COLORADO FLOWER GROWERS ASSOCIATION

INDEX ISSUE

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GREENHOUSE HEAT CONSUMPTION — 1976-1977.

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During 1976, 1977, several greenhouse operators forwarded their monthly fuel consumption to CSU. Because billing periods were different for most ranges, it was necessary to base gas consumption on degree-days of heating as recorded at Denver, Stapleton Airport. Degree-days are determined by calculating the average temperature each day from the maximum and minimum temperatures and subtracting from 65. Thus, an average temperature of 40°F would mean that 25 degree-days of heating was required for that day. The smallest range was 16,000 sq. ft., the largest in excess of 300,000 sq. ft.

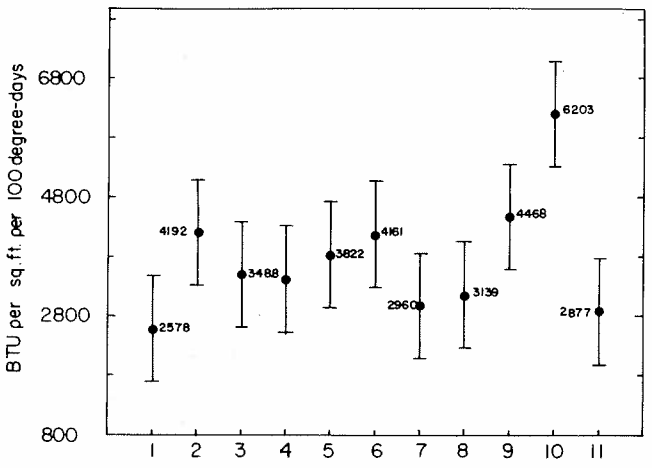

Fig. 1: Average BTU per sq. ft. per 100 degree-days for 11 greenhouse ranges in Denver during 1976-77. The vertical bars indicated the differences required for means to be significantly different from each other. Divide the means by 800 to determine the cubic-feet of gas required.

1. *Double polyethylene roof, ridge-and-furrow, potted and foliage plants, steam heated.*
2. *Carnations and roses combined, fiberglass ridge-and-furrow, steam heated.*
3. *Carnations, fiberglass and glass covered, three ranges, steam heated.*
4. *Carnations, natural gas, overhead unit heaters in ridge with 13 foot eaves, fiberglass covered.*
5. *Carnations, old glass, steam heated.*
6. *Roses, fiberglass covered, ridge-and-furrow, steam heated.*
7. *Carnations mostly some potted plants, fiberglass covered, ridge-and-furrow, steam heated, 2 ranges.*
8. *Carnations, fiberglass covered, ridge-and-furrow, steam heated.*
9. *Carnations, fiberglass and glass covered, ridge-and-furrow, steam heated.*
10. *Roses, fiberglass covered, ridge-and-furrow, steam heated.*
11. *Carnations, mixed fiberglass and double polyethylene, ridge-and-furrow, steam heated.*

The average BTU requirement (assuming 800 BTU per cu. ft. gas) for all eleven ranges was 37.3 BTU per sq. ft. per degree-day for the period September, 1976, through April, 1977. This converts, roughly to 0.046 cu. ft. of gas per sq. ft. per degree-day. The maximum BTU was 62.0 for a rose range, the minimum was 25.8 for a double-poly structure of around 140,000 sq. ft. total area (Fig. 1). The actual cubic feet of gas per square foot during any one billing period varied from around 17 to more than 40.

Fig. 2 plots the BTU per sq. ft. per degree-day for each billing period from the eleven greenhouses. Note the variability with double poly houses generally having the lowest requirement and rose ranges the highest. More of the variation could have been removed if there had been weather records for each greenhouse. Nevertheless, the high correlation (0.72) suggested that Denver records were fairly representative.

It is the general feeling that last winter was relatively mild for Denver. However, Denver Stapleton records do not show a large difference between degree-days and the usual frequency for the same period (Fig. 3) (CFGA Bul. 326). Fig. 3 shows, however, that December and January were relatively bright months with several clear days. Only during the last of November and the first of December did high degree-days of heating coincide with maximum cloudiness. Compared to December through February there were fewer days of maximum sunshine in September, November and again in March and April.

It is our estimation that greenhouse heat consumption can be reduced at least 50% or less than 20.0 BTU per sq. ft. per degree-day, compared to an existing load of nearly 40, through various insulation practices. But, this would require considerable investment for existing structures.

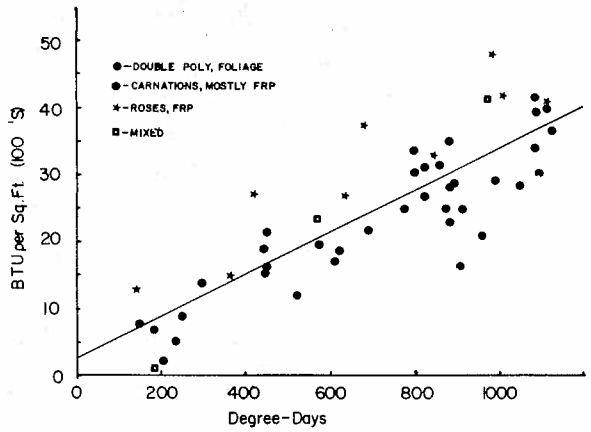

Fig. 2: Linear relationship between BTU's per sq. ft. and degree-days for 11 greenhouse ranges in Denver during 1976-77. The correlation for the line was 0.72 (perfect = 1.00) and the equation was (BTU per sq. ft.) = 26.7 + 31.4 (Degree-days). For every degree-day of heating an additional 31.4 BTU per sq. ft. were required to heat the greenhouse. Each point represents a monthly total for heating. Divide by 800 to obtain cu. ft. of gas required. The vertical axis is 100 times the values shown, or for example, (100) (20) = 2000 BTU.

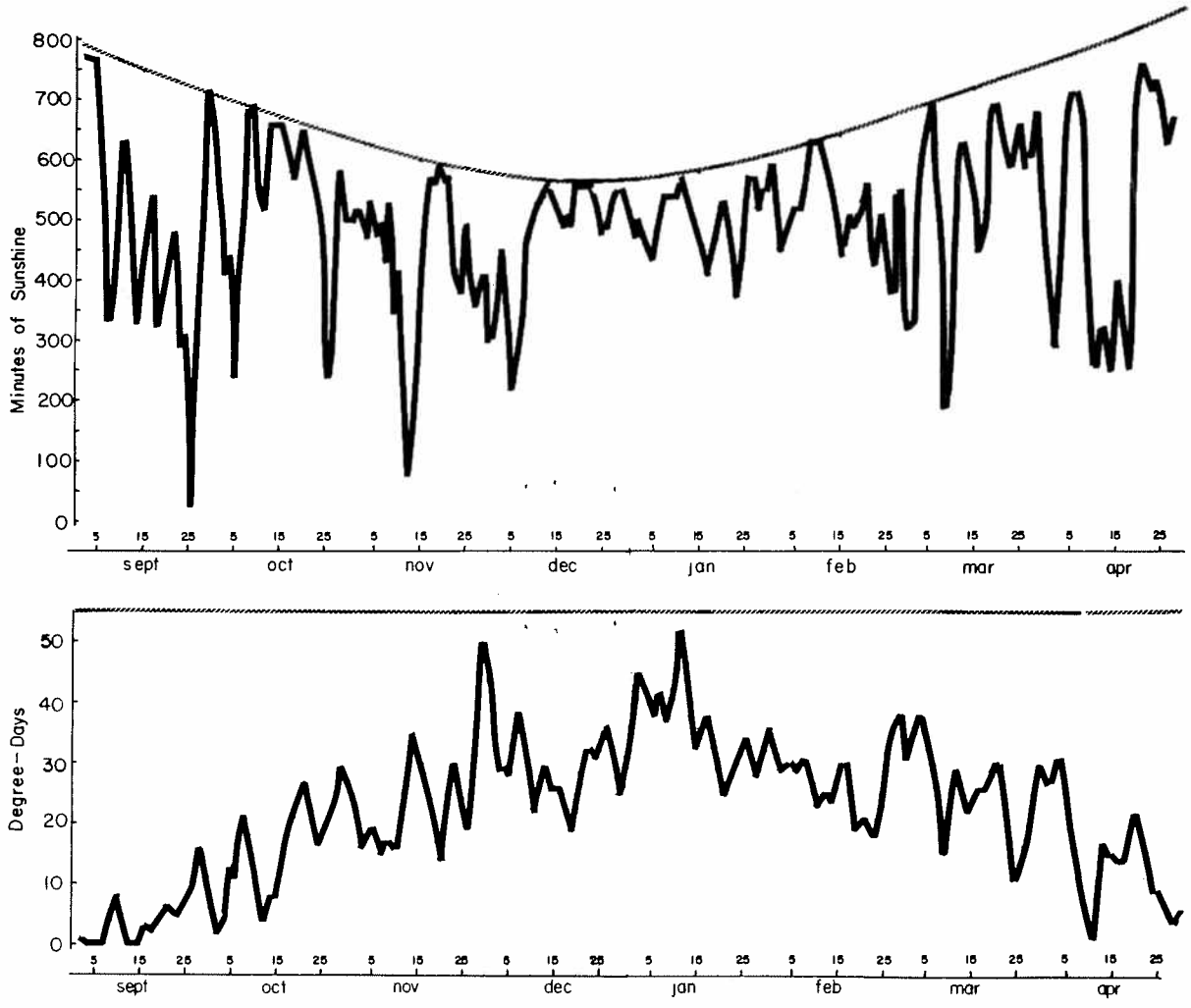

Fig. 3: Moving means of daily sunshine and degree-days heating for Denver, Stapleton Airport, Sept. 1976, through April, 1977. The hashed line for minutes of sunshine shows the maximum possible sunshine; the lower is the degree-days heating for an average daily temperature of 10°F. Each day is a moving average of 3 days, which tends to reduce the extremes, and smooth the curves.

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