical Pressure	727.65 psig
Critical Temperature	49.32°F
Density	
Gas at 32°F, 14.7 psig	0.016 lb./cu.ft.
Liquid at -154.66°F	4.74 lb./cu.ft.
Flammable Limits in Air	2.7 - 36.0 vol %
Ignition Temperature	1000°F
Melting Point	-273.1°F
Odor	Characteristically Sweet
Specific Gravity @ 59°F	0.9740
Specific Volume @ 70°F	13.7 cu.ft./lb.

## SAFETY CONSIDERATIONS

### Toxicity

### CAUTION!

Ethylene is classified by the American Conference of Governmental Industrial Hygienists as a simple asphyxiant. It displaces the air necessary to support life. Do not enter storage areas unless they are adequately ventilated. If a person is overcome by ethylene, remove the victim to fresh air and keep the person warm and quiet. If the person is not breathing, give artificial respiration, preferably mouth to mouth. CALL A PHYSICIAN.

### Flammability

### DANGER!

Ethylene is an extremely flammable gas under pressure. Keep away from heat, sparks and open flame. In case of fire, allow the gas to burn if the gas flow cannot be shut immediately.

### Safe Handling Literature

The following data sheet and pamphlet concerning the safe handling of compressed gases is available upon request from Air Products and Chemicals, Inc., Specialty Gas Department.

- (1) "Handling and Storage of Flammable Gases", data sheet, Air Products and Chemicals, Inc., Specialty Gas Department, P.O. Box 538, Allentown, Penna.
- (2) "Safe Handling of Compressed Gases", Compressed Gas Association, Inc. pamphlet P-1, New York.

### GENERAL HANDLING INFORMATION

Because ethylene is noncorrosive, no special materials of construction are required. Systems employed must be designed to handle the pressures involved. Ground all equipment and cylinders of ethylene before use. Do not use ethylene with non-explosion proof equipment.

AVAILABILITY

Ethylene for use as a plant regulator either in ripening / degreening processes or for witchweed control is available in the following cylinder sizes:

Cylinder Size	Content	
	cu. ft.	lb.
Technical Grade .... 99.5%		
B	411	30
D-1	62	4.5
D	34.25	2.5

Contact Air Products and Chemicals, Inc., Specialty Gas Department for pricing information.



## ETHYLENE FOR WITCHWEED CONTROL IN CORN, COTTON, PEANUTS AND SOYBEANS

### CAUTION:

1. For use by or under the supervision of U.S.D.A. personnel only.
2. Sequential application following other herbicides may result in crop injury.
3. Post emergent treatment with ethylene will give no witchweed control in the current year.

Witchweed (Striga Lutea) is a parasite to host plants such as corn, rice, sorghum and other gramineous crops. This weed was first found in the United States in 1956, and has been confined in the eastern Carolinas. Control programs utilizing ethylene have considerably reduced the amount of damage caused by this parasitic weed.

### WITCHWEED SEED GERMINATION

Witchweed seeds are microscopic in size and may persist in the soil for many years. An external stimulant is required to germinate the seeds. In nature, this stimulant is a root exudate produced by potential host plants. This natural stimulant, however, is not capable of effecting germination and the subsequent devitalization of the witchweed seed in a single year. Ethylene used as a stimulant, however, has been found to induce germination and is being employed to eradicate witchweed.

### THE APPLICATION OF ETHYLENE

A soil injector is used to apply ethylene which is similar to that used to apply the fumigant methyl bromide. Snanks inject the ethylene 6 to 10 inches below the soil surface. Compaction sealing behind the injectors is advantageous, but soil covers are not required.

The ethylene may be broadcast throughout an infected field or it may be injected between the crop rows if row spacing does not exceed 48 inches. In order to be effective, ethylene must be applied after the seeds have been preconditioned for germination usually May through July. This preconditioning period requires adequate moisture and temperatures above 72°F for a period of at least two weeks. Preconditioning of the seeds is necessary. Even if induced by a stimulant, the seeds will not germinate unless they are preconditioned.

A flowmeter is used to measure the flow rate (in. cu. ft./hr.) of the gas applied. The volume of ethylene (in. cu. ft.) applied to the soil depends upon the flow rate of the gas, the ground speed of the vehicle, and the shank spacing. The proper flow rate may be determined by use of the following equation: Tractor speed (MPH) x 0.12 x treatment width in feet x rate (cu. ft./A) = cu. ft./hr. The composition of the soil appears to have some bearing on ethylene diffusion. Soils having excessive moisture or a high organic matter content appear to deter diffusion of the gas somewhat. Witchweed infestation commonly occurs in light, sandy soil, which is favorable to ethylene diffusion. Application of 1.5 lb. (19.5 cu. ft.) per acre is effective in germinating preconditioned seeds. In light sandy soil penetration of ethylene generally extends to a 48 inch depth and to a 48 to 60 inch wide radius from the point of ethylene injection. Shank spacing should not exceed 48 inches. The percent of witchweed seed germination within this grid has been experimentally determined as between 80 to 90 % for the 1.5 lb. per acre application. Avoid tillage until 3 hours after ethylene application.

(1) R. E. Eplee, "Witchweed Seed Germination", USDA, APHS, Witchweeds Methods Development Laboratory, Whiteville, North Carolina 1972.

## ETHYLENE FOR THE RIPENING AND DEGREENING OF FRUITS

Ethylene is used in the food industry for ripening and/or degreening fruits and certain vegetables. Market conditions require that the rate of maturation of fruits be effectively controlled to result in produce of high quality and good appearance.

### EXPLANATION OF THE RIPENING PROCESS

During ripening of fruits, natural enzymatic changes occur simultaneously in the peel and pulp. Biological catalysts convert the starches present to sugars. The ripening fruits give off small amounts of ethylene, carbon dioxide and other volatile compounds. Applying ethylene externally controls the rate of ripening. Ethylene, a natural ripening stimulant, initiates the enzymatic changes in the fruit. It allows a normal but accelerated ripening process, and when used in the recommended concentrations, produces no damaging effects or changes in the taste of the treated fruits.

### THE APPLICATION OF ETHYLENE

The produce for which ethylene has been used as a ripening or degreening agent are listed in the Table, along with the optimum concentrations of ethylene required. Concentrations in excess of those recommended will not accelerate the ripening process and may result in discoloration of the fruit.

<u>PRODUCE</u>	<u>CONCENTRATION OF ETHYLENE</u>	<u>PURPOSE</u>
Banana	1000 ppm	Initiate degreening and ripening
Grapefruit	1000 ppm	Initiate degreening
Honeydew Melon	1000 ppm	Initiate degreening
Lemon	1000 ppm	Initiate degreening
Orange	1000 ppm	Initiate degreening
Pear (Bartlett, Rose)	1000 ppm	Initiate degreening and ripening
Persimmon	1000 ppm	Initiate degreening, decrease astringency, and ripening
Tangerine	1000 ppm	Initiate degreening
Tomato	200 ppm	Initiate degreening and ripening

NOTE: TIMING AND DURATION OF TREATMENTS MUST BE IN ACCORDANCE WITH RECOMMENDATIONS OF THE U.S.D.A. OR OF STATE DEPARTMENTS OF AGRICULTURE OR UNDER SUPERVISION OF EXPERIENCED PERSONNEL.

Ripening rooms are commercially available in which the air flow, temperature and relative humidity, which are critical parameters, may be monitored and controlled during the ripening process. In order to determine the volume of gas required for a particular ripening room, the following formula may be used:

$$\text{Size of room in cu. ft.} \times \frac{\text{Desired ppm}}{1,000,000} = \text{cubic feet of gas required}$$

A room having a volume of 1,000 cu. ft. where a concentration of 1,000 ppm is desired would require 1 cu. ft. of ethylene.

The amount of gas being discharged from a cylinder may be measured by using a flowmeter which indicates the flow rate (in. cu. ft./hr.) of the gas. Another method is to determine the volume of gas required for the application, convert it to the weight of ethylene in pounds, and allow the cylinder to discharge until this decrease in cylinder weight is reached. The cylinder may be weighed on a standard scale. The conversion formula for ethylene is 1 lb. = 13 cu. ft.

The amount of ethylene necessary for ripening or degreening when dispersed throughout the ripening room is well below the flammable limits of the gas.

**DANGER! HIGH CONCENTRATIONS OF ETHYLENE WITHIN THE FLAMMABLE RANGE AND CAPABLE OF EXPLODING UPON IGNITION MAY EXIST IN THE AREA OF THE DISCHARGING CYLINDER.**

Employing excessive concentrations of the gas in addition to damaging the fruit may result in explosive ethylene/air mixture.

