

COLORADO FLOWER GROWERS
ASSOCIATION, INC.

IN COOPERATION WITH COLORADO STATE UNIVERSITY
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ESTIMATED ETHYLENE LEVELS IN THE NORTH DENVER-SOUTH PLATTE RIVER VALLEY

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During the 1971-72 winter, three locations in Denver were selected as representative of the worst pollution areas in the Denver metropolitan region. Air outside greenhouses was sampled every 15 minutes from 0600 to noon. The locations are given in Figure 1. Location 1 was adjacent to the City of Denver's Weather Station at 51st and Emerson Streets, the Denver Station providing continuous records of total hydrocarbons, oxidants, SO₂, etc. This station was sampled every Thursday in October. Location 2 was roughly 500 yards southeast of the Denver-Boulder Valley Highway intersection, elevated about 100 feet above the surrounding territory on a small hill and sampled every Thursday in December. Location 3 was in the Platte River bottom, west of the oil refineries, and was sampled every Wednesday in February.

Figure 2 shows the individual determinations for all three stations. The variation was typical, showing usual peak concentrations around 0800 as the result of heavy automobile traffic. A second, less high peak is usually found during the late afternoon rush hours in most metropolitan areas. Figure 3 is the mean ethylene concentration for all stations and all dates. Table 1 gives the mean for each station and date. As a result of the large day-to-day variations, the 10-ppb lower mean concentration for Station 2 was not significantly different from Stations 1 and 3. However, the difference is likely "real" since the higher elevation of Station 2 would allow greater opportunity for pollution dispersal. Days on which C₂H₄ concentrations dropped to 12 ppb or less were days with high winds, gusting upwards to 30 mph. The effect

of wind was particularly evident on December 30 when levels reaching 148 ppb abruptly dropped to less than 10 ppb between 0900 and 0915.

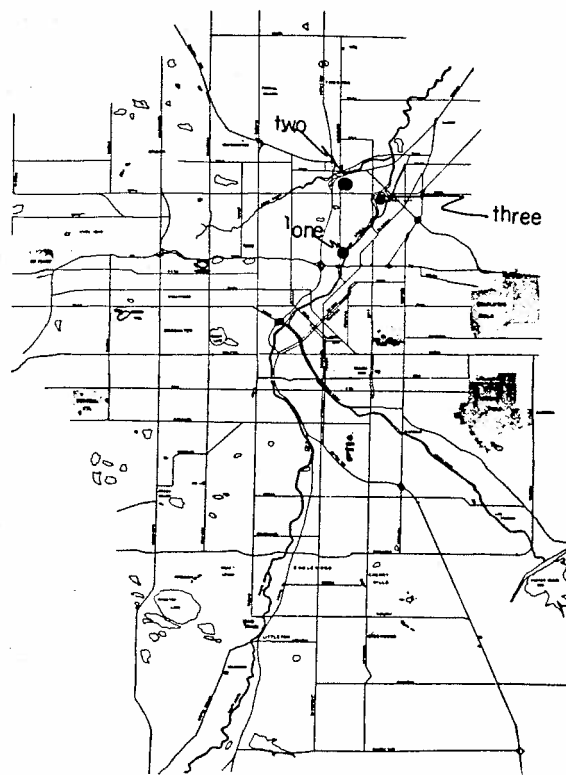


Figure 1. Sampling station location.

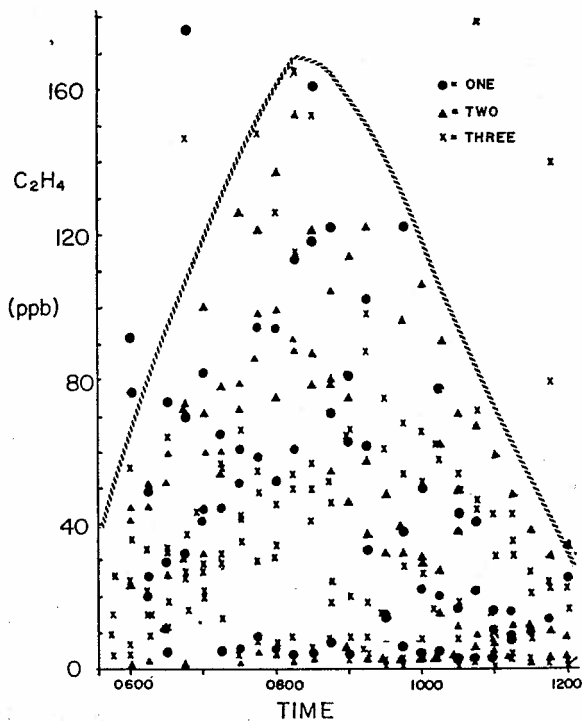


Figure 2. Plot of all ethylene measurements made in the North Denver-South Platte River Valley.

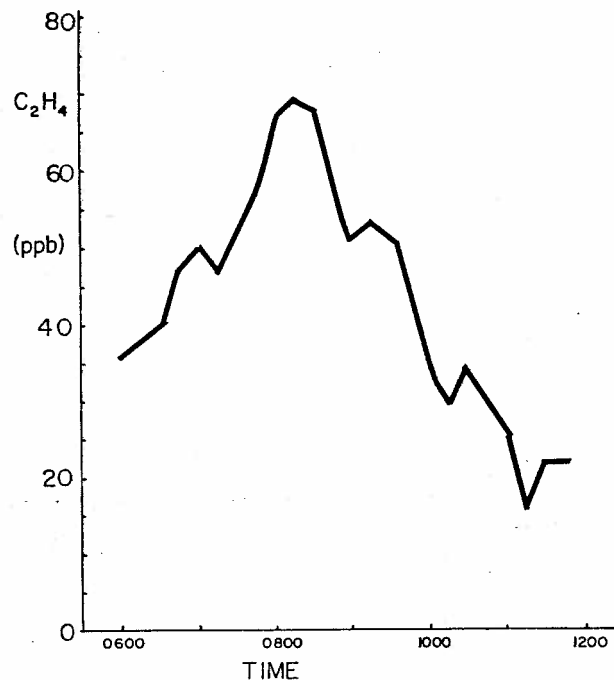


Figure 3. Mean ethylene levels for three locations in North Denver-South Platte River Valley between 0600 and 1200.

Denver weather is characterized by strong temperature inversions nearly every day of the year. The stronger the inversion, the less total air volume available for pollution dispersal. Fortunately, high solar radiation heats the ground and usually breaks up inversions before noon. It is only during the winter, with low sunlight, that temperature inversions may persist for one or more days, permitting pollutants to build up from one day to the next. Under such conditions, ethylene levels approaching 200 ppb have been detected in previous sampling surveys.

The data do not permit, at first glance, any straightforward assessment of damage to carnation cut flowers. As Barden (CFGA Bull. 263) has shown, the effect of ethylene on cut flowers is a function of temperature, duration of exposure, and concentration. For the 6-hour periods actually measured, the maximum ethylene dosage obtained (506 ppb-hours, Table 3) was not dangerous. Table 2 summarizes Barden's work, giving the ethylene threshold levels necessary for significant loss in keeping life at various temperatures. To arrive at any idea of the ethylene problem without considerable expense, it is necessary to extrapolate from the 12 6-hour periods actually sampled.

Table 1. Mean ethylene levels (ppb) for each station and individual days. Samples taken every 15 minutes between 0600 and 1200.

Station	Date	Concentration	Mean for station
1	10-7	56	47
	10-14	42	
	10-21	85	
	10-28	9	
2	12-2	34	37
	12-9	46	
	12-16	12	
	12-23	45	
	12-30	48	
3	2-9	69	45
	2-16	12	
	2-23	49	
Significant difference = 9 (5% level)			No significant difference

The ethylene samples obtained at Station 1 gave a high correlation with total hydrocarbons measured by the Denver Station. The correlation resulted in a mean value of 1.7% of the total hydrocarbons as C₂H₄. Using this figure, and data for mean daily non-methane hydrocarbons (1.2 ppm assumed methane background level) from the CAMP monitoring station on Broadway, a value of 934 ppb-hours was obtained. A mean value as high as this for a 24-hour period would suggest single day pollution episodes sufficient to cause problems if flowers were not refrigerated. A 3-day pollution episode would definitely exceed the lowest threshold dosage (2,100 ppb-hours) found by Barden. But, 3-, or even 2-day episodes are extremely rare in Denver. One-day episodes may occur from 3 to 5 times during the winter.

Table 2. Ethylene dosage levels required to obtain 100% and 20% loss of carnation cut-flower keeping life. Obtained from Barden's data, CFGA Bulletin No. 263.

		Percent keeping life loss ^a	
Temperature		100%	20%
Flowers	70°F	4,400	2,100
	50°	10,000	4,400
	35°	47,000	14,500
Buds	70°	8,400	3,100
	50°	25,000	14,000
	35°	55,000+	55,000+

^aPercent keeping life based upon 100% for a control group of flowers subjected to ethylene levels below 10 ppb for the duration of an experiment.

In still another approach to calculating possible dosages, the ethylene levels obtained were ranked according to frequency of occurrence. Thus, in Figure 4, it may be noted that 75% of all observations were 10 ppb or higher, and 2% of the observations exceeded 180 ppb. This shows that 75% of the time levels exceeded 10 ppb, whereas only 2% of the time did levels exceed 180 ppb. On this basis, Table 3 shows the number of days that would be required to reach a 3000 ppb-hr. dosage for 10, 20, 40, 80, and 160 ppb levels. Where it was assumed that levels of 10 ppb occurred 75% of the time, it would require 16 days to reach 3000 ppb-hrs. At levels of 160 ppb for 2% of the time, only 2 days would be necessary. Where frequencies of occurrence are 25% or higher, this method of calculation appears reasonable. At frequencies less than 25%, the calculations are highly suspect.

SUMMARY

For other locations in Denver metropolitan area, ethylene levels should not reach a point where

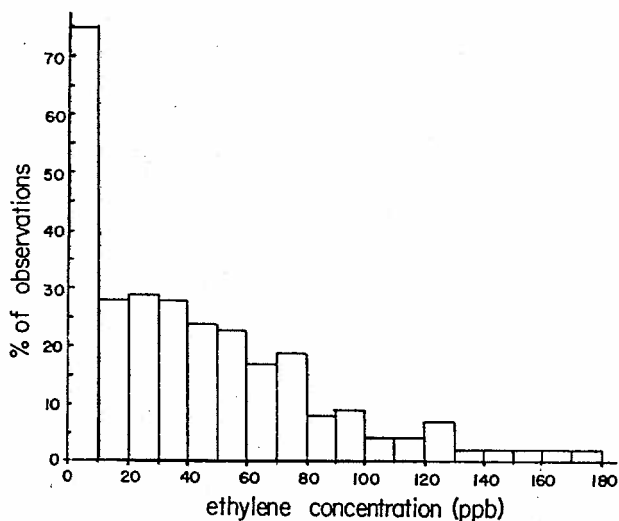


Figure 4. Frequency histogram of ethylene levels in the North Denver-South Platte River area.

observable reduction in keeping life will occur. For the most polluted regions as the South Platte and Clear Creek basins, pollution episodes of once or twice per year may cause some loss. If carnations are cut tight and immediately refrigerated, existing C₂H₄ levels will not be dangerous. Bud cutting carnations will eliminate all danger at present ethylene levels. It should be noted that none of the days sampled had sufficiently high pollution to cause the authorities to issue warnings. Under such conditions, tight bud cutting would probably be good insurance. Denver remains in a fortunate position in that pollution episodes, extreme

Table 3. Actual and estimated ethylene dosages in the North Denver-South Platte River Valley region.

Condition	
Dosages for the 6-hour period (0600 to 1200) actually measured:	
Mean ethylene dosage for 12 days	262 ppb-hrs
Maximum ethylene dosage found	506
Minimum ethylene dosage found	39
Mean ethylene dosage estimated for a 24-hour period, using CAMP station data (downtown Denver), January through March, September and October, and assuming that of the total hydrocarbons, ethylene comprises 1.7% with a mean methane level of 1.2 ppm	
	934 ppb-hrs
Average number of days to obtain a 3000 ppb-hr dosage from the above mean daily ethylene dosage	
	3 days
Time required in days to reach 3000 ppb-hrs. ethylene dosage:	
Assuming levels of 10 ppb, 75% of the time	16 days
Assuming levels of 20 ppb, 29% of the time	11 days
Assuming levels of 40 ppb, 24% of the time	6 days
Assuming levels of 80 ppb, 17% of the time	3 days
Assuming levels of 160 ppb, 2% of the time	2 days

enough to cause damage, occur only during certain restricted times of the year. The effect of low light and other cultural procedures probably hide any loss due to ethylene levels.

FLORICULTURE GRADUATES SUMMER 1972



David L. Kuebler

David L. Kuebler, a native of Kearney, Nebraska, completes his work in July. Dave grew up on a farm near Kearney, attended local schools, and participated in 4-H. He won many gardening awards as a youngster and was first runner-up in the state gardening contest. Dave ran his own greenhouse, growing and selling bedding plants, and later worked for Kearney Floral. He has worked for Paul Wood Florist while attending CSU.

Dave is interested by recent developments in mass marketing of flowers and would like to work in this segment of our industry.



Barbara Lynn Thaden

Barbara Lynn Thaden graduated from Arvada West (Colorado) High School and attended Michigan State University her freshman year before coming to CSU for her final 3 years. She has had several jobs in recent years and is currently helping at the CSU Research Greenhouses and at Leah's Flowers in Fort Collins. Her interests include insects, foliage plants, and gardening, among others. Hobbies are camping, hiking, and fishing.

Barbara is particularly qualified in garden center or florist sales to the public.

Your editor,

A handwritten signature in cursive script that reads "W. D. Holley".

COLORADO FLOWER GROWERS ASSOCIATION, INC.
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FIRST CLASS