



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.

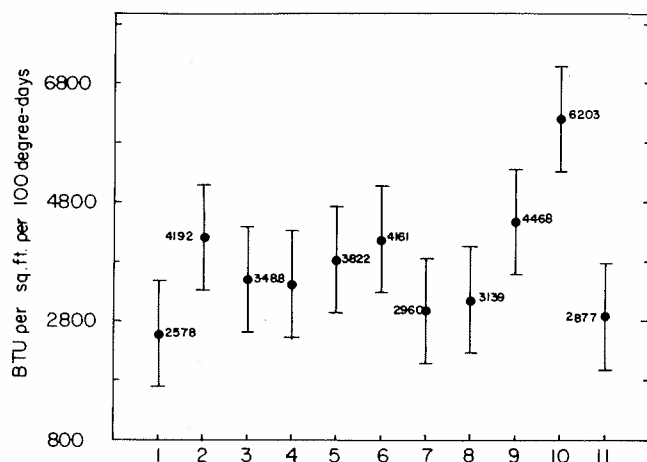


Fig. 1: Average BTU per sq. ft. per 100 degree-days for 11 greenhouse ranges in Denver during 1976-77. The vertical bars indicated the differences required for means to be

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) (CFG A 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.

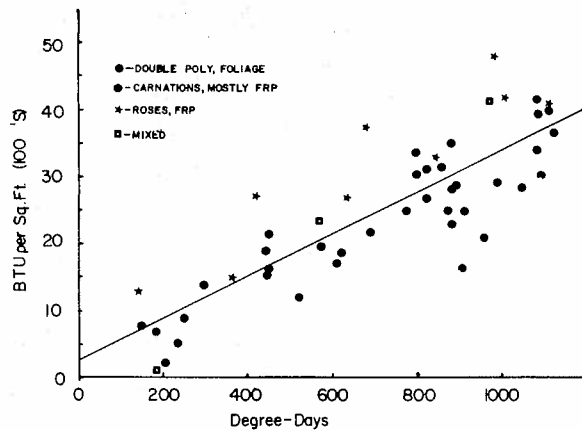


Fig. 2: Linear relationship between BTU's per sq. ft. and degree-days for 11 greenhouse ranges in Denver during 1976-77. The correlation for the line was 0.72 (perfect = 1.00) and the equation was $(\text{BTU per sq. ft.}) = 26.7 + 31.4 (\text{Degree-days})$. For every degree-day of heating an additional 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.

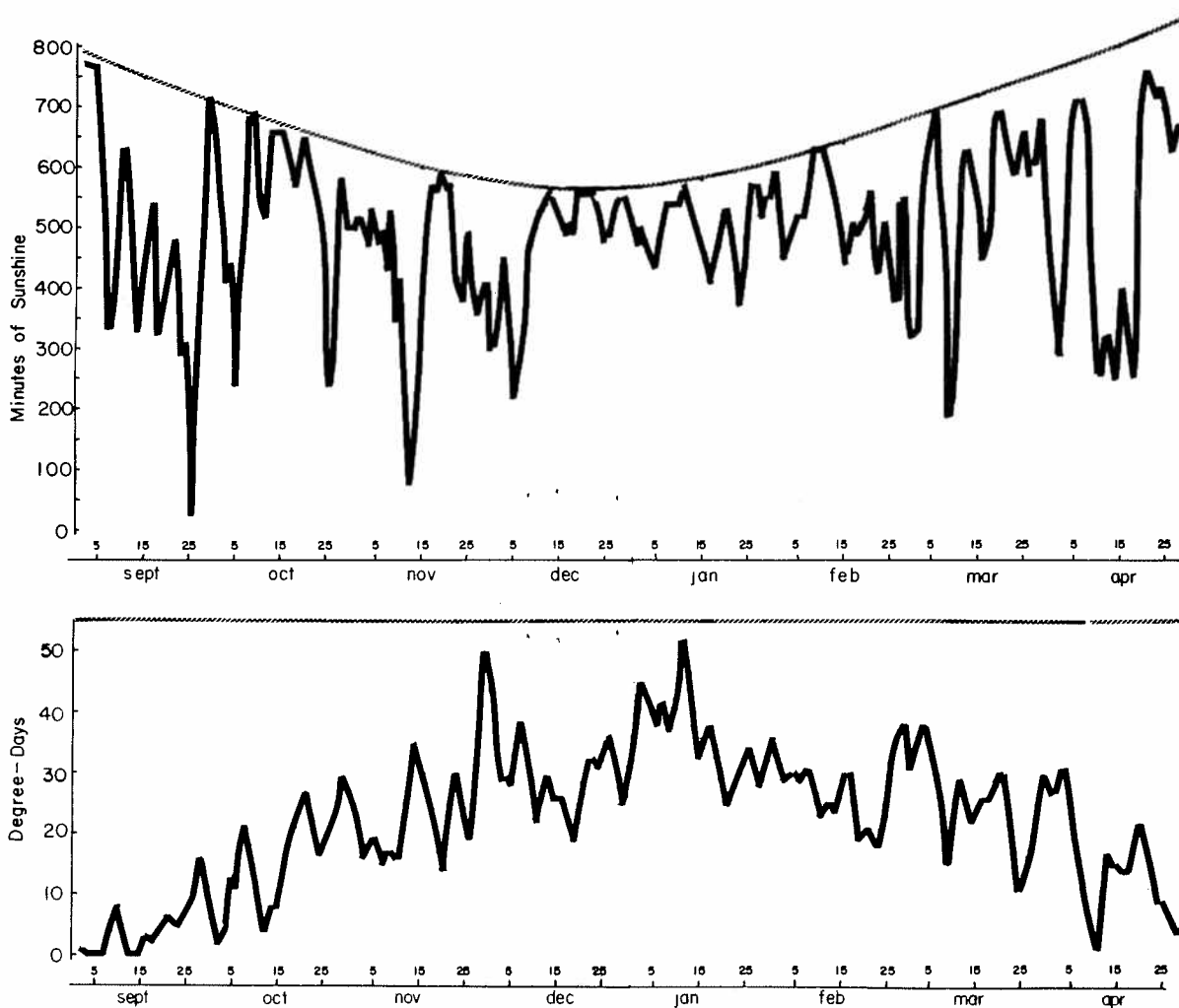


Fig. 3: Moving means of daily sunshine and degree-days heating for Denver, Stapleton Airport, Sept. 1976, through April, 1977. The hashed line for minutes of sunshine shows the maximum possible sunshine; the lower is the degree-days heating for an

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.

Index of Colorado Flower Growers Association Bulletins 230 to 279 July 1969 — August 1973

- Air inflated roof 276
- Air pollution 243,252,262,264
- Argentina, floriculture 231
- Benlate 260,271,272,273,274,275
- Boiler selection 247
- Boron, excess in rose 235
- Branching cytokinins 259
- Brazil, floriculture 237
- Breeding, carnations 242,243,261,278
- Burners, open flame 247,262
- Calcium-boron nutrition 259
- Calcium carbonate testing 240
- Carnation
 - Breeding 242,278
 - Bud cutting 232
 - Ca-B nutrition 259
 - Clonal comparisons 242
 - Cyclic lighting on 265
 - Disbudding studies 272
 - Ethylene effects on growth 277
 - Floral initiation 255
 - Fusarium stem rot 252,271,272,273,274,275
 - Fusarium wilt resistance 232
 - Gibberellins in 232
 - Growth and development 239,249,261,277,278
 - Inert substrates 240,256
 - Light and temperature 232
 - Lighting 257,265
 - Littleleaf necrosis 259
 - Miniatures 269,278
 - Micronutrition 258
 - Mutation frequency 268
 - Mutation, induced 241
 - Nematode control on 260
 - Nitrogen sources 253
 - Nutrition 248,249,250,251,259,261
 - Phialophora wilt 260
 - Planting density 277,278
 - Salinity effects 251,253,254
 - Seed production on 243,261
 - Single crop production 251
 - Spacing 277
 - Stomates, glass and FRP 233
 - Summer quality 276
 - Temperature effects 240,254,255,267
 - Timing 234
 - Tissue, nutrient content 261
 - Watering frequency 234,250
 - Water loss
 - under glass 233
 - under fiberglass 236
- Chile, floriculture 231
- Chrysanthemum
 - bud cut 232
 - fast crop 246
- CO₂ production from natural gas 262
- Colombia, floriculture 230
- Computer use in floriculture 244
- Condensation in greenhouses 244
- Cut flower life
 - carnation 239,255,263
 - ethylene effects on 263,267,276
 - gypsophila 277
 - rose, growth regulators on 266
- Dexon on Easter lily 247
- Easter lily 247
- Ecuador, floriculture 230
- Ethylene 262,263,264,267,276,278
- Ethylene measurements, Denver 264
- Ethylene on carnation growth 277
- Ethylene-temperature on cut flower life 263,276
- Europe, cut flower production 242,246
- Flammability of FRP 242
- Flue gas injury 262
- Foliage plants 246
- Fungicides, systemic 260,271,272,273,274,275
- Fusarium stem rot 271,272,273,274,275
 - biological control 252
- Fusarium wilt
 - control 260
 - resistance 232
- Gas heater check list 247,262
- Geranium, field tests 270
- Greenhouse
 - cooling 238,255,276
 - coverings
 - glass 233,235
 - fiberglass 233,235,236,242,244
 - temperature observations 255
- Gypsophila 277
- Imports 231,250,271
- Inert substrates 234,240,256
- Irrigation 232,234,250
 - water, calcium carbonate 240
 - systems 232,245
- Israel, floriculture 241
 - carnation growing in 241
- Kingman 234
- Leaf roller, roses 239
- Light energy 235,239
- Marketing 231
- Mediterranean horticulture 242,261
- Mertect 260,271,272,273,274
- Methyl bromide fumigation 269
- Micronutrition, carnation 258
- Miniature carnations 269,278
- Mutation frequency 268
- Mutation, induced 241
- Natural gas source of CO₂ 262,269
- Nematodes
 - carnation 260
 - roses 239
- Nitrogen, sources, carnations 253
- Nutrition, carnation 248,249,250,251,258,261
- Nutrient content, carnation leaves 261
- Paraquat 231
- Peru, floriculture 237
- Phialophora wilt control 260

Photoperiodism
 carnation 232,257,265
 Photosynthesis and stress 260
 Plant by-products 269
 Plastics, cellular 236
 Plastic structures 236
 inflated roof 276
 Pollination of carnation 243
 Poinsettia 246
 Production records, computer 244
 Radiation in greenhouses 239
 Relative humidity 238
 Roses 246,279
 Boron excess 235
 Cut flower life 266
 Inert substrates 256
 Omnivorous leaf roller 239
 Powdery mildew 252
 Pruning and development 273
 Temperatures 270,279
 Tight bud opening 234
 Salinity, carnation 251,253,254
 Seasonal growth rates 278
 Seed production, carnation 243,261
 Snapdragon 246
 Soil warming 269
 Sound, effects on plants 267
 South African floriculture 246
 South American floriculture 230,231,237
 Stomates, carnation 233
 Systemic fungicides 260,271,272,273,274,275
 Temperature 238,240,254,255
 carnation 267,276
 rose 270
 Timing production 234,257
 Tissue analysis 258,261,267
 Tomatoes, quick crop 236
 Watering frequency 234,250
 Watering systems 232,245
 Water loss under glass 233
 under fiberglass 236
 Water stress
 carnation 233,254
 on photosynthesis 260
 Width of carnation beds 277
 X-ray induced mutation 241

Index of Colorado Flower Growers Association Bulletins 280 to 329 September 1973 — November 1977

Acaricides, phytotoxicity 322
 ACS Biannual Research Survey 321
 Benlate 293
 Boiler Efficiency 295,297,303
 Calcium
 Carnation Tissue 305
 Sugar Beet Residues 298
 Carbon dioxide
 Roses (I) 306
 Roses (II) 307
 Transpiration 309
 Uptake 291
 Carnations
 Bench Light Energy 308
 Calcium Levels 305
 Cooling 285
 Cuttings 310
 Density and Production 296,302
 Ethylene and Growth (I) 288
 Ethylene and Growth (II) 290
 Fusarium roseum 293
 Fusarium wilt 301
 Irrigation Treatment 281
 Keeping Life 292,296
 Low Temperature Selection 312
 Pinching 318
 Postharvest Handling 295
 Preharvest Environment 292
 Return Crop Flowering 287
 Root Substrate 281
 Side Breaks 320
 Stem Rot 293
 Substrate Amendment 281
 Summer Cooling 285
 Summer Pruning 282
 Timing with Lights 284
 Tissue Analyses 284
 Yield Predictions 315
 Chrysanthemums, Temperature 299
 Cooling Pad Efficiency 294,314
 Cooling Pads, Fire Danger 327
 Cut Flowers
 Carnations 292,295,296
 Forced-air Pre-cooling 319
 Roses 296
 Cuttings, Carnation 310
 Denver Ethylene Concentrations 324
 Denver Water Quality 280
 Denver Weather 326
 Electricity Costs 311
 Ethylene
 Carnation Growth (I) 288
 Carnation Growth (II) 290
 Concentrations in Denver 324
 Rose Growth 286
 Evaporative Pads 294,314,327
 Fiberglass Panels 297
 Fungicides 293,301
 Fusarium roseum 293
 Fusarium Wilt, Carnations 301

- Gas Supply 283
- Greenhouse Heat Consumption — 1976-77 329
- Greenhouses, Air Infiltration 286
- Greenhouses, Residence 324
- Heat Consumption, Greenhouse 329
- Heating Costs 300
- Heating Pipes 319
- Herbicides 283,316
- Home Greenhouses 324
- Humidity 313
- Insecticides, Phytotoxicity 322
- Irrigation, Carnations 281
- Lighting, Timing Carnations 284
- Lily Root Rot 294
- Micro-elements, Sugar Beet Residues 298
- Mildew, Roses 308
- Ornamentals, Phytotoxicity 322
- Pesticides 309
 - Growth Injury 280
 - Phytotoxicity 322
- Photosynthesis
 - Leaf Age 290
 - Light Intensity 289
 - Water Stress and CO₂ Uptake 291
- Pinching, Roses 289
- Plant Growth and Heated Soil 328
- Poinsettias, Temperature and Growth 303
- Powdery Mildew, Roses 325
- Pruning
 - Carnations 283
 - Roses 282, 300
- Root Rot Control 294
- Root Substrate, Carnations 281
- Root Substrates, Solution Concentrations 324
- Roses
 - Bottom Breaks 285
 - CO₂ and Transpiration 309
 - CO₂ and Yield 307
 - CO₂ Uptake 306
 - Density and Production 301,317
 - Ethylene and Growth 286
 - Growth of 282
 - Keeping Life 296
 - Mildew 308
 - Night Temperatures 298
 - Photosynthesis and Leaf Age 290
 - Photosynthesis and Light Intensity 289
 - Photosynthesis, Water Stress, CO₂ Uptake 291
 - Pinching, Mid-winter 289
 - Powdery Mildew 325
 - Pruning 282,300
 - Salinity 304,327
 - Stock Plant Grade and Production 301,317
 - Variability 328
- Saline Water and Cut Flowers 296
- Salinity of Roses 304,327
- Salt Control in Soils 318
- Snapdragons 306
- Soil, pH, Root Rot Control 294
- Soil, Heating and Plant Growth 328
- Soils, Salt Control 318
- Solar Heated Greenhouses 324
- Substrate Amendment, Carnations 281
- Sugar Beet Residues, Nutrient Source 298
- Temik 10G 309
- Temperature, Root Rot Control 294
- Temperature Control 287
 - Carnations 285
 - Chrysanthemums 299
 - Poinsettias 303
 - Remote 307
 - Roses 297
- Thermometers 298
- Tissue Analysis, Carnations 284
- Vapam 301
- Water Stress, Roses 291
- Water Quality 327
- Water Quality, Denver 280
- Weather, Denver 326
- Wilt Control 301

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